Official Journal of the American College of Sports Medicine

CONCLUSIONS: These results demonstrate that during adolescence, sex is not a major determinant of fuel selection during exercise, at least of relatively high intensity. One implication might be that adolescent boys and girls can equally derive metabolic and performance benefits from consuming CHO during competition.

1399 Board #58 10:30 AM - 11:30 AM
Gender Differences in Response to Exercise Following a Low Carbohydrate Diet
Jennifer Glenn, Darlene A. Sedlock, FACSM, Michael G. Flynn, FACSM, Elizabeth A. Welsch, Kyung-Shin Park. Purdue University, West Lafayette, IN.

Low carbohydrate diets (LCD) have gained significant popularity yet lack comprehensive research as to their effectiveness on substrate utilization and exercise performance. PURPOSE: to determine the effect of LCD on substrate utilization and exercise performance, and to identify any gender differences in these responses. METHODS: Sixteen moderately trained subjects (8 men, 8 women) volunteered. Subjects completed a 40 min glycozgen-lowering treadmill run at 70% VO2max, followed by 3 of either a LCD (15% CHO, 60% FAT, 25% PRO) or normal mixed diet (55% CHO, 25% FAT, 20% PRO; NM) in a single-blind, crossover-balanced design. Upon completion of the last rest period, subjects ingested test beverages (6% CHO) given every 10 min, for a total of 30 g CHO. BG, ratings of perceived exertion (RPE), and respiratory exchange ratio (RER) measurements were obtained for 30 min at 70% VO2max (steady state; SS); following immediately by a one mile time trial (TT). VO2, HR and RPE were measured throughout exercise. Finger tip blood samples were drawn pre-exercise and immediately after SS and TT. Data were analyzed using a 2 (diet) x 2 (gender) ANOVA.

RESULTS: RER values were significantly lower (P<0.05) at rest and during SS and TT following LCD. Resting blood glucose was significantly lower (P<0.01) following LCD (6.0±0.2 mmoL/L) vs NM (7.8±0.6 mmoL/L). Lactate was significantly lower (P<0.01) following LCD (17.5±0.4) vs NM (15.0±0.4) during TT, while glyceral was significantly higher (P<0.01) during both SS and TT. TT performance was significantly longer (P<0.01) following LCD (493.3±20.9 s). A significant diet x gender interaction occurred during TT (P<0.01) such that men's RPE was higher in LCD (17.5±0.4) vs NM (15.0±0.4) whereas the women's was slightly lower (16.0±0.4 and 16.2±0.4, respectively). RPE was significantly higher following LCD during SS (P<0.01). In both SS and TT, CHO oxidation was significantly lower following LCD (P<0.01) and values for men were significantly greater than women (P<0.01).

CONCLUSIONS: Short-term LCD resulted in a shift toward greater fat oxidation and impaired running performance. Additionally, men but not women perceived TT performance to be more effortful following LCD.

1400 Board #59 11:30 AM - 12:30 PM
Carbohydrate Supplementation During Prolonged Intermittent Exercise in Women
Elizabeth A. Welsch, Darlene A. Sedlock, FACSM, Michael G. Flynn, FACSM, Jennifer Glenn, Kyung-Shin Park. Purdue University, West Lafayette, IN.

Intermittent activity is characteristic of some team sports and/or training regimens. The preferred strategy by many athletes for minimizing fatigue and increasing carbohydrate (CHO) availability throughout these events is to consume CHO-containing beverages during the rest periods. Research suggests that men experience performance improvements following CHO ingestion; however, it is unclear whether women respond as favorably to CHO supplementation. PURPOSE: to determine how women respond to CHO supplementation during prolonged intermittent exercise. METHODS: Ten endurance-trained female runners (mean±SD VO2max=54±14 mL/kg/min) completed two intermittent treadmill runs separated by one month (i.e., during the follicular phase of the menstrual cycle). Trials were double-blind and counterbalanced, and consisted of four 20 min steady state (SS) running bouts at 70% VO2max, each followed by a 5-min rest period. A 5k self-paced time trial performance run (TT) immediately followed the last rest period. Subjects ingested test beverages [6% CHO solution or an artificially sweetened placebo (P)] during the rest periods at a rate of 37 g CHO/h. Each dose was 0.6 g CHO/kg BV/h (~250mL). Perceived exertion ratings (RPE) and finger tip blood samples were taken during the last 2 min of each SS bout and immediately after the TT. RESULTS: TT performance significantly improved (P<0.05) with CHO (26.0±1.1 min) vs P (27.0±1.3 min), although RPE was similar between trials. Lactate (P=0.10) and CHO oxidation (P=0.03) tended to be higher with CHO. RESULTS: of a 2-way [drink x time(repeated)]ANOVA for SS data showed significantly higher (P=0.04) blood glucose with CHO, but glycerol and lactate were similar between trials. CONCLUSIONS: CHO supplementation in endurance-trained women improved running performance while maintaining the same perception of effort.

Support in part by Purdue University College of Liberal Arts Dean’s Research Incentive Grant

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1401 Board #40 9:30 AM - 10:30 AM
The Effect of Glycemic Index and Timing of Meal on Exercise to Fatigue
Amy M. Gyorkos, Timothy J. Michael, Christopher C. Cheatham, Mark D. Ricard. Western Michigan University, Kalamazoo, MI.

Pre-exercise meals have been studied in the past. In addition, the glycemic index (GI) of these meals has also been the subject of investigations. The timing of these meals may also have an impact on the efficacy of these pre-exercise meals to maintain blood glucose and to offset time to fatigue. PURPOSE: the purpose of this study was to investigate and describe the influence of pre-carbohydrate (low and high glycemic) feedings and timing of meal prior to exercise to fatigue. METHODS: Five individuals performed a peak bike test and four experimental trials, separated by 7 days. Upon arrival, subjects ingested 1g of carbohydrates (CHO) for every kilogram of body weight (BW) of a high glycemic index meal (H) or a low glycemic index meal (L) prior to exercise to fatigue. Subjects waited 30 or 60-minutes following each test meal, totaling four experimental conditions (H30, L30, H60, L60). These conditions were completed in a counterbalanced fashion. The exercise regimen was consistent following each meal; 90 minutes cycling at 70% peak oxygen consumption (VO2peak) followed by an all-out sprint until fatigue. The subjects, for the 60 minute trial, had blood draws taken at 30, 0, +10, +30, +60, +90 min, and fatigue. One less blood sample was taken from the subjects waiting 30 minutes (0, +10, +30, +60, +90-min, and fatigue). Heart rate was taken at rest, every 10 minutes of exercise, and at fatigue. VO2 and respiratory exchange ratio (RER) measurements were taken for the first 30 minutes of exercise and at 10 minutes surrounding each blood draw. RESULTS: No significant statistical differences (p>0.05) were found for any of the variables between trials (H30, L30, H60, L60) including blood glucose, blood lactate, RPE, VO2, and performance time. CONCLUSION: The timing and GI of meals used in this study did not effect time to fatigue. In addition, blood glucose levels remained essentially the same between conditions with no impact due to timing and/or GI.

1402 Board #41 10:30 AM - 11:30 AM
Carbohydrate Supplementation Attenuates Blood Glucose Decreases in Pregnant Exercisers
Christine W. St. Laurent, Judith A. Fohr, Michael J. Saunders, FACSM, Connie L. Peterson, James Madison University, Harrisonburg, VA.

The ACSM and ACOG recommend that healthy women, free of obstetrical complications participate in regular, moderately-intense physical activity throughout their pregnancies. However, a decrease in blood glucose (BG) is often observed with pregnant exercisers in their second and third trimesters when compared to non-pregnant controls. PURPOSE: to determine the effect of carbohydrate (CHO) supplementation on BG of pregnant exercisers during a 30-minute, moderate intensity, submaximal exercise session. METHODS: Six pregnant participants, (maternal ages 30.16 ± 4.17 years and gestational ages 20 ± 1.93) completed two exercise sessions consisting of a 30-minute treadmill walk at 55-65% of their maximal heart rate. Participants were given a placebo drink (PD) (150 ml water with Crystal Lite™ given every 10 min) during one trial and a concentrated CHO gel during the other trial (10 g CHO with 150 ml water given every 10 min, for a total of 30 g CHO). BG, ratings of perceived exertion (RPE), oxygen consumption (VO2), ventilation (VE) and respiratory exchange ratio (RER) were measured at 16-minute intervals before, during, and after the trials and analyzed using nonparametric K-related samples analysis and 2-related samples analysis statistical tests. RESULTS: In both trials there was a significant decrease in BG from rest to 10 minutes, (PD: 74.94 ± 8.04 vs. 71.83 ± 6.64 mg/dl, p<0.05; CHO: 84.00 ± 20.45 vs. 69.78 ± 14.92 mg/dl, p<0.05) rest to 20 minutes, (PD: 74.94 ± 8.04 vs. 67.58 ± 14.92 mg/dl, p<0.05; CHO: 84.00 ± 20.45 vs. 68.73 ± 11.09 mg/dl, p<0.05) and a significant decrease from rest to 40 minutes in the PD trial only, (74.94 ± 8.04 vs. 67.55 ± 7.31 mg/dl, p<0.05). In the CHO trial, there was a significant increase in BG from 26-30 minutes, (68.73 ± 11.09 vs. 77.95 ± 8.70 mg/dl, p<0.05) and 30-40 minutes, (77.95 ± 8.70 vs. 93.20 ± 11.00 mg/dl, p<0.05). There were no significant differences in RPE, VO2, VE, or RER between trials. CONCLUSIONS: It appears that during pregnancy, consuming a CHO supplement during a moderate intense, 30-minute exercise session helps prevent declines in BG that may occur with moderate-duration, moderate-intensity walking exercise. This intensity and duration of exercise are consistent with the guidelines from ACSM/ACOG for pregnant women.
Inhalation of internal combustion derived particulate matter (PM) is associated with airway inflammation and increased airway reactivity. Exhaled nitric oxide (eNO) is a marker of airway inflammation and has been found elevated in chronic high PM exposed urban children but not in low PM exposed rural children. However, little is know about eNO after acute PM exposure.

**METHODS**: To evaluate the effects of 30 min of high (PM) exposure exercise on eNO.

**RESULTS**: No difference in eNO levels noted between pre and post exercise measurements or between low and high (PM) exercise (20.7±16.41 vs 21.5±18.93 and 22.0±12.40 vs 21.3±17.75 ppb, for pre and post low PM and for pre and post high PM, respectively). Likewise, no difference was found in conducting airway NO flux between pre and post measurements or low and high (PM) conditions. No difference between pre and post FNO was identified for low (PM) breathing exercise, however, exercise while breathing high (PM) air resulted in a significant 26% decrease in FNO (p<0.025).

**CONCLUSION**: The decrease in FNO was contrary to a PM initiated inflammatory response but may be the result of reactive oxygen-initiated formation of oxides of nitrogen and peroxynitrite. Alternatively, a forced transformation of NO to more stable noncytotoxic nitrosotriols as a means of protecting the NO group from reacting with superoxide could be plausible.
### 2163 Board #100 2:00 PM - 3:00 PM

**Test to the Limit of Tolerance: A Lactate FTP and Selected Physiological Parameters during a Constant-power Cycle Test**

**Test to the Limit of Tolerance:**

**Purpose:** The aim of this study was to assess the test-retest reliability of time to T_lact and selected physiological parameters during a constant-power cycle test.

**Methods:** 11 physically active individuals (VO_2peak = 44±8.9 ml/kg/min) volunteered to participate in the study. Peak power output (pp) was determined using a ramp protocol to volitional exhaustion (6W/15sec, electromagnetically braked cycle ergo). Participants visited the laboratory on two further occasions to complete a submaximal incremental cycle test (4 x 3min) at 20, 30, 40 and 50% pp) followed by a test to T_lact at 70% pp, each visit was separated by at least 48hrs. PTTs, breath by breath metabolic and ventilatory data (Sensormedics, Vmax_22) were collected at rest and during exercise. Statistical analysis was performed using t-tests, Pearson product-moment correlation (r), intraclass correlations (ICC), coefficient of variation (CV) and 95% limits of agreement (LOA). Power and effect size were used to calculate sample size estimates.

**Results:**

- **Table 1:** Test-retest data with statistical analysis results

- A paired t-test demonstrated no significant differences between the two tests for time, VO_2peak, V_O2, R, V_c, Fb and TV. Failure to find significant differences may result from low power, calculation of sample size estimates with the appropriate α, power of 0.8 and P<0.05 indicate samples of between 76 and 194 depending upon the dependent variable. The test-retest data was highly correlated for time (r=0.949, ICC=0.99), and the physiological parameters (r and ICC=0.85) except R and VO_2 (r=0.7). The mean CV for all measures was low (<10%) indicating high reliability, individual CV ranged from 1.2% - 11.8%, however the random measurement error is 99%.

- **Conclusion:** LOA suggest random measurement error of the sample is large and may be viewed as unacceptable despite the small bias and low CV.

### 2164 Board #101 3:00 PM - 4:00 PM

**Use of Tidal Loop Analysis in Suspected Pediatric Exercise Induced Vocal Cord Dysfunction**

**Exercise Induced Vocal Cord Dysfunction (EIVCD):**

EIVCD is defined as a limit to the respiratory and/or phonatory functioning occurring during exercise. The main objective of EIVCD is to improve exercise performance in healthy young people. In these studies, two different forms of respiratory muscle training (RMT) have been shown to yield improvements in exercise performance. Isocapnic hyperventilation (VIH); 2) pressure threshold inspiratory muscle training (IMT).

**Methods:** Thirty-nine subjects, 19 female and 20 male, mean age 13.2 ± 2.5 years, performed a standard exercise protocol to establish the presence and severity of EIVCD symptoms. Subjects were placed on a treadmill and oxygen saturation, heart rate, and rate of perceived exertion were monitored continuously. Speed and grade were increased until onset of symptoms occurred at which time the subject exited the treadmill and pulmonary function tests were performed.

**Results:** Of the thirty-nine subjects tested, fifteen met diagnostic pulmonary function test criteria for EIVCD. Of those subjects that tested negative for EIVCD, twenty-four had blunted biphasic tidal loops and concomitant obstruction noted in the early expiratory portion that quickly normalized with recovery. Patients in this subgroup described symptoms including throat tightness, chest tightness, and dyspnea, both inspiratory and expiratory. Isocapnic hyperventilation (VIH) and pressure threshold inspiratory muscle training (IMT) were used to improve exercise performance. Isocapnic hyperventilation (VIH); 2) pressure threshold inspiratory muscle training (IMT).

**Conclusion:** EIVCD may be suspected based on flow-volume curve analysis and symptoms including throat tightness, chest tightness, and dyspnea, both inspiratory and expiratory. Exercise-induced bronchoconstriction (EIB) is more frequent in children with postural instability-gait disorders (PIG) than in controls. This study evaluated the hypothesis that EIVCD and PIG are related by measuring tidal loop analysis in children with PIG.

**Highlights:**

- EIVCD is a respiratory disorder characterized by the development of respiratory symptoms during exercise.
- Tidal loop analysis is a useful tool for the diagnosis of EIVCD in children with PIG.
- EIVCD and PIG may be related through common respiratory mechanisms.

### 2165 Board #102 4:00 PM - 5:00 PM

**Cold Environment Influences Exercise Capacity and Exercise Induced Bronchoconstriction**

**Cold Environment:**

The primary aim of the present study was to examine the influence of changing environmental temperature on exercise capacity measured by peak oxygen uptake (VO_2peak), peak ventilatory (V_vent) and peak running speed (V_max) and secondarily to assess the influence of changing environmental temperature upon EIB in adolescents suffering from EIB.

**Methods:** Subjects (10-45 years old, male/female; 13:7) with EIB underwent exercise testing by running on a treadmill in a climate chamber under standardised, regular indoor conditions (20°C and 40% relative humidity) and in a standardized cold environment (-18°C and 40% relative humidity) in random order on separate days. Day 1 consisted of a familiarization session. Day 2, 3, 4, and 5 consisted of exercise and 15 minutes after inhalation of salbutamol. Oxygen uptake (VO_2peak x minute ventilation (VE), respiratory exchange ratio (RER), heart rate (HR) and running speed (V) were measured during exercise.

**Results:**

- VO_2peak decreased 5.9%, from 47.6 (95% CI: 44.4 - 51.0) to 44.8 ± 8.9 ml·kg·min\(^{-1}\) (95%: CI: 41.7 - 48.9) (P<0.01) in the cold environment.
- VO_2peak also decreased significantly from 10.2 km·hours\(^{-1}\) in room temperature to 9.7 km·hours\(^{-1}\) (P<0.02) in the cold environment.
- No differences were found for VE_{vent}, RER, HR or V. The post-exercise reduction in forced expiratory volume in one second (FEV_1) increased significantly after exercise in cold environment as compared to exercise under regular, indoor conditions, AFEV_1 (31%: (95% CI: 24.38 - 34%: (24.19-29) respectively (P=0.04). Area under curve (AUC) for FEV_1, increased after exercise in cold environment (P<0.01).

**Conclusion:** Exercise in a cold environment markedly decreased exercise capacity measured by VO_2peak and VE_{vent} whereas EIB increased in the cold environment in adolescents suffering from EIB.

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**POSTER SESSIONS**

**#1362-1849—WEDNESDAY, MAY 31| #1850-2268—THURSDAY, JUNE 1 | #2269-2726—FRIDAY, JUNE 2 | #2727-2915—SATURDAY, JUNE 3**

**#2727-2915—SATURDAY, JUNE 3**

**S384 Vol. 38 No. 5 Supplement**

**Homeostasis of glucose and insulin in response to meal ingestion in nonhuman primates:**

**Objective:** Homeostasis of glucose and insulin in response to meal ingestion in nonhuman primates.

**Methods:** Subjects were fed a high-fat diet (HFD) or a low-fat diet (LFD) for 5 weeks, followed by a 5-week recovery period on a normal diet. During the meal test, subjects ingested 10% of their body weight as a mixed meal, and fasting and 10-minute intervals were monitored for glucose and insulin levels. Data were analyzed using repeated measures ANOVA.

**Results:** Fasting glucose levels were higher in the HFD group than the LFD group. Glucose levels decreased immediately post-meal in both groups, but the HFD group had higher glucose levels at 10 minutes compared to the LFD group. Insulin levels increased immediately post-meal in both groups, but the HFD group had higher insulin levels at 10 minutes compared to the LFD group. The HFD group had a greater increase in insulin levels compared to the LFD group.

**Conclusion:** HFD feeding results in increased glucose and insulin responses to meal ingestion in nonhuman primates. These findings suggest that HFD feeding may have adverse metabolic effects, which may contribute to the development of type 2 diabetes and related metabolic disorders.
**Methods**: Informed, written consent was obtained from 17 male rowers who were allocated randomly to either an IMT (n=10) or EMT (n=7) group for the first 4-wks of training. Performance and physiological responses were measured during an incremental rowing ergometer ‘step-test’ and a 6-min all-out (6MAO) effort. Respiratory muscle training was undertaken at the 36 repetition maximum load (~50% of the peak respiratory mouth pressure, Pmt or Pmax) using one of two pressure threshold devices.

**Results**: Table 1. Changes in respiratory muscle function and performance in the 6MAO (means±SDs; *p* different from baseline, P<0.05; V=different from preceding time point, P>0.05).

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>IMT</th>
<th>EMT/FIMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>P (cmH2O)</td>
<td>129±16.5</td>
<td>162.3±24.1*</td>
<td>168.3±31.2*</td>
</tr>
<tr>
<td>Mean power (W)</td>
<td>188.6±7.4</td>
<td>166.6±17.8</td>
<td>156.1±25.9*</td>
</tr>
<tr>
<td>P (cmH2O)</td>
<td>144.5±16.3</td>
<td>149.2±28.1</td>
<td>177.6±48.3</td>
</tr>
</tbody>
</table>

**Conclusions**: IMT improved rowing performance, but EMT and concurrent IMT/EMT did not.
DOMS, subjects performed maximal eccentric contractions of elbow flexors using their nondominant arm. Each subject performed two sets of 25 repetitions in a standardized fashion on a custom made preacher curl machine. Fifteen minutes of continuous ultrasound (0.5 MHz, peak intensity 1.0 W/cm²) for UG and sham-ultrasound for CG were administered at 24, 48, 72 and 96 hours after exercise while the tested subjects arms were completely submerged in the water maintained at 35°C. Maximum voluntary isometric contraction (822.9±155.7 vs 929.2±240.2 N; UG vs CG at baseline), relaxed arm angle (RANG: 156.5±5 vs 152.4±2°; UG vs CG at baseline), and muscle soreness (SOR) by visual analog scale were assessed before and after the treatments. Blood samples were obtained to measure serum creatine kinase (CK: 126±41 vs 136±61 U/L; UG vs CG at baseline) and aspartate aminotransferase (AST: 16±6 vs 14±8 U/L; UG vs CG at baseline) at 24, 48, 72, and 96 hours after treatment.

RESULTS: In all variables, there were no statistical differences in group by time interaction using one-way ANOVA with repeated measures. CK and AST were continuously increased up to 96 hrs (CK, 12,134.7±256 vs 12,804±660 U/L; AST, 121±84 vs 147±165 U/L; UG vs CG) after exercise in both groups. In treatment group, however, SOR (4.8±2.7 vs 3.8±2.6 at 72, and 3.4±2.1 vs 2.7±2.1 at 96; before vs after treatment) and RANG (143.7±174 vs 147±64 at 24, 143±71 vs 148.5±54 at 48, 145.7±74 vs 148±62 at 72, and 145±63 vs 149±66 at 96; before vs after treatment) were significantly different before and after each treatment using t-test (p < 0.05).

CONCLUSIONS: Based on the results, water mediated ultrasound treatments employed in this study did not demonstrate any efficiencies in managing DOMS as well as other indicators of muscle damage.

**2172 Board #109 2:00 PM - 3:00 PM**

**Dietary Cholesterol Alters Recovery from Eccentric Muscle Damage in Humans**
Steven Riechman, David Kearl, Ryan D. Andrews, Heath Gasier*, Steven Hammer*, Texas A&M University, College Station, TX; *Kent State University, Kent, OH.
Email: srriechman@tamu.edu

PURPOSE: In a previous study, we have previously shown that dietary cholesterol was directly associated to lean mass gain in response to resistance training. Additionally, blood cholesterol is significantly reduced as soon as 2 hours and for as long as 48 hours after an eccentric muscle challenge suggesting an efflux of cholesterol, possibly to skeletal muscle to aid in repair and recovery.

METHODS: To test the hypothesis that dietary cholesterol would aid in the recovery from eccentric muscle damage, eight young men (mean age=21) performed two high intensity eccentric trial separated by four weeks under conditions of highly restricted dietary cholesterol (~200 mg/day). Using a counterbalanced design, subjects were supplemented with either dietary cholesterol (cholesterol group) for one trial and egg white on the other. Strength and perceived soreness were determined at 24, 48, and 72 hours after each trial.

RESULTS: Strength loss was significantly greater in the cholesterol supplemented trial that was consistent with the significantly greater perceived soreness. Subjects who were supplemented with cholesterol first returned to the second trial with significantly greater strength at baseline and lower perceived soreness throughout the second trial. Those supplemented with egg white first returned to the second trial with significantly lower strength.

CONCLUSIONS: This results suggest that dietary cholesterol increases the magnitude of muscle injury responses during initial exposure to eccentric exercise but may enhance long term recovery.

**2173 Board #110 3:00 PM - 4:00 PM**

**Changes in EMG Mean Frequency During Eccentric Exercise Resulting in Symptoms of Muscle Damage**
Sean MacGibbin, Stefan Pasiakos, Malachy P. McHugh, FACSM, Nicholas Institute of Sports Medicine and Athletic Trauma, New York, NY.
Email: sriechman@hlkn.tamu.edu

PURPOSE: An increase in amplitude of surface EMG signals during eccentric exercise has been associated with the subsequent symptoms of muscle damage. The purpose of this study was to examine the association between changes in the frequency content of the EMG signal and subsequent symptoms of muscle damage.

METHODS: Nine subjects (5 men, 4 women; age 32±6 yr) performed 6 sets of 20 isokinetic (60°/s) eccentric quadriceps contractions with each limb (target intensity was 90% of maximum isometric strength at 70°). One limb exercised from 30° to 70° of knee flexion (Short) and the contralateral limb exercised from 70° to 110° (Long). Surface EMG signals were recorded from the vastus lateralis, vastus medialis and rectus femoris muscles during eccentric contractions. EMG mean frequency (FFT-based computation) and amplitude were computed from activity for the middle 30° of each contraction and averaged for each set. Isometric strength and pain (0-10 scale) were assessed immediately post exercise and on the next three days.

RESULTS: Strength loss and pain were greater following Long versus Short (strength loss P=0.01; pain P=0.001). EMG amplitude increased by 25% from set 1 to set 6 during the Long bout but only by 3% during the Short bout (Set x Muscle Length P=0.01). By contrast there was no change in mean frequency from set 1 to set 6 for the Long (1% increase) or Short (0% change) bouts (Set x Muscle Length P=0.72). As expected mean frequency (averaged across all sets) was 16% higher for Short versus Long (P<0.001).

CONCLUSIONS: The validity of FFT-based measures of mean frequency during dynamic contractions has been questioned. In this study a marked muscle length effect for mean frequency demonstrates that the measurement technique was able to detect known effects (higher frequency at shorter muscle lengths). Therefore, it can be concluded that damaging quadriceps eccentric exercise is not associated with changes in mean frequency despite marked increases in EMG amplitude.

**2174 Board #111 4:00 PM - 5:00 PM**

**Effects of Passive Warm-Up With Ultrasonic Diathermy on Exercise Performance and Muscle Damage**
Yi-Pin Wang, Kuo-Wei Tseng, Ruo-Ping Wu, Ching-Ya Huanh. Taipei Physical Education College, Taipei City, Taiwan Republic of China. (Sponsor: Hsieh, SS, FACSM)
Email: ypw1202@tpec.edu.tw

PURPOSE: This study investigated the effects of passive warm-up with ultrasound diathermy and heat packing on exercise performance and recovery on muscle damage.

METHODS: Eighteen females (22.16±0.84 yrs) participated in this study. All of them were involved into three groups as control group (CON), heat packing group (HP) and ultrasound group (US). CON never received any warming-up protocol before eccentric exercise, HP received 15 minutes of superficial heat with electrical heat pack before exercise, and US received 7 minutes of deep heat with ultrasound diathermy before exercise. Each subject processed 30 repeated bouts of eccentric exercise with 80% maximal voluntary isometric contraction force (MVC) level. Serum creatine kinase muscle isoform (CK-MM), MVC, range of motion (ROM) and cross section area of biceps brachii (CSA) were measured before, immediately after exercise and at 2nd, 4th, 7th, and 10th days post-exercise.

RESULTS: When measuring serum CK-MM and CSA, there were no significant difference between CON, HP and US (p>0.05). When measuring ROM and MVC, there were significant difference between CON, HP and US (p<0.05).

CONCLUSION: Passive warm-up with ultrasound diathermy and heat packing have better performance in muscle strength and range of motion in eccentric exercise. According to the recovery procedure. Subjects of US group took lesser damage on muscles than HP and CON. US group had lesser swelling then other groups in recovery stage after eccentric contraction exercise.

**2175 Board #112 2:00 PM - 3:00 PM**

**Effects of Electrotherapy And Icing on Damaged Muscle During Repeated Sets Exercise**
Ruo-Ping Wu, Kuo-Wei Tseng, Ching-Ya Huanh, Yi-Pin Wang. Taipei Physical Education College, Taipei County, Taiwan Republic of China. (Sponsor: Hsieh, SS, FACSM)
Email: tsy571@hotmail.com

PURPOSE: This study investigated which modality would be the best way to improve the recovery of muscle function and immediately performance between different two sets of repeated bouts eccentric exercise.

METHODS: Thirty-six non-weight-trained females (29.32±3.58 yrs, 175.75±3.76 cm, 77.00±12.02 kg) participated in this study. All subjects performed the best set of 30 eccentric actions (ECC1) with non-dominate elbow flexors using the dumbbell that was set at 80% of the pre-ECC1 maximal voluntary isometric contraction force (MVC) level, and then subjects were randomly placed into cryotherapy (CT; n=12), electrical therapy (ETG; n=12) or control (CON; n=12) groups based on their MVC response to ECC1. Immediately after ECC1, cryotherapy and electrical therapy groups were accepted cold pack and transcutaneous electrical nerve stimulation (TENS) treatments, respectively, for an hours. Including CON, all subjects were repeated the same bout of 30 eccentric exercise (ECC2) after treatments. MVC were assessed before, immediately after both ECC1 and ECC2, and 2, 4, 7, and 10 days (D2, D4, D7, D10) after ECC1 for all groups. Serum creatine kinase muscle isoform (CK-MM) was collected before, and D2, D4, D7, and D10 for all groups.

RESULTS: There was a significant further decrease (P<0.01) in MVC immediately after treatment when compared to pre-test for the ETG, but not in CTG and CON. The MVC for ETG were significant decrease than CTG (P<0.05) on day D4, D7, D10, were
significant decrease than CON (P<0.05) on D7. D10. There were significant increase in CK-MM on D4, D7 (P>0.05) when compared to pre-test for the ETG, was increase on D4 (P>0.05) for CON, but no significant different between each day for CTG. The CK-MM for ETG were significant increase than CTG and CON on D2, D4, D7 and D10 (P>0.05), and no significant different between CTG and CON on any day.

CONCLUSION: The long-term recovery outcomes showed cryotherapy is the most beneficial for muscle damage management between repeated sets, and the short-term outcomes showed cryotherapy and resting are beneficial to the muscle performance, such as muscle strength and active range of motion. Electrical therapy is disadvantaged to manage muscle damage between repeated sets exercise.

2177 Board #113
3:00 PM - 4:00 PM
The Effect of Static Stretching on Strength Loss and Pain Following Eccentric Exercise
Marcus Nesse, Malachy P. McHugh, FACSM, Nichols Institute of Sports Medicine and Athletic Trauma, New York, NY.

Email: mchugh@nisimat.org

PURPOSE: The purpose of this study was to determine if static hamstring stretching prior to eccentric exercise affected subsequent strength loss and pain.

METHODS: Eight men (34±9 yr) performed 6 sets of 10 unilateral isokinetic eccentric hamstring contractions (target force 100% of isometric MVC) on the dominant and non-dominant legs. Six 60 s static hamstring stretches were performed prior to eccentric exercise on one leg but not the other. Isometric hamstring strength was measured prior to eccentric exercise and stretching, immediately post-exercise and on each of the following three days. For each subject, isometric strength measures, eccentric exercise and passive stretches subjects were seated in slight forward trunk flexion with the test thigh flexed 45°. This ensured that maximum stretch occurred at, or prior to, full extension at the knee. Isometric strength was measured at 27°, 40°, 53°, 60° and 79° of knee flexion. Hamstring pain was documented each day on a 0-10 scale (0 = no discomfort, 10 = walking with a limp). The effect of stretching on strength loss and pain was assessed using repeated measures ANOVA.

RESULTS: Consistent with previous reports, strength loss was greater at short versus long muscle lengths (Time x Angle P<0.002). However, this pattern differed between the control and stretched leg (Time x Stretch P<0.011). At the longest muscle length (37°) strength was significantly depressed in the control leg on the 3 days following eccentric exercise (72-82% of baseline) but remained above baseline (102- 127%) in the stretched leg on all three days (Time x Stretch P<0.002). Pain peaked two days following eccentric exercise (Time effect P<0.001) with no difference between the stretch and control legs (P=0.94).

CONCLUSIONS: Stretching prior to eccentric exercise appeared to prevent subsequent strength loss at long muscle lengths but did not affect strength loss at short muscle lengths or the pain response. Preservation of strength with the muscle in a lengthened position following eccentric exercise may be functionally important in resisting potentially injurious muscle elongation.

2178 Board #115
2:00 PM - 3:00 PM
Developing Delayed Onset Muscle Soreness in the Lumbar Extensor Muscles
Brian E. Udermann, FACSM1, David M. Reineke2, John M. Mayer3, Steven R. Murray4, Rebecca A. Battista5, Molly J. Uhrich1

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Email: udermann.brian@uwlaus.com

Pain was significantly greater (p<0.05) in G3 at 24, 48, 72, and 96 hrs post exercise compared to G1 and at 48, 72, and 96 hrs compared to G2. Strength was reduced significantly (p<0.05) in G3 at 24, 48, 72, 76 hearing post exercise compared to G1 at 72 hours compared to G2. Group 3 reported significantly more disability (p<0.05) at 24, 48, 72, and 96 hrs post exercise compared to G1 at 24 and 72, and 96 hrs compared to G2.

CONCLUSION: Two sets of 25 repetitions of eccentric muscle contractions in the lumbar extensors at 90% of peak torque resulted in greater pain, strength deficits, and perceived disability than the same exercises performed at 70 or 50% of peak torque. Because many causes of low back pain have been attributed to soft tissue weakness and injury, studies of DOMS of the low back muscle could provide a useful model for understanding low back pain of muscular origin.

2179 Board #116
3:00 PM - 4:00 PM
Changes in Running Economy following the Repeated Bout of Downhill Running
Trevor C. Chen1, Jui-Hung Tu1, National Chiayi University, Dept. of P.E., Chiayi., Taiwan Republic of China. 2National Pingtung Education University, Dept. of P.E., Pingtung City, Taiwan Republic of China. 3National Chiayi University, Dept. of P.E., Chiayi., Taiwan Republic of China. 4Sponsor: Priscilla M. Clarkson, FACSM

Previous work has shown that a single bout of downhill running reduces running economy (RE), based on changes in stride length (SL), stride frequency (SF), oxygen consumption (VO2), minute ventilation (V' E), respiratory exchange ratio (RER), lactate (LA), heart rate (HR), and rating of perceived exertion (RPE). It is suggested that these changes are due to muscle damage, a consequence of the eccentric nature of the exercise.

PURPOSE: We hypothesized that a repeated bout of downhill running would result in less damage, and thus blunted measures of physiological (VO2, V' E, LA, HR, RER, RPE) and biomechanical RE (SL, SF, ROM-A, ROM-K) compared with changes found after the first bout.

METHODS: Ten men (20.5±1.5 yr) performed two bouts of downhill (-15%) running (DHR1, DHR2) for 30-min at 70% peak aerobic capacity (VO2peak) separated by 5 days. Maximal isometric strength of the knee extensors (MVC), muscle soreness, plasma creatine kinase (CK) activity, and myoglobin (Mb) concentration were measured before, at 1, 4, 24 hrs for 5 days after DHR1 and DHR2. All subjects performed level running at 65, 75, and 85% VO2peak (5 min each for each intensity) before, and, after, and for 5 days after DHR1 and DHR2, and during which VO2, V' E, RER, HR, RPE, and blood L A were measured. SL, SF, and range of motion for the ankle (ROM-A), knee (ROM-K) and hip joints (ROM-H) during the level run were analyzed using high-speed (120Hz) video images.

RESULTS: MVC decreased (p<0.05) after the downhill run, with no difference in percent MVC loss between DHR1 and DHR2. Soreness was increased (p<0.05) post-DHR1 and was unchanged after DHR2. Mb and CK were elevated (p<0.05) post-DHR1, with no change in Mb or CK post-DHR2. VO2, V' E, RER, HR, RPE, LA, and SF were increased (p<0.05) for 3 days post-DHR1, but were only elevated for 1
day post-DHR2. Similarly, SL, ROM-A, and ROM-K were decreased (p = 0.05) for 3 days post-DHR2, but only remained decreased for 1 day post-DHR2. ROM-M was unchanged post-DHR1 and DHR2.

CONCLUSIONS: A second bout of downhill running attenuated changes in markers of muscle damage (e.g. soreness, CK, Mb), measures of physiological RE (VO2, V̇̇̇̇̇Ė̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̇̈
Use of Biomarkers to Quantify Musculoskeletal Injury Resulting from a High Recoil Shoulder-Fired Weapon
Heath M. Isom1, Kenneth Blankenship1, Mark Lester1, William Harper2, Samson Ortega3, Rachel Evans1.
1Military Performance Division, U.S. Army Research Institute of Environmental Medicine, Natick, MA; 2Department of Physical Therapy, Fort Huachuca, AZ; 3Human Research and Engineering Directorate, U.S. Army Research Laboratory, Aberdeen, MD. (Sponsor: Edward Zambraski, FACSM)

Email: heath.isom@us.army.mil

Identifying simple, quantifiable measures of tissue damage following blunt-force trauma is an important need of healthcare professionals. Localized soft tissue injury results from repetitive firing of high-recoil weapons. This model was used to assess the efficacy of using biomarkers to quantify localized soft tissue damage.

PURPOSE: To determine if a compliment of urine and serum biomarkers demonstrate efficacy in quantifying musculoskeletal injury following repetitive firing of a high-recoil weapon.

METHODS: Fifteen male U.S. Army active duty and National Guard infantry soldiers (22±4 y, 173.4±6.5 cm, 74.6±9.8 kg) were recruited for this study. All volunteers were required to fire 15 rounds, with a 30-sec rest between shots, using a shoulder-fired weapon producing 59-78 lbs of recoil energy. Data were collected at the same time of day for each time point. Musculoskeletal injury was determined by changes in MRI signal intensity at six time points: prior to firing a weapon (pre), and at 30 min, 24 hr, 48 hr, 72 hr, and 96 hr post firing. A urine sample to assess hepcidin peptide (Hpt1) was collected on all subjects at all time points. Additionally, two serum biomarkers, creatine kinase (CK) and C-reactive protein (CRP), were collected at pre, 24 hr and 48 hr. Data were analyzed using separate repeated measures analyses of variance.

RESULTS: Soft tissue injury was evident in 14 of the 15 volunteers (93%) within 48 hours of firing the weapon. Data is presented in the following table:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pre</th>
<th>30 min</th>
<th>24 hr</th>
<th>48 hr</th>
<th>72 hr</th>
<th>96 hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI</td>
<td>79±12.3</td>
<td>75.1±46.6</td>
<td>*4.05±1.99</td>
<td>8.29±4.87</td>
<td>9.1±6.85</td>
<td>99±0.76</td>
</tr>
<tr>
<td>Hpt1</td>
<td>71±34.0</td>
<td>126.9±71.7</td>
<td>106.7±79.6</td>
<td>72.8±34.3</td>
<td>73.3±34.5</td>
<td>93.5±55.5</td>
</tr>
<tr>
<td>CK</td>
<td>145.7±6.9</td>
<td>*175.7±55.9</td>
<td>*44.3±39.5</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>CRP</td>
<td>0.08±0.05</td>
<td>*0.13±0.08</td>
<td>*0.14±0.11</td>
<td></td>
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</tr>
</tbody>
</table>

Values presented as: MRI (signal intensity); Hpt1 (ng/ml); CK (U/L); CRP(mg/dL)

* denotes significance at p<0.05

Hpt1 was the only biomarker that changed significantly, with a 44% increase evident 30 min post firing. Hpt1 peptide levels did not reflect changes in MRI signal intensity.

CONCLUSION: Hpt1 was a useful biomarker of the acute soft tissue response to blunt force trauma occurring to a small anatomical area.
extension (ext) after BR and did not differ between groups. The CON group had larger decreases (p<0.05 in LBNP), knee and ankle ext T

<table>
<thead>
<tr>
<th></th>
<th>CON</th>
<th>EX</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV</td>
<td>4.3±1.2</td>
<td>0±1.0*</td>
</tr>
<tr>
<td>Knee ext T, °60°/s, N-m</td>
<td>23±7</td>
<td>9±5*</td>
</tr>
<tr>
<td>Foot ext T, °60°/s, N-m</td>
<td>62±5</td>
<td>10±3*</td>
</tr>
<tr>
<td>Knee ext 120°/s, N-m</td>
<td>204±67</td>
<td>16±48*</td>
</tr>
</tbody>
</table>

Table 2: Post-BR and CON variables measured. *Significant difference from CON (p<0.05); tailed, non-paired t-test

MEANSE: n=12. __*

CONCLUSIONS: This LBNP exercise countermeasure prevented losses in lean leg mass and partially counteracted the decreases in knee and ankle extensor strength and in knee extensor endurance during 30 of bed rest. The addition of a resistive exercise countermeasure probably will be necessary. Supported by NASA grant NAG-1425 to Alan R. Hargens and by NIH grant MO1 RR00827 to the UCSD GCRC.

2188 Board #125 3:00 PM - 4:00 PM WISE-2005: LBNP/Treadmill and Resistive Exercise Countermeasures Maintain Upright Exercise Response during 60-Days of Bed Rest Paulette M. Yardad1, Suzanne M. Schneider1, Stuart M.C. Lee2, Donald E. Watenpaugh3, Brandon R. Macias3, Alan R. Hargens, FACSM3. 1Univ of New Mexico, Albuquerque, NM. 2Wyle Life Sciences, Houston, TX. 3Sleep Consultants, Inc., Fort Worth, TX. 4Univ of California, San Diego, CA.

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We previously documented that when subjects exercised 6 d·wk−1 on a vertical treadmill within lower body negative pressure (LBNP) exercise responses were maintained after 15- and 30-d of bed rest (BR).

PURPOSE: to determine if submaximal exercise response is maintained during 60-d of BR when LBNP is performed 2-4 d·wk−1 and REX is added 2-3 d·wk−1.

METHODS: Eight healthy women (age: 32.4±4 yrs, VO2peak: 38.4±2.0 ml·kg−1·min−1; mean±SD) were assigned to either a control (CON, n=4) no exercise group or an exercise group (EX, n=4). The EX group exercised (40-80% pre-BR VO2peak) within LBNP (−49.3 mmHg) to provide footward forces equivalent to 1:0.1-2 body mass times body weight. REX consisted of maximal concentric and eccentric supine leg press and heel raise exercises using a gravity-independent flywheel ergometer. Each subject was assigned an incremental upright treadmill test pre- and 3-d post-BR. Ventilatory threshold (VT1) was determined by the V̇O2VT criterion method and bi-segment regression as described by Cioceco et al. (1992). Pre- and post-BR responses were compared at an absolute exercise intensity corresponding to 75% pre-BR VO2peak using paired (within groups) and unpaired (between groups) t-tests. p<0.05.

RESULTS: Post-BR the CON group had significantly higher heart rate (HR), minute ventilation (V̇E), respiratory exchange ratio (RER) and rating of perceived exertion (RPE) during exercise. The CON group had an earlier reliance on glycolysis. The EX group had no significant change in any of the measured exercise responses with BR.

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<table>
<thead>
<tr>
<th></th>
<th>CON</th>
<th>EX</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>159±8</td>
<td>177±9*</td>
</tr>
<tr>
<td>VO2</td>
<td>44.4±4.5</td>
<td>57.9±7.3*</td>
</tr>
<tr>
<td>RER</td>
<td>1.06±0.04</td>
<td>1.16±0.03*</td>
</tr>
<tr>
<td>V̇E</td>
<td>24.2±2.6</td>
<td>28.3±2.8*</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>36.4±4.5</td>
<td>47.4±7.3*</td>
</tr>
</tbody>
</table>

CONCLUSION: The LBNP and REX countermeasures maintained submaximal exercise responses after 60-d of simulated microgravity. This suggests that astronauts who perform these countermeasures may be able to work with less physiological strain and fatigue and perhaps for a longer time compared to subjects who perform no countermeasures. Supported by NASA, ESA, and CNES and NASA Grant NNJ04HF71G to A. Hargens.

2189 Board #126 4:00 PM - 5:00 PM WISE-2005: Effect of Bed Rest and Countermeasures on Knee Extensor Strength and Endurance in Women Following 60-Days of Bed Rest Stuart M.C. Lee1, Suzanne M. Schneider2, Brandon R. Macias2, Alain Lemon2,1, Stephanie Beroud4, Alan R. Hargens, FACSM3. 1Hyde Laboratory, Houston, TX. 2University of New Mexico, Albuquerque, NM. 3University of California-San Diego, San Diego, CA. 4MEDES- Clinique Spatiale, Toulouse, France.

Email: slce1@ems.jsc.nasa.gov

We previously documented that supine treadmill exercise within lower body negative pressure (LBNP) partially maintained knee extensor strength (KES) and endurance (KEE) after 30-d bed rest (BR) in men and women.

PURPOSE: The purpose of this study was to determine whether LBNP, plus a resistive exercise countermeasure would prevent KES and KEE losses in women during a 60-d BR.

METHODS: Eight women were assigned to either a control group (CON, n=4) who performed no exercise or to an exercise group (EX, n=4). EX subjects performed a 40-min interval (40-80% pre-BR VO2peak) LBNP, exercise protocol at footward force equivalent to 1:0.1-2 body mass, plus 10 min of rest at LBNP 3 days·wk−1. Resistive exercise consisted of maximal concentric and eccentric supine leg press and heel raise exercises using a gravity-independent flywheel ergometer 2-3 days·wk−1.

ISOELECTRIC (5 reps @ 60 sec−1; peak torque) and KEE (20 reps @ 180°·sec−1; total work) tests were conducted twice before BR and once 5 days after BR. Change between the 2nd pre-BR and the post-BR tests were compared using paired t-tests (p<0.05). Between groups comparisons of pre- to post-BR %change were made with unpaired t-tests.

RESULTS: KES was reduced in the CON group after BR (Pre: 116±8; Post: 80±3 N-m), but was unchanged in the exercise group (Pre: 112±8; Post: 107±15 N-m). There was a significant difference in % change in KES between groups (CON: -31±4; EX: -5±10 %). KEE also was reduced in the CON group after BR (Pre: 951±60; Post: 880±55 N-m), but there was no change in the EX group (Pre: 905±50; Post: 1102±67 N-m). There tended to be a difference in % change in KEE between groups (CON: -72±6; EX: +15±9 %, p<0.06).

CONCLUSIONS: Vigorous LBNP and resistive exercise training during a 60-d bed rest was sufficient to maintain knee extensor strength and endurance in this small group of women. This combination of aerobic and resistive exercise countermeasures may be appropriate to prevent deconditioning during long-duration space flight. Supported by ESA, CNES, NASA, MEDES staff, and NASA grant N00014HF71G to A. Hargens.

2190 Board #127 2:00 PM - 3:00 PM WISE-2005: LBNP/Treadmill and Resistive Exercise Countermeasures Maintain Aerobic Capacity during a 60-Day Bed Rest Suzanne M. Schneider1, Stuart M.C. Lee2, Donald E. Watenpaugh3, Brandon R. Macias3, Alan R. Hargens, FACSM3. 1Univ of New Mexico, Albuquerque, NM. 2Wyle Life Sciences, Houston, TX. 3Sleep Consultants, Inc., Fort Worth, TX. 4Univ of California, San Diego, CA.

Email: schneidera@um.edu

We have previously documented that supine treadmill exercise within lower body negative pressure (LBNP) performed 6 sessions·wk−1 during 15- and 30-day bed rests (BR) maintained upright aerobic capacity (VO2peak).

PURPOSE: In the present study, we are evaluating whether aerobic capacity is maintained during a 60-d BR when the LBNP frequency is reduced to 2-4 sessions·wk−1 and resistance exercise (REX) is added 2-3 sessions·wk−1.

METHODS: Eight healthy women (32.4±4 yrs; 56±4.3 kg; 164±8 cm; mean±SD) performed maximal-exertion, graded treadmill tests before and 3 days after a 60-d, 6-head-down tilt BR. (Earliest day the medical monitors would permit a maximal exercise test post-BR). During BR, four subjects performed no exercise (CON), while four other subjects (EX) performed LBNP and REX on separate days. The LBNP countermeasure employed an intermittent (40-80% pre-BR VO2peak) 40-min protocol against an LBNP pressure (−49±3 mmHg) applied to provide a footward force equivalent to 1:0.1-2 body weight. REX consisted of maximal concentric and eccentric supine leg press and heel raise exercises using a gravity-independent flywheel ergometer. Comparisons were performed using paired (within-group) or non-paired (between-group) t-tests.

RESULTS: Three days post-BR, VO2peak of the CON group was reduced significantly from pre-BR (37.5±1.2, Post: 29.4±2.0 ml·kg−1·min−1, P<0.05), while the VO2peak of the EX group was not significantly reduced (Pre: 39.6±1.9, Post: 38.0±0.6 ml·kg−1·min−1). Peak heart rate, ventilation, rating of perceived exertion, and respiratory exchange ratio were not significantly different between the two groups pre- and post-BR.

CONCLUSION: These preliminary results suggest that the combined LBNP and REX countermeasures may be sufficient to maintain upright aerobic capacity after long-duration space flights. Supported by NASA, ESA, and CNES and by NASA Grant N00014HF71G to A. Hargens.

2191 Board #128 3:00 PM - 4:00 PM Effects of Heat Acclimation on Thermal and Cardiovascular Responses during Hypoxic Head Down Tilt Exercise Yong Seok Seo, Hyun Jong Park, Kil Koo Kang, Sang Chul Lee, Due Taek Lee. Kim Chang Kew Exercise Physiology Laboratory, Kookmin University, Seoul, Republic of Korea.

Email: yseo@korea.com

PURPOSE: To investigate the effects of exercise and heat acclimation at 6° head down tilt (HDT) position on thermoregulatory and cardiovascular responses during exercise with normoxic hypoxia.

METHODS: Eight healthy, non-heat acclimated, young men were recruited and equally assigned into two groups; heat acclimated (HA: 23±0.1 6, 67±4±7, 172±3, 12±4±5) and control (CG, 22±5±4, 71±4±8 kg, 176±8 cm, 12±3±2% body fat).

POSTER SESSIONS
fat) groups. Subjects participated in a HDT leg cycling program consisting of 65% of individual maximal capacity, 60 min/session, 5 times/week for 4 weeks at 39.0±0.5°C for HA and at 23.7±0.5°C for CG. Before and after the program, subjects underwent tests in 38.8±0.5°C room, in which they rested for 30 min while breathing 13% O2. Treadmill running at 60% of maximal capacity for 30 min, then recovered 30 min with breathing normal air. Throughout 90 min, they sustained HDT position. During testing, rectal (Tre) and skin (Tsk) temperatures and O2 saturation (SaO2) were continuously monitored and recorded. Heart rate (HR) and blood pressure (BP) were measured periodically. Blood samples were taken at the end of rest, exercise, and recovery periods. Naked body weight was measured before and after the testing.

RESULTS: In all tests, SaO2, was decreased during resting and exercise to 75~79%. Tre at 30 min of exercise and 30 min of recovery was lower in post (37.0±0.2 and 37.0±0.2°C) than pre (37.3±0.4 and 37.4±0.4°C) exercise program in HA (P<0.05) but not in CG (37.3±0.4 and 37.3±0.2°C at post vs 37.2±0.1 and 37.4±0.2°C at pre, respectively). Tsk was reduced after the program in both groups (P<0.05). HR during recovery was much lower from pre (84±11 bpm) to post (68±10 bpm) in HA (P<0.05) but not in CG (83±9 vs 77±17 bpm, respectively). BP was not different in any comparisons. Weight loss after program was less in HA (0.5±0.1) than CG (0.7±0.4 kg) (P<0.05). Calculated plasma oxygen at the time of exercise before the program changed to 1.29±0.9% in CG and 6.9±5.3% in HA, but after the program, it changed to 6.8±1.6% in CG and -2.1±0.9% in HA (P<0.05).

CONCLUSIONS: The results indicated that HDT exercise and heat acclimatization reduced thermal stress during hypoxic exercise in hot environment, but did not elicit modified thermoregulatory and cardiovascular responses to HDT exercise with hypoxic breathing.

2192 Board #129 4:00 PM - 5:00 PM
Influence of Unilateral Lower Limb Suspension on Cardiorespiratory Response during Exercise
Kohi Sato1, Keisho Katayama2, Norio Hotta3, Koji Ishida4, Motohiko Miyachi5, Kazumi Masaeda2, Hiroshi Akima6.1Research Institute of Physical Fitness, Japan Women’s College of Physical Education, Tokyo, Japan. 2Research Center of Health, Physical Fitness and Sports, Nagoya University, Nagoya, Japan. 3Laboratory of Physical Activity and Health Evaluation, National Institute of Health and Nutrition, Tokyo, Japan. 4Faculty of Education, Kansazawa University, Kansazawa, Japan.

Email: ksato@jwpcpe.ac.jp

Previous studies have reported that muscle dysfunction and a reduction of femoral arterial size were caused by unilateral lower limb suspension (ULLS) in humans. Since the decrease in function of the muscle and vessel could relate to change of aerobic capacity during exercise, it is possible to hypothesize that changes in cardiorespiratory response also occur after ULLS. However, there are no studies regarding the influences of ULLS on physiological parameters response during cycle exercise.

PURPOSE: The aim of this study was to clarify the effect of ULLS on cardiorespiratory response during one-legged cycle exercise.

METHODS: Eight healthy men participated as subjects in this study. They performed ULLS of the left leg for 20 days, and were restricted the physical activity with their ULLS leg. The measurements of cardiorespiratory response during one-legged incremental cycle exercise in the suspended (left) and control (right) legs were performed before (pre) and after (post) 20 days of ULLS.

RESULTS: Respiratory and cardiovascular parameters during one-legged submaximal cycle exercise in the suspended and control legs were unchanged after 20 days of ULLS. Peak oxygen uptake (VO2peak) in the suspended leg decreased significantly (P<0.05) after 20 days of ULLS (pre, 35.1±4.5; post, 31.5±3.8 ml/kg/min), while VO2peak in the control leg did not change following ULLS (pre, 34.5±2.8; post, 34.4±3.8 ml/kg/min).

CONCLUSION: In the present study, disuse with 20 days of ULLS led to the decrease in VO2peak (−9.8±10.0%) ml/kg/min. Our previous study reported that 20 days of head-down tilt bed rest (HDBR) induced a decrease in VO2peak (−25.9% ml/kg/min). These data suggest that the magnitude of the decrease in aerobic capacity following ULLS is approximately one third of that after HDBR as the experimental period is the same.

2193 Board #130 2:00 PM - 3:00 PM
Influence of Motor Imagery on Dose-Induced Stress Loss and Central Activation Function
Summer B. Cook, Brian C. Clark, Lor L. Ploutz-Snyder, FACSM, Syracuse University, Syracuse, NY.

Motor imagery (MI) is known to activate several cortical areas of the brain and has been shown to alter corticospinal excitability. Previous studies have shown increases in muscle strength after MI training and therefore it is speculated that MI training may be effective in attenuating the disuse-induced loss in muscle strength.

PURPOSE: To evaluate the efficacy of motor imagery training on plantarflexor (PF) and knee extensor (KE) strength and PF central activation during unilateral lower limb suspension (ULLS).

METHODS: Eighteen volunteers completed 4-weeks of ULLS. Twelve subjects were assigned to a control group (4 men and 7 women; 20.7±5.7 years, 166.7±3.2 cm, and 66.3±3.5 kg) and 6 subjects (2 men and 4 women; 21.0±1.41 years, 166.01±2.61 cm, and 64.35±4.12 kg) engaged in MI training sessions during the ULLS four times per week. In the MI training sessions, subjects performed 10 imagined maximal contractions of the left plantarflexor muscles only. The duration of each imagined contraction was approximately 15-seconds, and was followed by ~1-min of rest. Soleus EMG was measured during the training sessions to ensure that muscle and KE strength did not change along with PF central activation via the interpolated twitch method was assessed after before and after ULLS.

RESULTS: The MI training was specific to the PF muscles, which displayed decreases in muscle strength on the magnitude of 9.9% and 14.2% in the MI and control group respectively. The KE, which were not targeted by MI, demonstrated 27.0% and 17.0% decreases in the MI and control group respectively. Overall, we did not observe a significant mitigation in PF muscle strength in the MI group (p=0.17), although a modest effect size was observed (ES=0.18). No changes were observed in central activation following ULLS within or between groups (p≥0.21, ES=0.07), although these results seemed to be highly variable between subjects.

CONCLUSIONS: MI training on the plantarflexor muscles did not have a statistically significant effect on PF muscle strength and central activation. However, the modest effect size for MI attenuating PF strength loss suggests it may have positive effects, thus further work in this area is warranted. It is suggested that future investigations delineate the impact of MI on different muscle groups, as well as training frequencies, intensity and duration.

ACKNOWLEDGEMENTS: This work was supported in part by the following: NASA Training Grant (NIGT-50446), the 2004 and 2005 NASA Space Physiology Research Grant through the American College of Sports Medicine (ACSM) Foundation, and the 2003 ACSM Mid-Atlantic Regional Chapter Research Award.

Astronauts onboard the International Space Station use treadmill locomotion as an exercise countermeasure to musculoskeletal deconditioning. A subject loading device (SLD) provides an external load (EL) that tethers the astronaut to the treadmill surface and applies axial skeletal loading via the ground reaction force (GRF). GRF parameters while running in microgravity should be equivalent to those obtained in normal gravity (1g) if musculoskeletal benefits are to be received.

PURPOSE: To determine the relationship between mean dynamic EL and vertical GRF parameters during running in weightlessness (0g).

METHODS: Four subjects (28.0±5.6 yrs, 170.2±8.6 cm, 74.5±14.0 kg) ran on an instrumented treadmill at 3.13 m/s during 0g (parabolic aircraft flight) and 1g (laboratory). During 0g, EL was provided by an SLD that attached to a waist and shoulder harness worn by the subjects. EL was measured via load cells (120 Hz) and the instrumented treadmill measured and KE strength (250 Hz). GRF parameters included peak impact force (PIF), peak active force (PAF), max loading rate (LR) and impulse (Imp). Simple linear regression examined the relationship between mean dynamic EL and each vertical GRF parameter (p<0.05). Mean 1g GRF values were placed back into significant regressions for calculations of the predicted mean dynamic EL to replicate values found in 1g.

RESULTS: The mean dynamic EL ranged between 57% and 94% of body weight (BW). Significant relationships were observed between mean dynamic EL and both PAF (r=0.58) and Imp (r=0.78). No significant relationships were found between EL and PIF or LR. The predicted mean dynamic EL for 1g replication was 126% BW for PAF and 109% BW for Imp.

CONCLUSION: These results suggest that not all GRF parameters are dependent on EL provided by an SLD while running in weightlessness. The observed r-values for PAF and Imp suggest that EL accounts for only a portion of the variance in vertical GRF. Future regression analysis should try to determine what variables correlate to PIF and LR in weightlessness, as these GRF parameters may be the most beneficial for musculoskeletal integrity.

2195 Board #132 4:00 PM - 5:00 PM
Heart Rate Variability during Simulated Space Extravehicular Activity
Andreas D. Flouris, Jessica M. Scott, Sheryl Bishop. International Space University, Strasbourg, France.

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A major factor in human space missions is extravehicular activity (EVA) which requires numerous training hours in underwater microgravity-simulation environments prior to each mission launch. Heart rate variability (HRV) measurements are a valuable

#1362-1849–WEDNESDAY, MAY 31 #1850-2268–THURSDAY, JUNE 1 2269-2728–FRIDAY, JUNE 2 #2727-2915–SATURDAY, JUNE 3
and non-invasive tool that can provide extensive insights on the cyclic variations in heart rate for investigating the modulatory effects of neural mechanisms elicited by the autonomic nervous system on intrinsic heart rate during EVA.

**METHODS:** Given the limited literature regarding cardiovascular responses and HRV in simulated EVA (EVA) environments and underwater conditions, our purpose was to evaluate the cardiovascular responses to a EVA scenario. Ten healthy adult volunteers (seven male; three female; BMI 23.7±2.1; age 26.4±2.9) performed a 20-minute EVA sortie in a neutral buoyancy water tank environment (27°C) at a depth of 5 meters. The EVA scenario was a Hubble Telescope repair mission using a high fidelity task mock-up. Data for HRV (three from the mean time domain and three from the frequency domain) was obtained for five minutes prior to, during, and for five minutes following the EVA using non-invasive telemetry sensors (Polar, Kempele, Finland). Participants were instructed to refrain from vigorous exercise, as well as consumption of caffeine and alcohol for at least 12 hours prior to diving.

**RESULTS:** Heart rate during EVA was increased when compared to pre-dive (74.10 vs. 108.16 beats/min, \( p < 0.05 \)). In contrast, the time domain measure pNN50 (73.3±16.9 vs. 14.1±11.6 %, \( p < 0.05 \)), and the R-R interval (7.02±0.26 vs. 5.96±0.11, \( p < 0.05 \)) showed a significant decrease during EVA when compared with pre-dive conditions, while no changes were detected in the frequency domain measures between conditions. Further, general linear models incorporating covariates for age, gender, and BMI demonstrated associations between pre-dive and dive sympathovagal balance values, as well as between dive R-R interval and pre-dive mean heart rate and sympathovagal drive (\( p < 0.05 \)).

**CONCLUSION:** In contrast to previous studies examining HRV during scuba diving, we found a decrease in HRV during an underwater EVA sortie. The observed results may be due to the increased psychological stress of performing the EVA scenario tasks.

Supported by the Canadian Foundation for the International Space University.

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**2196 Board #133 2:00 PM - 3:00 PM**

**Orthostatic Intolerance in Women: Diminished Splanchnic Vasoconstriction During 70° Head-Up Tilt**

Sara S. Jarvis, John P. Florian, Michael J. Curren, James A. Pawelczyk, FACSM. Penn State University, University Park, PA. Email: ssj120@psu.edu

Although women (W) are generally recognized to be less orthostatically tolerant than men (M), the sex differences leading to this disparity have not been fully elucidated. We hypothesized that during head-up tilt W would demonstrate less splanchnic vasoconstriction than M, leading to blood pooling in the splanchnic region, lower blood pressure, and lower orthostatic tolerance.

**PURPOSE:** To determine the change in splanchnic vascular conductance (SpVC) between baseline (supine) and 70° head-up tilt in women and men.

**METHODS:** Splanchnic blood flow (SBF), heart rate (HR), blood pressure (SBP, DBP, MAP), cardiac output (Q), systemic vascular conductance (SVC), stroke volume (SV), SpVC (SBF/SVC), and non-SpVC (SVC-SpVC) were measured during supine baseline, 70° head-up tilt, and recovery in 14 healthy W (23±6 yrs; mean±SD) and 13 age-matched M (24±5 yrs). To assess changes in SpVC and non-SpVC we examined the difference between baseline and tilt (ΔSpVC, Δnon-SpVC). All other variables were assessed by stage and sex. A Kaplan-Meier survival curve was used to assess differences in tilt time between the sexes.

**RESULTS:** Median tilt times to presyncope tended to be lower in W when compared to M (15.7 vs. 22.5 mins; \( p = 0.06 \)). ANOVA indicated that W had lower blood pressure than M. MAP was lower during supine rest (77±5 vs. 87±8 mmHg, \( p < 0.0001 \)) and decreased similarly during tilt (4.49±1.35 vs. 4.42±0.92 L/min, \( p > 0.05 \)). ΔSpVC was not different between the sexes (\( p = 0.07 \)).

**CONCLUSIONS:** Women demonstrate lower blood pressure during head-up tilt, and consequently lower tilt-table tolerance. The principal reason for this difference appears to be diminished vasoconstriction in the splanchnic vascular bed.

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**2197 Board #134 3:00 PM - 4:00 PM**

**The Effect of a Somatostatin Analog on Splanchnic Blood Volume During Head-Up Tilt**

Christopher N. Sinollo, Sara S. Jarvis, John P. Florian, James A. Pawelczyk, FACSM. The Pennsylvania State University, University Park, PA.

Blood volume shifts are an important factor contributing to the physiological responses to head-up tilt. In particular, capacitance organs such as the liver store large volumes of blood that may be redistributed during orthostatic stress.

**PURPOSE:** In this investigation we attempted to measure blood volume changes in the abdominal region during 70° head-up tilt. Furthermore, we quantified changes in abdominal blood volume distribution in response to selective splanchnic vasoconstriction induced by a somatostatin analog (125 mg octreotide acetate iv).

**METHODS:** Thirteen men (24±5 yrs; mean ± SEM) were outfitted with band electrodes bracketing the abdominal region (xiphoid to iliac crest) for measurement of electrical impedance shifts (Minnesota Impedance Cardiograph). Abdominal blood volume changes were calculated from the change in impedance using the Nyboe equation. Blood resistivity was estimated from hematocrit. On separate days, measurements were recorded before, during and after tilt, one with octreotide and one with placebo (double-blind, randomized order).

**RESULTS:** Analysis of individual data revealed both increases and decreases in abdominal blood volume in response to tilt with a mean change of ±34.2±6.4% (\( p < 0.05 \)). No significant effect of octreotide administration was noted.

**CONCLUSIONS:** The changes in abdominal electrical impedance between baseline and tilt reflects the collection of blood in the abdomen during orthostatic stress. Furthermore, selective constriction of the splanchic circulation by octreotide infusion is unable to mitigate this response.

Supported by NASA NNX04HF45G and NIH MO1RR010732

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**D-30**

**Free Communication/Poster – Sport Biomechanics**

**2198 Board #135 4:00 PM - 5:00 PM**

**Kinematic Analysis of Jump-Landing Technique During Various Foot-Landing Styles**

Nelson Cortes, James Onate, Joao Abrantes, Linda Gagen, Bonnie Van Lunen, Elizabeth Dowling. ’Old Dominion University, Norfolk, VA. ‘Technical University of Lisbon, Lisbon, Portugal. (Sponsor: David Swain, FACSM)

Jump-landing tasks require the body to utilize various movement patterns in order to absorb the body’s energy when landing.

**PURPOSE:** The purpose of this study was to analyze lower extremity motion patterns during the stop-jump landing phase from a box of 30cm during different foot position aspects (self-preferred, forefoot, and rear foot). The study aimed to evaluate kinematic (knee flexion, knee valgus, ankle plantar-flexion, and hip flexion) differences at four instants (initial contact, maximum vertical ground reaction force, maximum knee flexion, and maximum proximal anterior tibial shear force) between the different foot-landing techniques and gender.

**METHODS:** Twenty-five males (23.2±2.5 yrs, 176.2±27.3cm, 68.2±8.4kg) and twenty-five females (23.2±2.5 yrs, 176.2±27.3cm, 56.2±8.4kg) were selected from a sample of convenience from a University student population. A 3-D electromagnetic motion analysis system set at a sampling rate of 100Hz was used for data collection. The rearfoot technique consisted of initial contact with the heel followed by the forefoot, while the opposite occurred for forefoot landing technique. Five trials were averaged for each technique and exported into SPSS version 12.0 for analysis. Separate multivariate repeated measures analyses of variance (MANOVAs), with an alpha level set at \( p < 0.05 \), were used to analyze each variable at the different time instants with gender as the between factor and technique as the within factor.

**RESULTS:** There were no significant differences found between genders at the four instants for each variable. There were significant differences found at initial contact in hip flexion angles between landing techniques (\( p < 0.001 \)), the forefoot technique (25.79±11.78°) resulted in less hip flexion than the self-preferred (41.25±11.89°) and rearfoot (43.15±11.77°) techniques. A significant difference was found between landing techniques at maximum vertical ground reaction force for knee flexion (\( p < 0.001 \)). The rearfoot technique (26.77±9.49°) presented lower knee flexion angles as compared to forefoot (58.77±20.00°) and self-preferred (54.21±23.78°) techniques. A significant difference of knee valgus angles was found between landing techniques at maximum vertical ground reaction force (\( p < 0.001 \)). The self-preferred (4.12±3.51°) and forefoot (4.97±7.90°) techniques presented greater knee varus angles as compared to the rearfoot technique (0.68±6.52°).

**CONCLUSION:** The rearfoot landing technique presented significant differences in the kinematic parameters when landing. Future studies should evaluate foot landing style effects on kinematic and kinetic variables during functional tasks.

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**2199 Board #136 2:00 PM - 3:00 PM**

**Biomechanical Determinants of Metabolic Cost of Submaximal Cycling Power**

Lex Gidley, James C. Martin, FACSM. The University of Utah, Salt Lake City, UT.

Email: jml martin@utah.edu

Previous authors have reported that metabolic cost increases linearly with increasing net mechanical cycling power output. This metabolic cost has also been reported to increase with increasing pedaling rate. Several investigators have speculated that the mechanism responsible for the effect of pedaling rate might be increased negative work.
PURPOSE: We conducted this study to determine the relationship of metabolic cost of producing submaximal cycling power with summed net and positive powers at the ankle, knee, and hip, and to test the hypothesis that positive joint powers would account for previously reported differences in metabolic cost associated with different pedaling rates.

METHODS: Five trained cyclists (31.8±8 yrs, 178±9 cm, 74.8±11 kg) cycled at 60, 90, and 120 rpm/min, at intensities of 30, 60, and 90% of ventilatory threshold. Pedal forces, and pedal and crank position were sampled at 120 Hz for 20 sec. Hip position and geometrically calculated leg kinematics were determined from 20 sec of recorded motion capture data. Net joint moments and reaction forces were determined using inverse dynamic techniques. Ankle, knee, and hip joint powers were calculated as the product of net joint moment and joint angular velocity and power transferred across the hip joint was calculated as the dot product of joint reaction force and joint linear velocity. Pedal force and position data were recorded in the fifth minute of each trial. Expired gases were collected throughout the trial and values during the fifth minute were averaged and used to calculate metabolic cost via the Weir equation. Multiple linear regression analyses were used to determine the relationship between metabolic cost and pedaling rate with two additional model variables of net joint power and net positive joint power.

RESULTS: Both regression analyses produced significant relationships (R2=0.94, p<0.001) but the pedaling rate coefficient was positive when predicting net joint power but negative when predicting positive joint power.

CONCLUSION: Our novel finding was that the metabolic cost of producing positive power decreased with increasing pedaling rate. We interpret these results to suggest that a pedaling rate of 120 rpm, which has been reported to be the optimal pedaling rate for producing maximum cycling power, allowed for more efficient positive joint power production. The commonly reported increase in metabolic cost associated with increasing pedaling rate appears to be due to additional power required to overcome negative joint powers. Whether negative powers represent poor technique or are required to stabilize the two degrees of freedom leg system is a topic of ongoing investigation in our lab.

The ITBS group exhibited significantly greater KIR and HADD peak angles and greater KMOMY and KMOMZ compared to controls. These data suggest that repetitive exposure to increased joint motion and loading over time would require greater restraint from the ITB and result in the cascade of events that cause ITBS. Prospective studies are necessary to more fully determine if these running biomechanics are predictive of future injury.

Supported by the Department of the Defense (DAMD17-01-1-0515)
second bouts of effleurage, pétrissage, and tapotement applied to the subject’s back and one calf. All treatments were performed by the same qualified massage therapist. The timing and force of each massage technique was recorded using a Kistler force plate. The massage couch was mounted onto the force plate using a custom built interface. Mean force, mean cycle duration, and mean cycle rate were measured for each massage technique and body region.

**RESULTS:** During effleurage mean force was higher, mean cycle duration was longer, and mean cycle rate was slower than pétrissage ($p < 0.0001$), and tapotement ($p < 0.0001$). During pétrissage mean force was also found to be higher, mean cycle duration longer, and mean cycle rate slower than tapotement ($p < 0.0001$). Mean values and test-retest coefficients outcomes are presented in Table 1.

**CONCLUSIONS:** Stroke force and speed varies between massage techniques, however test-retest reliability of massage delivery is moderate. Standardization of experimental massage protocols might be improved by using a timing device rather than depending on a therapist’s self-regulation skills.

### Table 1. Mean ± SD values with test-retest coefficients.

<table>
<thead>
<tr>
<th>Effleurage</th>
<th>Mean Force ($N$)</th>
<th>Cycle Duration (s)</th>
<th>Cycle Rate (Hz)</th>
<th>Mean Force ($N$)</th>
<th>Cycle Duration (s)</th>
<th>Cycle Rate (Hz)</th>
<th>Mean Force ($N$)</th>
<th>Cycle Duration (s)</th>
<th>Cycle Rate (Hz)</th>
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<td>Trial 1</td>
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<td>11.1 ± 0.4</td>
<td>3.4 ± 0.8</td>
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</tr>
<tr>
<td>Trial 2</td>
<td>11.8 ± 0.4</td>
<td>3.8 ± 0.8</td>
<td>0.6 ± 0.1</td>
<td>11.7 ± 0.4</td>
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<td>0.6 ± 0.1</td>
<td>11.5 ± 0.4</td>
<td>3.7 ± 0.8</td>
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<td>0.7 ± 0.1</td>
<td>12.1 ± 0.2</td>
<td>3.5 ± 0.8</td>
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<td>12.2 ± 0.2</td>
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<tr>
<td>Call 2</td>
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<td>3.6 ± 0.8</td>
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<td>11.9 ± 0.2</td>
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<td>Cycle Duration (s)</td>
<td>Cycle Rate (Hz)</td>
<td>Mean Force ($N$)</td>
<td>Cycle Duration (s)</td>
<td>Cycle Rate (Hz)</td>
<td>Mean Force ($N$)</td>
<td>Cycle Duration (s)</td>
<td>Cycle Rate (Hz)</td>
</tr>
<tr>
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<td>1.1 ± 0.2</td>
<td>1.0 ± 0.2</td>
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<td>1.1 ± 0.2</td>
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<td>Trial 2</td>
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<td>TAPOTEMENT</td>
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<td>Cycle Rate (Hz)</td>
<td>Mean Force ($N$)</td>
<td>Cycle Duration (s)</td>
<td>Cycle Rate (Hz)</td>
<td>Mean Force ($N$)</td>
<td>Cycle Duration (s)</td>
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<td>0.7 ± 0.1</td>
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<td>2.4 ± 0.2</td>
<td>0.7 ± 0.1</td>
</tr>
<tr>
<td>Trial 2</td>
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<td>5.1 ± 0.1</td>
<td>2.4 ± 0.2</td>
<td>0.7 ± 0.1</td>
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<td>2.4 ± 0.2</td>
<td>0.7 ± 0.1</td>
</tr>
<tr>
<td>Call 1</td>
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<td>2.4 ± 0.2</td>
<td>0.7 ± 0.1</td>
<td>5.1 ± 0.1</td>
<td>2.4 ± 0.2</td>
<td>0.7 ± 0.1</td>
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<td>2.4 ± 0.2</td>
<td>0.7 ± 0.1</td>
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<tr>
<td>Call 2</td>
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<td>2.4 ± 0.2</td>
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<td>5.1 ± 0.1</td>
<td>2.4 ± 0.2</td>
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</tbody>
</table>

**RESULTS:** The lead (in this case left) hip maximum internal rotational velocity was significantly greater than the back hip external rotational velocity ($227.8 ± 96.6$, 145.3 ± 68.0 deg/sec, $p < 0.003$). Furthermore, the peak velocities of each hip were reached at 89.1% (lead hip) and 85.2% (back hip) of the downstroking time.

**CONCLUSIONS:** It appears that the lead hip of a golfer may experience much higher rotational velocities during the downstroking than the back hip. It is likely that this would influence the torsion acting on the hip, which may influence the risk for labral pathology. Further research assessing the role of muscular activity around each hip in diminishing the forces associated with this torsion is needed. Similarly, data for the occurrence rates of labral tears in elite golfers, and at which hip this occurs, is essential in developing a thorough understanding of this problem.

### 2020 Board #143 3:00 PM - 4:00 PM

#### Bilateral Pedaling Asymmetry during a Simulated 40 km Cycling Time-Trial

Felipe P. Carpes¹, Mateus Rossato¹, Carlos B. Mota¹, Irvin E. Faria², FACSM;¹, Federal University of Santa Maria, Santa Maria, Brazil.²California State University, Sacramento, Sacramento, CA.

Email: felippecarpes@gmail.com

Pedaling asymmetry is frequently observed in the cycling task. However, little is known about the variability in pedaling asymmetry during long-term high-intensity cycling. The mechanisms that underlie its presence and absence and the relationship to lower limb dominance or exercise intensity remain unknown.

**PURPOSE:** The objective of this study was to determine the extent to which bilateral pedaling asymmetry is evident during a 40 km cycling time-trial (TT) and the influence of the dominant (DO) and non-dominant (ND) leg, exercise intensity and crank torque output to pedaling asymmetry.

**METHODS:** Six sub-elite male competitive cyclists pedaled a SRM Training Systems ergometer at a constant pedal rate of 98 ± 3 rpm during a simulated 40 km time-trial (TT). The SRM crank dynamometer measured the propulsive crank torque every 5 min for 10 consecutive crank cycles throughout the 40 km TT. All data were divided into 4 equal stages with respect to time. Comparisons between each stage of the 40 km TT were made by one-way repeated-measures ANOVA. From crank torque measurements, asymmetry was quantified by two dependent variables, the crank torque difference in average positive power between the DO leg, as determined by kicking, and ND leg and the difference in peak output torque. Asymmetry index was determined by the Chavet et al., equation: $A^P = \frac{(DO-ND)}{DO}$. Coefficient analysis was performed to ascertain the relationship between exercise intensity, mean crank torque and crank torque peak.

**RESULTS:** The crank peak was significantly ($P = 0.05$) greater in the 4th stage (18.14 ± 4.6 N/m) compared with stages 1 (15.58 ± 6.3 N/m), 2 (14.25 ± 3.9 N/m) and 3 (13.48 ± 5.5 N/m) of the 40 km TT. However, mean crank torque did not significantly differ among stages. During the intermediate TT stages 2 and 3, the asymmetry index of 13.51% and 17.28% respectively was significant. Exercise intensity was greater for stage 4 compared with other stages (P<0.05) and was highly correlated with mean crank torque ($r = 0.97$) and crank torque peak (r = 0.92). The DO limb was always responsible for the larger crank torque.

**CONCLUSIONS:** It was concluded that pedaling asymmetry changes systematically with crank torque power output and exercise intensity during a simulated 40 km TT and a high cranking forces associated with this torsion is needed. The e3 Fitness grips™ are marketed as a device that improves the stability of the
shoulders and hips while running and results in more efficient muscle use by positioning the body in a more "neutral" position. The manufacturer suggests this position ultimately reduces effort and therefore, stress on the joints of the lower extremities. The e3 Fitness grips have not been scientifically studied.

METHODS AND MEASURES: 21 recreational and competitive runners with a mean age of 25 years old were recruited. Subjects ran at least 6 miles per week prior to participation. None of the subjects had sustained injury within the 6 months prior to the study. 3D Motion Capturing System was used in order to collect and analyze static and dynamic position of reflective markers located on shoulders, the sternum and both anterior inferior iliac spine (ASIS). A series of pulsing infrared strobe lights that operated at a sampling frequency of 60Hz illuminated the position of the markers at discrete time intervals, and an array of six cameras positioned in a U-shaped pattern in front and along the sides of a Quinton Q55 series 90 treadmill. Each subject ran on the treadmill with the e3 Fitness grips in their hands; with sham grips in their hands, or without handgrips. Motion analysis was used to determine change in shoulder level, pelvis level and combination of the two. Following three minutes of running, kinematic data was collected for 5 seconds. Analysis of kinematic data was restricted to motions occurring in the frontal and sagittal planes.

RESULTS: The means and standard deviations for the three levels of the independent variable were calculated. A repeated measures design was used and a single factor ANOVA was completed for each level of the independent variable, clavicle angle (F (9, 98) = 9.82, p = 0.0001, ω2 = 0.493, and combined angle (F (9, 122) = 0.885). A probability level of P<.05 was selected to determine statistical significance. No significant difference was found in any joint angles when compared across the three conditions. Subjective response to running with the grips was mixed.

CONCLUSIONS: The e3 Fitness grips do not appear to change alignment or running biomechanics compared to running without grips or running with sham grips.

2208 Board #145 2:00 PM - 3:00 PM Techniques Used By Elite Gymnasts In Performing The Roche Vault: Angular Aerial Body Motion Yoshiaki Takei, FACSM, Northern Illinois University, DeKalb, IL.

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The handspring and double salto forward tucked, also called the Roche, is one of the most difficult and high-risk vaults today. Aerial body motion control strategy is the key to successful performance and safe landing of the Roche Vault. In the last two decades, there have been cases of spinal injuries and even death when a gymnast attempted the vault and landed on his neck. However, there has been no study on the analysis of the aerial body control technique.

PURPOSE: The purpose of the study was to determine the mechanical variables that govern successful aerial body control of the angular motion in the performance of the Roche vault.

METHODS: The subjects were 23 gymnasts performing the Roche vault at the 2000 Olympic Games. The vaults were filmed by a 16-mm camera operating at 100 Hz. The 2-D direct linear transformation was used for spatial reconstruction. Approximately 65 frames of each vault were digitized for each subject. A theoretical model was developed to identify the mechanical variables that govern the angular motion of the vault. Correlational analysis was used to establish the strength of the relationship between the calculated mechanical variables identified in the model and the judges’ scores.

RESULTS: Significant correlations (p<.05) indicated that the higher judges’ scores were negatively related to: (a) the angular distance and the time from horse take-off to knee grasp, (b) the angular distance and the time from peak of post-flight to knee release, and (c) the landing point deduction; and positively related to: (d) the angular distance and %th of knee grasp to peak of post-flight, (e) angular distance and the time from knee release to mat touchdown; and (f) the normalized average moment of inertia from knee release to mat touchdown.

CONCLUSIONS: Success of the Roche vault is likely when focus is on: (a) grasping the knees quickly with the hands immediately after the take-off from the horse; (b) moving into the tightest tuck position for high angular velocity and large angular distance of somersaulting rotation during the ascent to the peak; (c) completing the majority (or two-thirds) of the required somersaults at as great a height as possible; (d) releasing the knees shortly after the peak of post-flight has been reached, and (e) displaying the fully extended body position throughout the remainder of the flight, as the body travels over the large angular distance and long duration of time until touchdown, and simultaneously preparing for a “stick” landing for the final impression to the judges and a bonus point.

2209 Board #146 3:00 PM - 4:00 PM Wrist-hinge Angle and Velocity in Golfers of Varying Proficiency John T. Jolly, James M. Smoliga, Joseph B. Myers, Timothy C. Sell, Scott L. Lephart, FACSM, Neuromuscular Research Laboratory, University of Pittsburgh, Pittsburgh, PA.

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Mathematical modeling has shown that wrist-hinge angle (WH) and wrist-hinge angular velocity (WHV) prior to impact in the golf swing are important contributors to ball velocity. While, golf professionals appreciate the importance of WH for increasing ball velocity and subsequently driving distance, the relationship between WH and ball velocity has not been established in actual golfers.

PURPOSE: To demonstrate that these golfers with greater ball velocity will have greater WH and faster WHV during the downswing compared to golfers with slower ball velocity.

METHODS: 109 male right handed golfers (age: 44 ± 14 years, USGA handicap: 6.8 ± 5.6) underwent a swing analysis using their driver. Swing mechanics were assessed using an 8-camera high speed 3D optical motion analysis system (200 Hz). WH was calculated as the angle between the club and the lead arm, and WHV was the derivative of WH. Golfers were assigned into equal groups, (L1), medium (M), and high (H), according to their ball velocity measured with a golf launch monitor. For determining the group differences, a one-way analysis of variance (ANOVA) was performed for each variable at top of swing (Top), lead-arm parallel (LAP), 40ms prior to impact (IMP), impact (IMP), and maximum (Max) value during the downswing. Subsequently, a Bonferroni correction was used to identify the group differences. Statistical three parameters were set at a p<.05.

RESULTS: Mean ball velocity was significantly different for each group (L: 128.3 ± 4.3, M: 134.4±4.6, H: 159.1±6.4 mph, p<.0001). No differences were observed between groups for WH or WHV at Top. Significant group differences are presented in Table 1.

CONCLUSIONS: Given no differences at Top and differences in WH and WHV during the downswing, golfers with greater ball velocity retained their WH longer and generated more WHV before impact, generating more ball velocity. This supports both the mathematical and anecdotal evidence. Furthermore, the timing of WH release to achieve maximal WHV may be critical for greater ball velocity.

2210 Board #147 4:00 PM - 5:00 PM Biomechanics Concept Inventory 3 Duane Knudson, FACSM, Chico State University, Chico, CA.

Email: dkknudson@csuchico.edu

Standardized tests of core concepts in exercise provide a mechanism for evaluating student preparation and instructional effectiveness.

PURPOSE: Describe the improvement in understanding of core biomechanics concepts following an introductory biomechanics class.

METHODS: A pre- and post-test of a third version of the biomechanics concept inventory (BCI3) was administered to an intact biomechanics (n = 41) class of physical education and exercise science majors. The BCI3 was modeled after previous versions (Knudson et al. 2003; Knudson 2005) with 24 questions to evaluate four prerequisite competencies and eight biomechanics competencies.

RESULTS: The mean (SD) pre- and post-test scores were 11.0 (3.0) and 14.8 (3.4). Post-test scores significantly (p < .0001) improved 34%. When improvement was normalized (Hake 1998) the mean (SD) improvement was 29 (21)% of maximum possible improvement. This improvement was nominally larger than previous BCI tests of a similar class (24%) and a national sample of classes (13%). These moderate improvements are also consistent with several studies of improvements in mechanics concepts in introductory physics classes.

CONCLUSIONS: Traditional biomechanics lecture/lab instruction results in moderate improvement in understanding of key biomechanics concepts critical to professional practice. Standardized tests like the three versions of the BCI may be used to evaluate innovative instructional programs hypothesized to help students with these difficult concepts.

2212 Board #148 2:00 PM - 3:00 PM The Influence Of Push Frequency On Force Application During Steady-State Hand-رم Wheelchair Propulsion Vicky L. Goosen-Tolfrey, John P. Lenton, Neil Fowler, Lucas van der Woede, Graham Nicholson, Institute of Biophysical and Clinical Research into Human Movement, Manchester Metropolitan University, Stoke-on-Trent, United Kingdom. Faculty of Human Movement Sciences, Vrije Universiteit, Rehabilitation Center Amsterdam, The Netherlands. Aspire Centre for Disability Sciences, Institute of Orthopaedics and Musculo-Skeletal Sciences, University College London, Stannmore, Middlessex, United Kingdom. (Sponsor: Dr Alan Batterham, FACSM)

Email: v.tolfrey@mmu.ac.uk

PURPOSE: To evaluate the effect of push frequency on the application of force to the hand-رم during wheelchair propulsion.

METHODS: Eight male participants (22 ±4 yr; 85.5 ±12.3 kg) completed a series of exercise bouts on a wheelchair ergometer in a basketball wheelchair fitted with a force-sensing hand-رم (SMARTTM). Initially participants self-selected their freely chosen push frequency (FCF) (100%) at 1.7 m.s-1, with a rolling resistance of 47 ±9 N (mean power output of 77 ±17 W). This was followed by four counter-balanced trials at the same velocity pushing at 60%, 80%, 120% and 140% of the FCF. Gross mechanical efficiency (GME) was calculated during the last 30 s of each 4-min exercise bout. The forces applied to the hand-رم were recorded for the final 30 s of each exercise bout. The means and standard deviations for the three levels of the independent variable were calculated. A repeated measures design was used and a single factor ANOVA was completed for each level of the independent variable, clavicle angle (F (9, 98) = 9.82, p = 0.0001, ω2 = 0.493, and combined angle (F (9, 122) = 0.885). A probability level of P<.05 was selected to determine statistical significance. No significant difference was found in any joint angles when compared across the three conditions. Subjective response to running with the grips was mixed.

CONCLUSIONS: Success of the Roche vault is likely when focus is on: (a) grasping the knees quickly with the hands immediately after the take-off from the horse; (b) moving into the tightest tuck position for high angular velocity and large angular distance of somersaulting rotation during the ascent to the peak; (c) completing the majority (or two-thirds) of the required somersaults at as great a height as possible; (d) releasing the knees shortly after the peak of post-flight has been reached, and (e) displaying the fully extended body position throughout the remainder of the flight, as the body travels over the large angular distance and long duration of time until touchdown, and simultaneously preparing for a “stick” landing for the final impression to the judges and a bonus point.
booth. From these data, a number of parameters were calculated including: the total force \( F_T \) (calculated from the three force components \( F_x, F_y \) and \( F_z \)); the tangential force \( F_T \) defined as the ratio of torque around the wheel axle and the radius of the hand-rim; the fraction effective force (\( F_{FEF} \)) was calculated by averaging the ratios of peak value \( F_T \) and that of the \( F_T \) over the push phases; and the negative impulse \( (\dot{N}) \) calculated from the \( F_T \) multiplied by the time between pushes. A series of one-way analysis of variances with repeated measures were applied (\( p<0.05 \)). The relationship between \( F_{FEF} \) with either GME and push rate (push\( \pm \)min\( ^{-1} \)) were examined using Pearson Correlations.

**RESULTS:** The average force was found to be \( 59 \pm 9 \) push\( \pm \)min\( ^{-1} \). GME was considerably lower during the 140% FCC condition (8.5%) when compared to either the 80% or 100% FCC conditions (9.8% and 9.4 % respectively; \( p<0.01 \)). These conditions (80% and 100% FCC) were found to be the most efficient. Comparing the push frequencies revealed that \( F_T \) increased significantly from 161 to 224 N (\( p<0.01 \)), while there was a trend with the tangential forces suggesting that as the push frequency decreased \( F_T \) increased (82-125 N; \( p<0.01 \)). However, the effectiveness remained fairly consistent across the push frequency conditions (69-72%; n.s.). Moreover the mean negative impulse did not display any trends with respect to push frequency. It is worth noting that the highest \( F_{FEF} \) (72%5%) occurred at the 80%C FCC condition. There was no association between \( F_{FEF} \) with either GME or push\( \pm \)min\( ^{-1} \).

**CONCLUSION:** Results showed that GME was optimised at the 80% FCC, which happened to coincide with the highest \( F_{FEF} \) value. Comparing the different frequency conditions demonstrated that effectiveness of force application is not affected. Future studies must verify these results with wheelchair dependent participants.

**2212 Board #149 3:00 PM - 4:00 PM Landing Pattern During the Change of Direction Akira Masegaki, Hirokazu Ito, Koji Watari. The University of Tokyo, Tokyo, Japan.**

**BACKGROUND:** The change of direction needs in running or the other activities. When the change of direction unstable, the injuries like ankle sprains or anterior cruciate ligament injuries can occur. An appropriate landing skill during the change of direction is important for prevention of injuries.

**PURPOSE:** The purpose of this study is to investigate the performance of the change of direction from the landing pattern.

**METHODS:** Subjects were 55 university students (Height: 171.8±8.5cm, Weight:62.4±9.0kg, Age: 18±4.05yrs). Using pressure distribution measurement system (BIGMAT, Tecscan, Co.), we analyzed the pattern of first landed region and the internal rotation (IR) angle of the foot. Subjects were ordered to start running from right foot. When the third step (right foot) lands on the tactile sensor belt, subjects change direction and run through. The angle of start position was changed from 0° as straight to 30°, 60°, 90° in clockwise. Landing patterns and the IR angles were investigated from the graphic image of BIGMAT.

**RESULTS:** The pattern of first landing region was varied according to the tasked angle. The number of heel landing subjects was 32 (58.2%) in 0° and 23 (42.6%) in 90°. Although IR angle increased significantly (\( p<0.001 \)) as the tasked angle increased (-7.8±7.38° in 0°, 14.0±10.58° in 30°, 32.7±12.43° in 60°, 64.8±14.66° in 90°). IR angles were less than tasked angle.

**CONCLUSIONS:** We showed that first landing region and IR angle of landing foot during the change of direction were varied according to tasked angle. Especially, IR angle of landing foot was inadequate. We thought that the change of direction is difficult performance. Above all, we concluded that adequate landing skills need in the prevention of lower extremity injuries.

**2213 Board #150 4:00 PM - 5:00 PM MASHITAVAGE Is a Novel Rehabilitation Regimen for Upper Extremity Injuries Hirokazu Ito, Koichi Nakazato, Akira Masegaki, Hirokiyo Nakajima, Koji Watari. The University of Tokyo, Tokyo, Japan. 3Nippon Sport Science University, Tokyo. Japan.**

**BACKGROUND:** Throwing injuries in the upper extremity frequently occur in baseball players. Prevention and recovery of such injuries is very important for them. One of our colleagues, Dr. WATARAI, clinically found that patients with throwing injuries could throw with less or no pain in the upper extremities when their throwing movement is just in front of the thrower’s landing leg. This throwing motion is designated as MASHITAVAGE (MNG) in Japanese. We reported that MNG is effective as a novel rehabilitation regimen for throwing injuries in the upper extremity at the point of trunk rotation analysis and quantification of pain (ACSM 2004).

**PURPOSE:** In this study, we further examined the effectiveness of MNG as a novel rehabilitation regimen for throwing injuries in the upper extremities.

**METHODS:** Subjects were 680 baseball players with shoulder pain and 831 baseball players with elbow pain. We surveyed a part of shoulder and the elbow pain in detail when subjects performed MNG and actual throwing. In addition, we analyzed pelvic and trunk rotation movement of MNG in 40 male university baseball players without shoulder and the elbow pain to determine why upper extremity pain decreased when performed MNG.

**RESULTS:** The number of lateral shoulder pain subjects was 234(34.4%), anterior was 227(33.4%), and posterior was 219(32.2%). The VAS score of 680 shoulder pain subjects during MNG(42.2±2.2) was significantly(p<0.001) lower than that during regular throwing(5.3±2.1). The number of inside elbow pain subjects was 486(58.5%), backside was 186(22.4%), outside was 96(11.6%), and forearm was 63(7.6%). The VAS score of 831 elbow pain subjects during MNG(4.2±2.3) was significantly(p<0.001) lower than that during regular throwing(5.2±2.1).

**CONCLUSIONS:** We showed that players with upper extremity injuries could throw with less or no pain in MNG. We also demonstrated that the larger and higher pelvis and trunk rotation movement during MNG were significantly larger and higher than that during regular throwing.

**PSP SESSIONS**
weeks compared to the control group 3 ± 6% (P < 0.05).

CONCLUSION: An externally applied thoracic constriction band at rest can improve aerobic capacity without having to perform aerobic exercise.

METHODS: 15 sedentary college age individuals (between 18-35 yrs) were studied over a period of 4 weeks during which they participated in their normal everyday activities. Participants completed an activity questionnaire, a Physical Activity Readiness Questionnaire (Par-Q) and an aerobic capacity (VO2max) test. VO2max was measured Pre and Post 4 weeks using the 1.5-mile run/walk field test. Participants were instructed to cover the specified distance in the fastest time possible. A VO2max prediction equation (VO2max (mL/kg/min) = 3.5 × 483/time in minutes) was used. Following pre testing, participants were randomly placed into one of two groups: (1) Chest Wall Restriction Group (CWR)(n=10), or (2) Control (Non-Chest Wall Restriction Group (N-CWR)(n=5). Each participant in the Chest Wall Restriction Group (CWR) had their chest wall restricted with the use of an elastic strap for 1.5 hours 5 days / week. Strap widths ranged from 10 to 15 cm adjusted to fit just beneath the axillae and around the chest to envelop the rib cage. It is worth noting that this apparatus does not prevent the chest wall from expanding like earlier studies, but offers elastic eccentric resistance for the inspiratory muscles to work against.

RESULTS: A significant 11 ± 0.7% improvement in aerobic capacity was observed in the experimental group (P = 0.05). Estimated VO2max values for CWR increased from 27.92 ± 5.98 to 31.46 ± 6.42, while the N-CWR group showed no significant change (30.22 ± 5.67 to 30.51 ± 5.61). Units for VO2max are shown in mL/min ± SD.

CONCLUSION: This pilot study shows the potential benefit of wearing an externally applied thoracic constriction band at rest. Sedentary individuals with low exercise tolerance may be able to increase their aerobic capacity without performing aerobic exercise.

2217 Board #154 2:00 PM - 3:00 PM Effects of Gender on Landing Mechanics in an Unanticipated Landing Task in Children

Ronald P Pfeiffer1, Michelle Sabick1, Kristof Kipp1, Kristin Kipp1, Mark DeBeliso1, Kevin G Shear1, 1Center for Orthopaedic & Biomechanics Research (COBR), Boise State University, Boise, ID.

2Intermountain Orthopaedics, Boise, Idaho, Boise, ID. (Sponsor: Kent J. Adams, PhD, FACSM, CSCS, FACSM)

Email: rpfeiffer@boisestate.edu

PURPOSE: To investigate lower-extremity biomechanical differences between preadolescent boys and girls when performing a drop-landing. The landing task incorporated a visual cue provided just prior to ground contact directing the subjects to run in one of three possible directions after landing. The landing task incorporated a visual cue provided just prior to ground contact directing the subjects to run in one of three possible directions after landing.

METHODS: Forty-four subjects (20 males & 24 females) were recruited from a local youth sports league to participate in this study. In this preliminary analysis, data from five females (mean age = 10.8 yrs, mean mass = 37.19 kg, mean ht. = 1.45 m) and five males (mean age = 11.4 yrs, mean mass = 33.82 kg, mean ht. = 1.43 m) were examined. Three dimensional lower limb kinematics were recorded at 250 Hz using a commercial motion capture system. Subjects hung with both hands from a horizontal bar (mean drop distance = 30.5 cm) and on a verbal command released their grip and dropped onto one leg landing on one of two floor mounted force plates (landing leg determined before trial commenced). Upon landing, subjects were instructed to run as fast as possible to one of three floor mounted targets placed 3.66 m in front of the landing area. Run direction was unanticipated (UA) since subjects did not know until after bar release which one of the three targets would illuminate. The targets were located directly ahead of the landing area, 30° to the left, and 30° to the right. Three trials were collected for each direction for each landing leg, resulting in straight ahead, sidestepping, and crossover trials with the order of trials randomized for each leg (18 trials/subject). In this preliminary analysis, data from left leg landings with a sidestep to the right were analyzed for coronal, sagittal, and transverse plane kinematics at the hip, knee and ankle at the time of initial contact (IC) with the ground. Differences between boys and girls were assessed for each variable using a Student’s t-Test.

RESULTS: Our preliminary analysis found no significant kinematic differences at the hip and ankle between boys and girls at IC. However, a significant difference between boys and girls was found for knee flexion angle at IC (p = 0.04) with girls landing with less flexion than boys. No difference was found on knee valgus or rotation, and no other significant kinematic differences were found.

CONCLUSIONS: Our results conflict with recent research that found differences in knee valgus but not in knee flexion at IC in middle and high school aged athletes who performed an unanticipated cutting maneuver. These preliminary results indicate that differences in landing mechanics between genders may exist prior to pubescence.

2218 Board #155 3:00 PM - 4:00 PM Bilateral Differences in Lower-Extremity Biomechanics during Step-Close and No-Step Jumps

Brooke R. Lawson, Thomas M. Stephens, II, Dale E DeVoe, Raoul F. Reiser. Colorado State University, Fort Collins, CO. (Sponsor: Matthew S Hickey, PhD, FACSM)

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Due to the dynamic nature of many sports, the countermovement of a vertical jump is often initiated simultaneously with stepping into the jump location. This is often referred to as a step-close (SC) jump with a lead leg (LL) stepping in and a trail leg (TL) closing the stance. Since forces are at or near maximal towards the end of the countermovement, separate demands may be placed on each leg. There may also be differences compared to the no-step (NS) jump that could be important for training, performance, and injury prevention.

PURPOSE: The goal of this investigation was to characterize the biomechanical differences of the lower extremities during a SC jump as well as compare to the NS jump.

METHODS: Recreationally competitive volleyball players volunteered for the study (12 men and 12 women, age = 21.9 ± 1.9 yrs, height = 175±/8 cm, mass = 71.2±/9.0 kg (Mean ±/ SD). Three maximal effort jumps in each condition, as measured by a double hand reach, were analyzed. Ground reaction forces were measured with two force platforms and lower-extremity kinematics with optical capture. Joint motion as well as net muscular moments and powers from inverse dynamics were analyzed in the anatomical flexion/extension plane of movement for the hip, knee, and ankle. Significance was assessed at p = 0.05 for appropriate maximum, minimum, and average values during the propulsion phase (analysis began when the total vertical ground reaction force exceeded bodyweight towards the end of the countermovement).

RESULTS: Subjects jumped higher in the SC condition (51±/11 versus 48±/11 cm). The hip, knee, and ankle of the TL were flexed/plantarflexed to a greater degree at the bottom of the countermovement compared to the LL in the SC jump. Maximum and average hip and knee extensor moments and average ankle plantarflexor moments were greater in the LL compared to the SC in the SC jump with only the maximum ankle power greater in the TL. Maximum average and single leg extensor/plantarflexor moments of the LL were greater at all joints in the SC compared to NS jump. Maximum hip and ankle joint extensor/plantarflexor moments of the TL were greater in the SC compared to NS jump as was the maximum knee joint power while the average ankle joint extensor moment was reduced.

CONCLUSION: Due to the increased demands placed on the LL and differences observed compared to the NS jump, strength and conditioning programs should be tailored to promote appropriate development and prevent injury. This includes activities, such as plyometric jumps, that incorporate a SC technique and the alternating of lead and trail legs between sets/repetitions to minimize the potential development of functional asymmetries.

2219 Board #156 4:00 PM - 5:00 PM Reliability and Precision Measures of Force/Time Variables during Vertical Jumps

Brian K. Schilling, Jacque L. Barnes, Michael J. Falvo, Christopher A. Moore, Andrea K. Creasy, Lawrence W. Weiss, FACSM, University of Memphis, Memphis, TN.

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Measures of lower body performance during vertical jumps are associated with performance in various sport activities.

PURPOSE: To assess the reliability of force/time measures acquired during two different types of vertical jumps using a force plate and Vertec™ system.

METHODS: Twenty-nine female collegiate volleyball players between the ages of 18-25 years participated in this investigation. Subjects performed both countermovement (CMJ) and drop (DJ) jumps on two separate days, with 4-7 days between. Drop jumps were performed by stepping off a 30-cm box. Two trials of each jump were performed on a vertical axis force platform interfaced to a PC via a Measurement Computing 12-bit analog-digital converter with the highest resolution used for analysis. Data were acquired at 1000 Hz and analyzed using DataPac 2KC v3.11 utilizing a low-pass 4th order Butterworth filter with a cutoff frequency of 30 Hz. Variables of interest include: jump height (jump reach - standing with plantar flexion using Vertec™), mean rate of force development (RFD), peak force (PF), time to peak (TTP) force, impulse (IMP), contact time for drop jumps (CT) and reactive strength index (this index is calculated as jump height / the contact time of the drop jump). Rate of force development measures were derived from the part of the force time curve from minimum to maximum force of the propulsion phase. Reliability was assessed via intraclass correlation coefficients (ICC) and precision was assessed via coefficient of variation (CV%).

RESULTS: Results are shown in table 1.
CONCLUSIONS: Using a minimum ICC of 0.7 and maximum CV of 15%, all measures, not including mean and peak rate of force development, show sufficient reliability. It is unclear from the findings herein if the reliability and precision of rate of force development variables would improve with practice.

Table 1. Reliability and precision of vertical jump force/time measures

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean±SD Session 1</th>
<th>Mean±SD Session 2</th>
<th>ICC (95%)</th>
<th>CV (%)</th>
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<tr>
<td>CMJ</td>
<td>12.6±2.4</td>
<td>12.2±2.2</td>
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<tr>
<td>CMJ XFD</td>
<td>241.8±2485.6</td>
<td>241.7±2770.0</td>
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<td>CMJ PRF</td>
<td>13885.5±10893.3</td>
<td>13812±10025.9</td>
<td>0.91</td>
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<td>CMJ PF</td>
<td>10726.3±3243.4</td>
<td>10726.3±2954.5</td>
<td>0.80</td>
<td>12.4</td>
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<td>CMJ TTP</td>
<td>0.74±0.2</td>
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<td>0.71</td>
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<td>CMJ IMP</td>
<td>243.2±97.2</td>
<td>243.2±105.7</td>
<td>0.87</td>
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<td>CMJ FT</td>
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<td>DJ Height</td>
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<td>DJ CI</td>
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<td>DJ RSI</td>
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<td>0.24±0.46</td>
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2220 Board #157 2:00 PM - 3:00 PM

Comparison of Popular Mouthguard Materials to a Photocured Thiol-Ene Thermoset

Trenton E. Gould, Scott G. Piland, Charles E. Hoyle, Sergei Nazarenko. The University of Southern Mississippi, Hattiesburg, MS.

PURPOSE: The purpose of this investigation was to compare the material properties of a novel photocured thiol-ene thermoset to popular contemporary materials used in sport dental applications.

METHODS: We measured the Shore A hardness values and energy dissipated upon impact for the thiol-ene-acrylate based photocured materials as well as 3 popular contemporary dental materials (GlideWell Eoros®(EVA), Proform®(EVA), and Veloar®(EO Foam)). The Shore A hardness of each photocured thiol-ene acrylate was measured at room temperature according to ASTM guidelines (D2240-97). Materials were fabricated into 6 mm test specimens at least 12 mm in length and width. For testing, the specimen was placed on a surface that was hard and horizontal. The hardness indenter was introduced to the test specimen from the vertical position as quickly as possible without shock and held for one second. The results from multiple sites were used to obtain an average hardness. The capacity of the material to dissipate energy upon impact was measured using the Charpy tup impact head mounted on a Titmus Olsen Model 9700 pendulum impactor at room temperature. The charpy tup that was affixed to the pendulum device was raised to a height where 1.13 joules of energy would be imparted to the specimen. Multiple samples were run and the mean value determined.

RESULTS: As anticipated, the foam showed the lowest hardness (6 durometer). The hardness of EVA based elastomers was found to be in the range of 80-90 durometer and in agreement with the literature. The hardness of the thiol-ene acrylate material was comparable to EVA based elastomers and was in compliance with the range of hardness of traditional materials used for mouthguard applications. Commercial EVA based mouthguard elastomers absorbed 40-50% of the impact energy. The foam absorbed slightly higher energy, 60 %. The thiol-ene acrylate system showed promising impact energy dissipation, 86%.

CONCLUSIONS: Our results suggest that the novel thiol-ene acrylate thermoset material can absorb shock forces better than currently recommended materials while maintaining similar Shore A hardness values. Such materials have tremendous potential to exceed the current standards (Academy of Sports Dentistry, American Society for Testing and Materials, and Standards Australia International) for athletic mouthguard materials. Unlike current materials, our photocured thiol-ene acrylate material is environmentally friendly. Further investigation into the complete mechanical properties of this thiol-ene acrylate thermoset system and its potential application for use as protective materials is warranted.

2221 Board #158 3:00 PM - 4:00 PM

The Effect of Altering the Width of a Single Step of a Running Stride on Knee Joint Kinematics

Grace M. Golden, Michael J. Pavol, Mark A. Hoffman, FACSM. Oregon State University, Corvallis, OR.

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Sidestep cutting maneuvers are considered a common mechanism of injury and are frequently studied in the athletic literature. However, to date, there is no evidence regarding the mechanics of the single step in running or jumping. The purpose of this investigation was to examine sidestep cutting mechanics during the stance phase of a running/ jumping motion.

METHODS: Thirteen healthy female collegiate basketball players (age: 19.7 ± 1.1 yr, height: 172.3 ± 8.3 cm, mass: 71.8 ± 8.8 kg) completed 10 trials each of RUN, SW20, SW35 conditions at an average speed of 3.54 ± 0.03 m·s⁻¹. Kinematic data were obtained using a 3D motion capture system. Angles of the stance knee during the widened step (typical step for RUN) were determined as a fixed sequence of rotations of the leg about its anatomical axes, relative to the thigh. Separate one-way repeated ANOVA (n=0.05) were used to analyze the effect of different step width conditions on peak knee angles (flexion, extension, abduction, adduction, internal rotation and external rotation).

RESULTS: Increasing the width of a single step in a running stride produced significant differences in peak knee angles: flexion (p<0.001; RUN 40.7±4.3°, SW20 42.5±4.4°, SW35 44.1±4.2°), extension (p=0.024; RUN -13.2±2.9°, SW20 -14.3±2.9°, SW35 -13.6±2.5°), abduction (p=0.001; RUN 0.7±3.7°, SW20 1.7±3.4°, SW35 3.2±4.0°), and internal rotation (p<0.001; RUN 13.1±5.4°, SW20 15.2±5.9°, SW35 17.6±6.9°). Peak knee flexion was greater for SW20 and SW35 than RUN. Peak knee extension was greater for SW35 than for RUN and SW35. Peak knee abduction was greater for SW35 than for SW20 and RUN. Peak knee internal rotation increased progressively from RUN to SW20 to SW35.

CONCLUSION: Increasing the width of a single step during running altered the peak angles of the stance knee in a manner believed to increase the force on the ACL, particularly the changes that occurred in the transverse and frontal planes. Greater evident effects were as step width increased, suggesting that the risk of ACL injury increases with step width. Further investigation is needed to determine whether increasing step width in initiating a sidestep cutting maneuver places the ACL at more risk than increasing step width or sidestep cutting alone.
jump height. The first 5 JL trials were performed following a brief warm up while the participants were in a non-fatigued condition (NF). The last 5 JL trials were performed during a fatigued condition (F). The protocol to induce the fatigued condition included: a timed T-test (TT), a timed 274 meter shuttle run (SR), a repeated sprint test consisting of 12. 28m sprints departing every 20 seconds (RS), and continuous TT until attainment of the fatigued criteria (90% age predicted maximum heart rate and an RPE ≥ 17). Rest periods between TT, SR, and RS were 30 seconds as was the time from the last TT to the first JL. Lading kinetics were collected on flush mounted Kistler force plates at 1250 Hz. The resultant ground reaction force normalized to body weight (GRF) was compared between the NF and F conditions using a paired t-test with significance set at α=0.05.

RESULTS: All subjects attained the fatigue criteria (%dRMRx = 91.0±0.0, RPE = 17.6±0.3). No significant difference was found between the NF and F condition for GRF (F(3,96) = 1.7, vs. 3.01±1.18 BW).

CONCLUSION: While fatigue has been suggested as a mechanism of knee injury, no difference in resultant GRF was present between a non-fatigued and a fatigued condition. It is not known whether lower limb kinematics or bi-lateral leg differences in GRF may be influenced by fatigue.

2224 Board #161 3:00 PM - 4:00 PM Trunk Marker Placement Does Not Affect Sagittal Plane Measures of Segment or Joint Kinematics and Energies During Drop Landings
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Email: ajdecker@ilstu.edu

To collect sagittal plane kinematic data during drop landings, a reflective marker attached to the trunk defines the superior segment of the relative angle at the hip joint. Although alternative sites include the acromion process (AP) or the 12th rib on the midline of the body (12b), the effect of marker placement on calculated kinematic, kinetic and energetic measures has not been evaluated.

PURPOSE: To determine if the two marker placement sites cause differences in trunk and hip joint measurements.

METHODS: Eight college age subjects (7 male, 1 female) were recruited. Markers were attached at both trunk sites in addition to landmarks defining lower extremity segments. Subjects performed 10 trials of landing from a 38 cm box onto a force platform (960 Hz) while recorded with video (120 Hz). Sagittal plane kinematics were calculated using the difference process (AP) or the 12th rib on the midline of the body (12b), the effect of marker placement on calculated kinematic, kinetic and energetic measures has not been evaluated.

RESULTS: Trunk and hip angles at touchdown were significantly more extended (4º) when measured using the AP, but maximum flexion angles and ROMs were not significantly different. Although peak flexion angular velocity was about 0% higher measured with the AP (83 ± 27º/s) than with the 12b (78% ± 26º/s), it was not significantly different. Calculated hip joint work was less than 1% different when calculating using the different markers.

CONCLUSION: The results suggest that the trunk may flex along the vertebral column during landing, with possible implications for loading. However, differences in the measured hip joint kinematics were minimal and did not have a significant effect on calculated energetics. 12th rib marker placement during focused lower extremity extensions would allow capture of a larger image size during landing performance with the potential to improve measurement accuracy.

2225 Board #162 4:00 PM - 5:00 PM Highly Proficient Golfers Exhibit Greater Consistency In Driving Ball Flight Characteristics Than Less Proficient Golfers
James M. Smoliga, Joseph B. Myers, John T. Jolly, Timothy C. Sell, Scott M. Lephart, FACSM. University of Pittsburgh, Pittsburgh, PA.

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It is believed that consistency of golf ball flight characteristics (BFC) is more indicative of golf proficiency than traditional measures of golf performance such as club velocity (CV) and total driving distance (TD). Highly proficient golfers are believed to have more consistent BFC between swings than less proficient golfers.

PURPOSE: To determine whether BFC consistency differs between highly proficient golfers and less proficient golfers.

METHODS: Ninety male golfers (43.5 ± 14.4 years) performed ten golf swings with their own driver. A golf launch monitor was used to measure BFC. The mean and standard deviations (SD) of CV, ball velocity (BV), vertical launch angle (VLA), horizontal launch angle (HLA), backspin (BS), carry distance, and TD were calculated for each subject using the five drives with the greatest TD. The SD of BV, CV, and TD were normalized (SDN) to their respective mean values. Lower SD and SDN were interpreted to represent greater consistency. Golfers were grouped based on proficiency by USGA handicap: low (L; <8, n=56), mid (M; 8-14, n=25), and high handicap (H; ≥15, n=9). One-way analysis of variance and Tukey’s post hoc procedure were used to determine differences between groups. Statistical significance was set a priori at α=0.05.

RESULTS: There were no significant differences between groups for BS or CV consistency. Statistically significant differences are italicized in the table below.

<table>
<thead>
<tr>
<th>Consistency</th>
<th>High</th>
<th>Mid</th>
<th>Low</th>
<th>High vs. Mid</th>
<th>Low vs. Mid</th>
<th>Low vs. Val</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BV (ft/s)</td>
<td>1823.9±159</td>
<td>29.7±0.9</td>
<td>1.74±0.08</td>
<td>0.025±0.013</td>
<td>0.029±0.011</td>
<td>2.83±0.96</td>
<td>p=0.031</td>
</tr>
<tr>
<td>CV (º)</td>
<td>3.01±1.18</td>
<td>2.83±0.96</td>
<td>2.00±0.95</td>
<td>p&lt;0.001</td>
<td>p=0.006</td>
<td>p=0.021</td>
<td>p=0.031</td>
</tr>
<tr>
<td>TD (ft)</td>
<td>2484.5±80</td>
<td>2.31±0.69</td>
<td>0.047±0.021</td>
<td>0.025±0.012</td>
<td>p&lt;0.001</td>
<td>p=0.03</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>

CONCLUSION: Lack of significant differences between groups in SD or SDN of CV indicates that golfers generate power with similar consistency. Significantly lower SD for VLA and HLA and SDN for CV, TD, and BV in L compared with M and H indicate that proficient golfers are more consistent in transferring the generated power to the ball, resulting in more consistent BFC. Consistency and proficiency is further demonstrated by significantly lower SDN for CV, TD, and BV for M compared to H. Though not significant, there is a trend for lower SD of VLA and HLA in M compared to H. Together, these data suggest that consistent BFC are a key contributor to golf proficiency.
surface, during which time the investigator tallied the steps with a hand counter (Lab Safety Supply Inc, Model No. 77270, USA). Each step with the lead foot elicited a tally on the counter. Participants were instructed to perform the movement at a brisk pace, to jump-stop at the end of the court, and to remain still until after the pedometer reading was taken. Time was given, if needed, to recover before the next trial. Repeated measure ANOVAs using the Bonferroni technique were used to compare differences between pedometer counts and hand counts.

RESULTS: Step count measured by the pedometer while walking was not significantly different than step count measured by the investigator using the hand counter, \( p = 0.013 \). Pedometer counts obtained from skipping, galloping, sliding, and hopping were significantly different from hand counts (table 1).

### Table 1. Step Counts Measured Using the Pedometer and Hand Tally

<table>
<thead>
<tr>
<th>Activity</th>
<th>Pedometer</th>
<th>Hand Tally</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>15.6±4.4</td>
<td>16.0±3.7</td>
</tr>
<tr>
<td>Skipping</td>
<td>32.4±9.8</td>
<td>32.3±9.7</td>
</tr>
<tr>
<td>Galloping</td>
<td>27.9±6.1*</td>
<td>17.1±2.3</td>
</tr>
<tr>
<td>Sliding</td>
<td>23.9±6.3*</td>
<td>18.1±2.7</td>
</tr>
<tr>
<td>Hopping</td>
<td>55.0±6.5*</td>
<td>22.0±4.4</td>
</tr>
</tbody>
</table>

*Significantly different from hand tally, \( p < 0.01 \)

CONCLUSIONS: The pedometer may not consistently register the vertical force produced by the knee joint, the lead foot contact, or a combination of the two while skipping, galloping, and sliding. Higher readings during the hop may be due to a greater force generated upon foot contact from the ground to the pedometer, possibly causing the pedometer to function more than once. It is also possible the pedometer is reacting to vertical forces during the preparatory or follow-through phases of these skills. Biomechanical research is needed to explore when the pedometer reaches its threshold to register a count during these movements, and if the speed during these movements affects the pedometer readings.

2228 Board #165 4:00 PM - 5:00 PM

**Reliability of Selected Kinetic Variables Obtained from Bench Press Throws**


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Isokinetic dynamometry may be useful in analyzing functional muscular characteristics during resistance exercise. However, its utility is dependent upon its ability to provide consistent and precise measures of selected variables.

**PURPOSE:** To determine the reliability and precision of selected kinetic variables obtained during bench press throws (BFT) at 30% and 70% of one-repetition maximum (1-RM).

**METHODS:** 10 resistance trained men (23.5±3.2 yrs; 174.2±5.5 cm; 79.7±18.8 kg; mean±SD) participated in this project. The first session was used to determine their 1-RM (≥ 1x body mass) bench press and practice throws. Subjects returned for an additional practice session 24-72 hours post. Between 3-7 days following this session, subjects completed duplicate single repetition concentric BFT at 30% and 70% 1-RM. Loads were not counterbalanced. A linear velocity transducer was inverted and tethered to the center of a barbell for bar velocity measurements while a force platform was used under an exercise bench for vertical force measurements. Power was determined through inverse dynamic calculations. Data were sampled at 1000Hz and low-pass digitally filtered using a 4th order Butterworth filter (20Hz cutoff frequency) via DataPac 2K2 software. Variables of interest included mean and peak values for rates of force development (XRFD, PRFD), force (XF, PF), velocity (XV, PV), and power (XP, PP) for each load. These procedures were repeated two weeks later.

**RESULTS:** Reliability was determined using intraclass correlation coefficients (ICC) and precision via coefficient of variation (CV%).

**CONCLUSIONS:** The mean, SD, ICC, and CV% are presented in Table 1.

![Table 1. Reliability of Selected BFT measures](#)

**2229 Board #166 2:00 PM - 3:00 PM**

**The Effects of Sprinting Induced Fatigue on Ground Reaction Force Symmetry in Jump Landing Kinetics**

Mirdy Bennett1, Kathy Berg2, Chad Harris3, Kristof Kapp4, Mark DeBeliso5, Kent J. Adams, FACSM6. 1Boise State University, Boise, ID; 2University of Vermont, Burlington, VT; 3Oregon State University, Corvallis, OR; 4California State University Monterey Bay, Seaside, CA. Email: mbind01@hotmaill.com

Several sports associated with knee injury involve repetitive sprinting and jumping (e.g. basketball, soccer). These activities have the potential to induce fatigue in the muscles of the lower extremity. Fatigue has been implicated as a contributing factor in the mechanisms of knee injury. Also, the symmetry of dominant versus non-dominant leg action during landings has been questioned.

**PURPOSE:** To determine if dominant versus non-dominant leg kinetics during jump landings differ during non-fatigued and fatigued conditions.

**METHODS:** Female collegiate soccer players (n=14, Age: 19.6±0.9, Wt: 64.2±10.8 kg) completed 10 trials of jump landings (JL). The JL required subjects to jump horizontally at a distance of 1/3 of their maximal standing broad jump and reach a height vertically at the middle of the horizontal jump that was 1/3 of their maximum vertical jump height. The first 5 JL trials were performed following a brief warm up while the participants were in a non-fatigued condition (NF). The last 5 JL trials were performed during a fatigued condition (F). The protocol to induce the fatigued condition included: a timed T-test (TT), a timed 274 meter shuttle run (SR), a repeated sprint test consisting of 12-20 sprints departing every 20 seconds (RS), and continuous TT until attainment of the fatigue criteria (90% age predicted maximum heart rate and an RPE > 17). Rest periods between TT, SR, and RS were 30 seconds as was the time from the last TT to the first JL. Landings kinetics were collected on flush mounted Kistler force plates at 1250 Hz. The resultant ground reaction force normalized to body weight was calculated for the dominant leg (GRFD) and the non-dominant leg (GRFN) from three dimensional force recordings. GRFD and GRFN were compared in the NF and F conditions using a paired t-test with significance set at \( p < 0.05 \).

**RESULTS:** All subjects attained the fatigue criteria (\%HRmax = 91.0±6.0, RPE = 17.6±0.7). Although approaching significance, no difference was found between GRFD and GRFN in either the NF condition (0.01±0.7 vs. 1.85±0.51 BW, \( p = 0.08 \)) or the F condition (2.09±0.8 vs. 1.88±0.48 BW, \( p = 0.08 \)).

**CONCLUSIONS:** Fatigue has been suggested as a mechanism of knee injury. However, it does not appear that fatigue results in changes in dependence of dominant versus non-dominant leg during jump landings. It is not known whether fatigue alters lower limb kinematics between dominant and non-dominant legs during landings.

2230 Board #167 3:00 PM - 4:00 PM

**Recreational Athlete Kinetics and Kinematics of the Lower Extremity During Activities Associated with ACL Injuries**

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Email: lpitti03@gmail.com

**PURPOSE:** Female athletes have a significantly higher incidence (ten fold) of ACL injuries compared to men in non-contact sports. It is thought that activities such as landing a jump or cut may result in injury or different muscle firing patterns may be involved. Little research has been performed on the recreational athlete during these types of activities and since the number of participants far exceeds those in organized collegiate level sports, it is imperative to investigate this group.

**METHODS:** 15 female and 15 male recreational athletes with no history of ACL injury participated. Surface EMG electrodes were placed over the Gluteus Maximus, Gluteus Medius, VM0, Semitendinosus, Biceps Femoris, Gastrocnemius, Peroneus Longus Muscles and data sent to Noraxon software. Subjects performed MVIC's at each muscle and this value used to normalize for use during the activities which followed. This included: drop landings from heights, jump landings, cut to L+R, deceleration. Values were recorded form 200 msec pre-contact through 250 msec post-contact with force plate (AMT). Mean and peak values (in mV) were recorded as calculated on the dominant leg and converted to %MVIC for each activity. MANOV was used to analyze the data, pyrometric training instituted for 4 weeks, and an identical post-test performed.

**RESULTS:** Deceleration showed that in the Gluteus Medius the women utilized a mean of 134% (SE 17%) of MVIC compared to men 73.4% (SE 13.6%) (\( p < 0.01 \)). Peak Gluteus Maximus post-contact males used a mean peak MVIC of 110 (SE19.3%) MVIC while the women used 209% (27.8%) MVIC (\( p = 0.007 \)); cutting to the left also produced a greater force generated upon foot contact from the ground to the pedometer, possibly causing the pedometer to function more than once. It is also possible the pedometer was triggered by forces produced by jumping, skipping, galloping, and sliding. Higher readings during the hop may be due to a greater force generated upon foot contact from the ground to the pedometer, possibly causing the pedometer to function more than once. It is also possible the pedometer may be reacting to vertical forces during the preparatory or follow-through phases of these skills. Biomechanical research is needed to explore when the pedometer reaches its threshold to register a count during these movements, and if the speed during these movements affects the pedometer readings.

**CONCLUSIONS:** Inadequate time of hamstring and other core muscle contraction during activities such as backward running may assist to reduce this risk.
CoNCLUsIoNs

P<0.05) in post-test samples after ES supplementation, significantly differing from the time to exhaustion (4138 ± 980 s vs. 4025 ± 1087 s, P<0.05) and increased in HRmax.

Methodology

Eight male subjects who were unaccustomed to eccentric exercise, (mean ± SD for age, body mass and height = 23 ± 2 yr, 81 ± 6.7 cm and 79.1 ± 10.3 kg, respectively), were assigned in a randomised crossover design to an HMB & KIC treatment (3 g HMB and 0.3 g KIC, daily) or a placebo treatment lasting 17 days. After 14 days, 3 sets of 15 reps of maximal isokinetic eccentric contractions of the elbow flexors were performed at 30 ± 0% on either the dominant or non-dominant arm in a randomised order. Peak isometric torque, isokinetic torque at 210 °s⁻¹, delayed onset muscle soreness (DOMS), range of motion (ROM), upper arm limb girth and plasma creatine kinase activity (CK) were determined pre-exercise and at 24 h, 48 h and 72 h post-exercise.

Results

Independent analysis demonstrated the supplement to be free of contamination by stimulants or anabolic steroids. There was no difference in the total work performed during the eccentric bout in each treatment (P > 0.05). Exercise-induced muscle damage was indicated by significant time effects for peak isometric and isokinetic torque, DOMS, ROM and limp girth (P < 0.05); there were however no significant treatment or interaction effects for any of the variables tested (P > 0.05).

Conclusions

Supplementation with HMB and KIC prior to, and following, a single bout of maximal eccentric exercise was not effective in reducing signs and symptoms of exercise-induced muscle damage.

Effect of Three Different Drinks on Physical Variables in Male Athletes, During a Running Trial


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Athletes consume different drinks during exercise; however, the effects of these drinks on physical variables has not been compared yet.

Purpose

To determine the effects of different drinks on physical variables in male athletes.

Methods

In a double-blind, crossover randomized design, 13 runners (mean age = 25.54 ± 6.75 yrs old) completed three, one hour running trial on a treadmill under stressful conditions (mean temperature = 30.6 °C, mean relative humidity = 70%).
Results: There was no significant difference in voluntary mean intake during the trials (SD = 987.4 ± 290.00 mL; ED = 782.4 ± 274.30 mL; PL = 766.8 ± 212.36 mL) (p = .055). No difference in mean total distance was found between the drinks (SD = 11.72 ± 1.21 km; ED = 11.49 ± 1.26 km; PL = 11.38 ± 1.42 km) (p = .34). There was no difference in RPE or any other variable during the trials, including palatability (SD = 7.33 ± 0.82, ED 6.60 ± 1.38, PL = 6.61 ± 0.97). More subjects reported GI problems when drinking ED or PL (92%) compared to SD (62%). No significant association was found between the type of drink and GI symptoms during the tests (p = .131).

Conclusions: Performance in one hour running trial under stressful conditions was the same when consuming any drink.Subjects perceived the same effort, palatability and sensation of fullness when drinking SD, ED or PL. No association between type of drink and GI problems was found, but a high percentage of subjects reported this problem (ED and PL = 92% ; SD = 62%).

Methods: Four male and 2 female elite middle-distance runners with mean VO2max of 77.1 ± 5.4 mL·kg−1·min−1 and 60.7 ± 2.6 mL·kg−1·min−1 (x ± sd) respectively, ingested four progressively larger doses (600 mg/kg·body weight total) of either CaCO3 (placebo) or NaHCO3 (modified chronic NaHCO3) during the 24 hours prior to, and at a 60% dose of NaHCO3 (300 mg/kg) 90 minutes pre-performance. Doses were administered in gelatin capsules in a double-blind, randomized, and counterbalanced manner. Each performance trial consisted of a run to exhaustion at approximately 1500m running race intensity (110% VO2max) on an inclined (4%) treadmill. Pre-ingestion, pre-exercise, and post-exercise blood plasma was analyzed for sodium, lactate, and bicarbonate concentrations, hematocrit and pH.

Results: The modified chronic ingestion protocol led to significantly higher pre-exercise plasma bicarbonate concentration (29.8 ± 2.5 mmol·L−1) than the acute (28.4 ± 1.8 mmol·L−1) and placebo (25.5 ± 1.5 mmol·L−1) trials (p<0.05), and induced less GI distress. Although both chronic and acute NaHCO3 ingestion significantly increased plasma bicarbonate concentration (30% and 26% higher, respectively, p<0.05), no significant differences in time to exhaustion were observed between groups. Plasma lactate increased approximately 11-fold post-exercise in all groups, but there were no significant differences between groups in absolute decrease in bicarbonate concentration or CO2 exhalation during exercise. Chronic sodium bicarbonate ingestion also led to a significant decrease in hematocrit and a significant increase in body weight (p<0.05).

Conclusion: The modified chronic sodium bicarbonate ingestion protocol administered in the current study elevated plasma bicarbonate concentration more than typical acute ingestion, and was better tolerated. However, there was no improvement in performance, even though the exercise protocol induced a 11-fold increase in plasma lactate concentration. Increasing capacity by increasing plasma bicarbonate concentration above normal levels may not have an ergogenic effect on competitive middle-distance running.

MEDICINE & SCIENCE IN SPORTS & EXERCISE®

POSTER SESSIONS

2236
Board #173
3:00 PM - 4:00 PM
Conjugated Linoleic Acid Decreases Insulin Sensitivity and Increases Skeletal Muscle Ceramides in Overweight, Sedentary Humans.
A. Brianne Thrul,1 Adrian Chabowski,2 George JF Heigenhauser1, David D. Dyck2.1University of Guelph, Guelph, ON, Canada. 2Medical University of Bialystok, Bialystok, Poland.

Background: The effect of conjugated linoleic acid (CLA) on insulin sensitivity (IS) in humans is controversial with some studies demonstrating an improvement and others a worsening of IS. In Zucker diabetic fatty rats, CLA improves IS and this is correlated with a reduction in intramuscular triglycerides (IMTG). Elevated IMTG is associated with the development of insulin resistance; however it is likely the more reactive lipid species such as diglycerides (DG) and ceramides that cause insulin resistance by interfering with insulin signaling in skeletal muscle. To date, no research has attempted to measure skeletal muscle ceramide and DG content following CLA treatment. The purpose of this research was to determine the effects of CLA on IS and skeletal muscle lipid content in overweight, non-diabetic humans. It is hypothesized that CLA will improve IS with an associated reduction in skeletal muscle IMTG, DG and ceramide content in skeletal muscle.

Methods: Nine overweight, non-diabetic, sedentary humans (BMI 29.6 ± 0.6 kg/m2, age 31.2 ± 3.7 yrs) were supplemented with 4 g of mixed isomer CLA/d for 12 weeks. Subjects underwent oral glucose tolerance tests and resting skeletal muscle biopsies prior to and following supplementation. Total and individual species of skeletal muscle IMTG, DG and ceramide were measured prior to and following CLA treatment. Blood samples were assessed for glucose and insulin in response to the oral glucose tolerance test.

Results: GA and insulin area under the curves were significantly increased following CLA supplementation with a resultant 20% decrease in insulin sensitivity (P<0.05). Total (pre vs post 403 ± 34.4 vs. 660 ± 44.0) and polyunsaturated (81.4 ± 9.0 vs. 148.3 ± 32.1) ceramide content was significantly increased following CLA supplementation (P<0.05). There was a trend towards an increase in total saturated and monounsaturated fatty acid species (p=0.06). Total DG and IMTG were not changed following treatment. Conclusion: This research demonstrates that CLA supplementation decreases insulin sensitivity in overweight, sedentary individuals. This reduction in insulin sensitivity may have been the result of elevated skeletal muscle ceramide content interfering with enzymes involved with the insulin signaling pathway. Supported by NSERC.

2237
Board #174
4:00 PM - 5:00 PM
The Effects of Modified Chronic Sodium Bicarbonate Ingestion on Short-Duration, High-Intensity Performance in Elite Middle-Distance Runners
Amerigo Rossi1, Jeffery E. Herrick2, Andrew Cornwell3, David J. Dyck1, Jeffrey E. Herrick1.1University of Guelph, Guelph, ON, Canada. 2Southern California, Los Angeles, CA. 3Medical University of Bialystok, Bialystok, Poland.

Purpose: To determine the efficacy of a modified chronic NaHCO3 ingestion protocol that may increase blood bicarbonate more than previous methods without causing GI distress.

Methods: Four male and 2 female elite middle-distance runners with mean VO2max of 77.1 ± 5.4 mL·kg−1·min−1 and 60.7 ± 2.6 mL·kg−1·min−1 (x ± sd) respectively, ingested four progressively larger doses (600 mg/kg·body weight total) of either CaCO3 (placebo) or NaHCO3 (modified chronic NaHCO3) during the 24 hours prior to, and at a 60% dose of NaHCO3 (300 mg/kg) 90 minutes pre-performance. Doses were administered in gelatin capsules in a double-blind, randomized, and counterbalanced manner. Each performance trial consisted of a run to exhaustion at approximately 1500m running race intensity (110% VO2max) on an inclined (4%) treadmill. Pre-ingestion, pre-exercise, and post-exercise blood plasma was analyzed for sodium, lactate, and bicarbonate concentrations, hematocrit and pH.

Results: The modified chronic ingestion protocol led to significantly higher pre-exercise plasma bicarbonate concentration (29.8 ± 2.5 mmol·L−1) than the acute (28.4 ± 1.8 mmol·L−1) and placebo (25.5 ± 1.5 mmol·L−1) trials (p<0.05), and induced less GI distress. Although both chronic and acute NaHCO3 ingestion significantly increased plasma bicarbonate concentration (30% and 26% higher, respectively, p<0.05), no significant differences in time to exhaustion were observed between groups. Plasma lactate increased approximately 11-fold post-exercise in all groups, but there were no significant differences between groups in absolute decrease in bicarbonate concentration or CO2 exhalation during exercise. Chronic sodium bicarbonate ingestion also led to a significant decrease in hematocrit and a significant increase in body weight (p<0.05).

Conclusion: The modified chronic sodium bicarbonate ingestion protocol administered in the current study elevated plasma bicarbonate concentration more than typical acute ingestion, and was better tolerated. However, there was no improvement in performance, even though the exercise protocol induced a 11-fold increase in plasma lactate concentration. Increasing capacity by increasing plasma bicarbonate concentration above normal levels may not have an ergogenic effect on competitive middle-distance running.

2238
Board #175
2:00 PM - 3:00 PM
Lemongrass Supplementation During Endurance Exercise May Compensate for Reduced Carbohydrate Intake
Jochen Kressler,1 Mark Stoutenbour,2 Kevin A. Jacobs,3 Joseph F. Signorile.1University of Miami, Department of Exercise and Sport Sciences, Coral Gables, FL.

Purpose: To compare the effects of sports drinks without (CO) and with lemongrass (LG) on exercise performance and RPE.

Methods: Following a familiarization trial, 10 experienced male cyclists (25 ± 5 yr, 51.2 ± 4.7 m/kg, VO2 max of 77.1 ± 5.4 mL·kg−1·min−1) completed three 30 min time trials on a cycle ergometer while consuming the CO and LG drinks in randomized order and double-blind fashion. The time trials were separated by a week and the CO and LG drinks consisted of 6% CHO, respectively. Subjects consumed 230 mL of the assigned drink immediately prior to and at each 20% completed segment (~ every 15 min) throughout the test. Subjects were instructed to provide a maximal sprint effort over the final 1 km of the time trial. Time, power, speed, RPE and HR were recorded at each 20% completed segment.

Results: Subjects rode at approximately 82% of maximal HR during the time trials. No significant differences were found between the CO and LG drinks in total time (74.1 ± 3.7 vs. 74.6 ± 3.6 min), power (189.4 ± 25.4 vs. 185.7 ± 25.4 W), speed (31.1 ± 3.8 vs. 32.3 ± 1.6 km/h), HR (153 ± 11 vs. 151 ± 13 b/pm), and RPE (13.4 ± 1.0 vs. 12.9 ± 0.8). Similarly, there were no significant differences between drinks in any of the measured variables at any of the 20% completed segments or the final 1-km sprint.

Conclusion: Lemongrass supplementation during endurance exercise may compensate for reduced CHO intake, but does not appear to do so by reducing RPE.

Supported by Ergonu Inc.
suspension (FRS) bicycles over terrain that generalizes to race settings.

**PURPOSE:** The intent of this study was to compare FS and FRS bicycles under conditions that simulated competitive race conditions.

**METHODS:** Seven highly trained competitive mountain bikers (age: 21.5± 4.9 y, VO2peak: 58.9±7.3 mL/kg·min-1) completed two randomly ordered FS and FRS trials separated by 3-7 days. Bicycles were matched on all components with the exception of rear suspension and frame geometry. Tiers consisted of 5 laps of a 5-mile course with 504 feet of ascending per lap. The first 4 laps of each trial were performed at ~75% VO2peak, which was controlled via feedback from a heart rate monitor. Metabolic measures (VO2, VE, HR) and global positioning data were collected on the first and 4th laps of the trial via a portable metabolic gas analyzer. Mean metabolic data were calculated for an ascending segment (~2.5 miles) and descending segment (~2.5 miles) using GPS data. Following 4 laps at 75% VO2peak, subjects were instructed to complete a final lap of the course with maximal effort.

**RESULTS:** Mean data for all metabolic measures were averaged over the 1st and 4th laps after no [lap number*bike design] interactions were observed. VO2, VE and HR were not significantly different between FS and FRS during ascending, descending or complete laps, which demonstrated controlled sub-maximal intensity between trials. Despite equality in metabolic responses during the first 4 laps, the FRS (19.3±3 min) was significantly (p<0.05) slower than the FS (17.8±3 min) during the ascent. Alternatively, the FRS (8.3±3 min) appeared faster on the descent than the FS (9.4±3 min), although this was not statistically significant (p=0.067). Performance time during the final lap were significantly faster (p<0.05) for the FS (24.86±3 min) than the FRS (25.78±3 min).

**CONCLUSIONS:** Despite similar metabolic responses during sub-maximal mountain cycling, the FS ascended faster, but descended slower than the FRS bicycle. However, due to greater time spent ascending on a loop course, the superior climbing ability of the lighter FS offset the slower descending times by a ratio of 1.8:1. This difference in climbing ability between bikes likely explains the faster performance of the FS bike design during the maximal performance lap.

The authors wish to thank Cannondale, Inc. and Massanutten Resorts for supporting this study.

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**Board #177 4:00 PM - 5:00 PM**

**Comparison of the Effects of Medication Used to Treat Cardiac Conditions on Resting Energy Expenditure**

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Dietary calcium has been shown to have a direct, positive effect on fat oxidation. Calcium (Ca) channel blockers are a class of medications used in the treatment of heart disease and its symptoms. The medication works to decrease the oxygen demand and load on the heart by inhibiting Ca ion influx across cardiac and smooth muscle cells. However, if these medications have a similar impact on skeletal muscle cells, the result could be a decrease in overall metabolism, and the corresponding non-desirable affects of that condition.

**PURPOSE:** To compare resting energy expenditure (REE) of persons taking a Ca-channel blocking medication, amiodarone (AM), with that of a group taking a beta-blocking medication, metoprolol (MET), and with a third group of control (CON) subjects taking neither medication.

**METHODS:** A total of 28 individuals (13 males, 15 females) volunteered to participate in the study. Subjects were assigned to one of three groups based on the medication regimen recommended by their personal physician: AM (N=7), MET (N=9), and CON (N=12). Participants ranged in age from 45-73 years (56.9± 7.2). Persons using nicotine or illegal drugs, or having diabetes were ineligible to participate. Subjects reported to the laboratory after a 12-hr overnight fast with no caffeine and no alcohol consumed or exercise 48 hrs prior. REE was measured through indirect calorimetry (ParvoMedics, Sandy, UT). Body composition was assessed by skinfold technique and dietary Ca intake was determined through a 24-hr dietary recall. Calcium (Ca) channel blockers are a class of medications used in the treatment of heart disease and its symptoms. The medication works to decrease the oxygen demand and load on the heart by inhibiting Ca ion influx across cardiac and smooth muscle cells.

**RESULTS:** No differences in AUC for VO2, were observed between AM and CON. However, further examination showed that 70% of the subjects (7/10) had a higher AUC for VO2 in AM compared to CON during the three hour period. Subsequent statistical analysis showed this difference was not statistically significant (p=0.067). Performance time during the final lap were significantly faster (p<0.05) for the FS (24.86±3 min) than the FRS (25.78±3 min).

**CONCLUSIONS:** Despite similar metabolic responses during sub-maximal mountain cycling, the FS ascended faster, but descended slower than the FRS bicycle. However, due to greater time spent ascending on a loop course, the superior climbing ability of the lighter FS offset the slower descending times by a ratio of 1.8:1. This difference in climbing ability between bikes likely explains the faster performance of the FS bike design during the maximal performance lap.

The authors wish to thank Cannondale, Inc. and Massanutten Resorts for supporting this study.
PSE 2243 Board #180 4:00 PM - 5:00 PM
The Efficacy of Cherry Juice Supplementation in Preventing the Symptoms of Exercise-Induced Muscle Damage
Kameeri Cote¹, Declan AJ Connolly, FACSM, ¹Malachy P. Mc Hugh, FACSM², Olga Padilla-Zakour³, ¹University of Vermont, Burlington, VT; ¹NISMAT, New York, NY. ²Cornell University, Ithaca, NY.

PURPOSE: Numerous antioxidant and anti-inflammatory agents have been identified in tart cherries. The purpose of this study was to test the efficacy of supplementation with a tart cherry beverage (Cherry Good, CHERRYPHARM Inc. Summit, NJ) in preventing the symptoms of exercise-induced muscle damage.

METHODS: This was a randomized, placebo-controlled, crossover design. Fourteen male college students drank 16 fl oz of cherry juice, or a placebo, twice per day for eight consecutive days. A bout of eccentric elbow flexion contractions was performed on the fourth day of supplementation. Isometric elbow flexion strength, pain, muscle tenderness and relaxed elbow angle were recorded prior to, and for four days following the tetanic group (CON), exercise group (E), exercise + moxibustion Shenshu group (EM), exercise + moxibustion on non-point group (EN). Rats were trained for 6 weeks using a swimming model with the swimming duration gradually increased (from 30 min to 180 min) and moxibustion Shenshu treatment began after 2 weeks of training, the treatment group treated on right side of Shenhu for 10 min, every other day for 4 weeks. Anatomical location of stimulated acupoints were determined according to the rat acupoint atlas. All subjects were sacrificed by decapitation immediately after the last submaximal training. Trunk blood and tissues was collected for assay.

RESULTS: Strength loss and pain were significantly lower with cherry juice supplementation versus placebo (Time by Treatment: Strength P<0.001, Pain P<0.05). Relaxed elbow angle (Time by Treatment P=0.85) and muscle tenderness (Time by Treatment P=0.81) were unaffected by cherry juice supplementation.

CONCLUSIONS: These data show efficacy for cherry juice supplementation in decreasing some of the symptoms of exercise-induced muscle damage. Most notably, strength loss averaged over the four days after eccentric exercise was 24% with placebo trial but only 5% with cherry juice.

PSE 2244 Board #181 2:00 PM - 3:00 PM
The Effects of Acupuncture on Exercise-Induced Rats
Yunhong Wang¹, Lufen Zhang². ¹Capital college of physical education, Beijing, China. ²Beijing University of Chinese Medicine and Pharmacy, Beijing, China.  ¹Sponsor: Frank Hoolin Fu, FACSM

PURPOSE: To investigate the effects of moxibustion (a form of acupuncture) on exercise-induced fatigue and to better understand its possible regulatory mechanisms

METHODS: Male SD rats, weighing 200±10g, divided randomly into four groups: control group (CON), exercise group (E), exercise + moxibustion Shenshu group (EM), exercise + moxibustion on non-point (EN). Rats were trained for 6 weeks using a swimming model with the swimming duration gradually increased (from 30 min to 180 min) and moxibustion Shenshu treatment began after 2 weeks of training, the treatment group treated on right side of Shenhu for 10 min, every other day for 4 weeks. Anatomical location of stimulated acupoints were determined according to the rat acupoint atlas. All subjects were sacrificed by decapitation immediately after the last submaximal training. Trunk blood and tissues was collected for assay.

RESULTS: The serum level of Interleukin-1 (IL-1) in E were significantly higher than EM (0.93±0.21 vs. 1.73±0.20, p<0.05). The level of IL-6 in E were significantly lower than EM (1708.05±225.23 vs. 1137.22±147.80 U/L, p<0.05). The level of IL-10 in E were significantly lower than EM (123.91±22.78 vs. 167.46±35.83 U/mL, p<0.05). The level of IL-12 in E were significantly lower than EM (7.37±1.21 vs. 10.73±1.54 U/mL, p<0.05). The level of TNF-α in E were significantly lower than EM (7.37±1.21 vs. 10.73±1.54 U/mL, p<0.05). The level of IFN-γ in E were significantly lower than EM (123.91±22.78 vs. 167.46±35.83 U/mL, p<0.05). The level of IL-12 in E were significantly lower than EM (7.37±1.21 vs. 10.73±1.54 U/mL, p<0.05).

CONCLUSIONS: Exercise induced increases in the levels of reactive oxygen species (ROS) and ROS have been recognized as mediators of signal transduction pathways able to induce cytokine production from various cell, and Moxibustion Shenhu showed its effect on exercise-induced ROS and the production of cytokines.
To determine whether four weeks of oral Echinacea supplementation altered resting leukocyte responses,

METHODS: Twenty-four apparently healthy and recreationally active males 24.9 ± 4.2 yrs, height 178.9 ± 7.9 cm, weight 87.9 ± 14.6 kg and 19.3 ± 6.5 % body fat were randomly assigned to either an Echinacea (ECH; n=12) or a placebo (PLA) group. Subjects were required to be free of any symptoms of upper respiratory tract infections (URTI) or other changes in health status during their four week study period. Participants were supplemented with 8 g/day of ECH or PLA (18 mg/kg) for 28 consecutive days. Fasting, morning blood samples were collected prior to and at weekly intervals for four weeks and were analyzed for white blood cell counts (WBC), lymphocytes, neutrophils, monocytes, eosinophils and neutrophil/lymphocyte (N/L) ratio. Subjects were queried during each visit regarding illness symptoms or other changes in health status. Frequency, severity, and duration of events were recorded. ANCOVA was used to determine if any differences were related to the possible immune-enhancing affects of Echinacea remain to be identified.

PURPOSE: To determine whether four weeks of oral Echinacea supplementation altered resting leukocyte responses.

RESULTS: There were no significant differences (p>0.05) between ECH and PLA for WBC, neutrophils, monocytes or eosinophils at any time. However, the N/L ratio was significantly altered in the PLA group (52.67 ± 9.19 vs. 29.0 ± 7.35, p<0.05) but not the placebo group. Despite the clear performance enhancing effects of testosterone in as little as three weeks, four of the nine subjects in the testosterone group (44%) had a T/E ratio of <4. T/E ratios for the testosterone group ranged from 2 to 37. T/E ratios for the placebo group remained unchanged between week 0 and week 6.

CONCLUSION: The AAS, testosterone enanthate, enhances 1RM bench press strength and total work during the cycle sprint increased significantly at week 3 (p<0.01) and week 6 (p<0.01) in the testosterone group but not the placebo group. At week 3, 1RM bench press increased 9% from baseline whilst at week 6 the increase was 15%. No significant differences were found between groups for 1RM leg press and peak power. The 1RM leg press significantly increased from week 0 to week 6 (p<0.01) in the testosterone group but not the placebo group. At week 3, 1RM leg press increased 10% from week 0 to week 3 (p<0.01) but not the placebo group. Despite the clear performance enhancing effects of testosterone in as little as three weeks, four of the nine subjects in the testosterone group (44%) had a T/E ratio of <4. T/E ratios for the testosterone group ranged from 2 to 37. T/E ratios for the placebo group remained unchanged between week 0 and week 6.

CONCLUSION: The AAS, testosterone enanthate, enhances 1RM bench press and 10-second cycle sprint performance in 3 weeks in a dose that is used therapeutically. Using the T/E ratio of 4:1 (currently used to screen urine samples), not all subjects could be detected who were being administered the steroid and gaining performance enhancement from it.

Supported by Mentor Television Corporation, London, U.K.

PURPOSE: Verify if athletes undergoing creatine supplementation and intense resistance training would show increase of free radical production.

METHODS: 29 male handball athletes from Sorocaba/SP (17.1 ± 1.63 years) were divided into three groups: GC (N=10) is the control group. The creatine supplementation was performed during 12 days. All individuals were undergone a resistance training program, which concomitantly began to CR supplementation. At the beginning and at the end of supplementation period, blood samples were drawn for the analysis of three important markers of oxidative stress: malondialdehyde (MDA), total antioxidant status (TAS), and urinary 8-hydroxy-2-deoxyguanosine (8-OHdG).

RESULTS: The main revealed results related to physical fitness were that, it was only noticed significant statistical differences on RM which was increased in CG group (52.6 ± 8.90 vs., 62.50 ± 7.77 kg, p<0.05). No differences were seen (noticed) on MDA levels in any of the groups studied, though. However levels of aciduria increased in all groups - GC (4.6 ± 1.0 vs., 7.4 ± 1.6 mg/dl p<0.01); GP (4.4 ± 1.1 vs., 6.7 ± 2.3 mg/dl p<0.05); COT (5.1 ± 0.9 vs., 6.7 ± 1.2 mg/dl p<0.01) and such data suggested we ischemic-reperfusion syndrome induced by resistance training. Finally, it was observed that TAS only decrease significantly on CG (1.11 ± 0.34 vs. 0.6 ± 0.19 mmol/l p<0.01).
CONCLUSIONS: We conclude that in this group, the Cr supplementation promoted a significant increase on muscular strength, on the other hand, these subjects (CG) presented a significant decrease in TAS indicating an over consumption of antioxidant reserves in order to defend themselves of free radical.

2251 Board #188 3:00 PM - 4:00 PM
Creatine Supplement Enhances Rat’s Endurance in a Treadmill Performance Test
Steven Malinić, Christine Kodr, 1 University of Delaware, Newark, DE. 1King’s College, Wilkes-Barre, PA. (Sponsor: Dr. William Farquhar, FACSM, FACSM)
Email: smalunic@udel.edu
Creatine (Cr) supplementation increases the availability of Cr phosphate in skeletal muscle that enables a greater rate of ATP resynthesis for energy production. It is widely documented that Cr increases performance during anaerobic exercise, yet fewer studies note improvement during aerobic bouts of exercise.

PURPOSE: The purpose of this study was to examine the effect of Cr supplementation on the enhancement of aerobic performance in rats over 30d.

METHODS: Fourteen male Sprague-Dawley rats (60d) were divided into match-paired groups based on body weight and distances run in baseline training. Double-blind experimentation was carried out for 30d with the treatment group receiving Cr supplementation dissolved in their drinking water (2.55g of CrL). Rats ran with approximately 7% body weight on their back on a 15° incline at a preliminary velocity of 10m/s with 1m/s increases in velocity every 2 minutes until exhaustion. Total distances run were used to determine aerobic performance.

RESULTS: Mean distances run from baseline to 30d showed statistically significant (p<0.005) difference between the Cr group (128.9m ± 18.2m vs. 217.3m ± 18.1m) compared to the control group (137.2m ± 10.1m vs. 101.0m ± 14.9m) in run performance.

CONCLUSION: Cr supplementation appears to improve energy metabolism during aerobic exercise without altering total body weight in rats. Supported by King’s College Neuroscience Program (2004)

2252 Board #189 4:00 PM - 5:00 PM
Effects of Short-Term Creatine Monohydrate Supplementation on High Intensity, Anaerobic Exercise Performance
John W. Womack, Adam G. Parker, Benjamin J. Head, John S. Green, FACSM, Stephen F. Crouse, FACSM. Texas A&M University, College Station, TX.
Email: jww@hkn.tamu.edu

Many studies have examined the ergogenic effects of short-term creatine monohydrate supplementation and its ability to improve power production. However, the results are inconsistent and more research is warranted in this area.

PURPOSE: To determine the effect of short-term (5 day) creatine monohydrate supplementation on maximal anaerobic exercise performance.

METHODS: 44 college aged subjects were randomly assigned to supplement for 5 days with either 20 g/day of creatine monohydrate (Cr; n=22; 11 male, 11 female, age=23.5, Ht = 172.5 cm, Wt=72.5 kg) or a sucrose placebo (P; n=22; 8 male, 14 female, age=20.9, Ht=170 cm, Wt=68.1 kg). Following the supplementation regimen, the identical exercise bouts and lactate measurement procedures were repeated.

RESULTS: Data were analyzed using apaired independent t-test with Type 1 error rates given as actual calculated p-values. The Cr group exhibited a trend toward decreased lactate production post exercise (p=.06).

CONCLUSION: These data suggest that Cr supplementation may decrease lactate production following intense anaerobic exercise.

2253 Board #190 2:00 PM - 3:00 PM
Effect of Creatine Supplementation on Lactate Levels Following Intense, Anaerobic Exercise
Benjamin J. Head, John W. Womack, Adam G. Parker, John S. Green, FACSM, Stephen F. Crouse, FACSM. Texas A&M University, College Station, TX.
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Numerous studies have examined the effects of creatine monohydrate (Cr) supplementation on athletic performance; however, few studies have explored the effects Cr supplementation has on lactate levels following intense anaerobic exercise.

PURPOSE: To determine the effect of Cr supplementation on lactate levels following high intensity, anaerobic exercise.

METHODS: 44 subjects performed a 30 second Wingate cycle ergometry test. This was followed by three 30 second cycle sprints at 50% of peak power with 2 minutes recovery between exercise bouts. Blood lactate levels were measured prior to, 5 minutes post, & 10 minutes post exercise by finger stick blood collection using a commercially available lactate analyzer. Subjects were then randomly assigned to supplement for 5 days with either 20 g/day of creatine monohydrate (Cr; n=22; 11 male, 11 female, age=23.5, Ht = 172.5 cm, Wt=72.5 kg) or a sucrose placebo (P; n=22; 8 male, 14 female, age=20.9, Ht=170 cm, Wt=68.1 kg). Following the supplementation regimen, the identical exercise bouts and lactate measurement procedures were repeated.

RESULTS: Data were analyzed using apaired independent t-test with Type 1 error rates given as actual calculated p-values. The Cr group showed a trend toward decreased lactate production post exercise (p<.06). These findings suggest that Cr supplementation may decrease lactate production following intense anaerobic exercise.
Effect of Electrolyte Containing Beverages on Measures of Hydration During Rest
Filippo Macaluso, Neil M. Johannsen, Michaela C. Carlson, David S. Senchina, Megan Miller, Tracy Sharp, Rick L. Sharp, FACSM. Iowa State University, Ames, IA. Email: filippo.mac@iastate.edu

Previous research indicates that electrolyte beverages (chicken noodle soup) ingested before exercise augments fluid balance by increasing ad libitum water intake and reducing urine volume during exercise. However, we are unable to determine whether sodium or other macronutrients contained in the pre-exercise beverages were responsible for this effect.

PURPOSE: To determine the efficacy of four different “pre-exercise” beverages on measures of hydration at rest.

METHODS: Ten healthy young male ingested 355 ml of one of four experimental beverages: water (W), water with 1355 mg sodium (SW), chicken noodle soup (CS), or V8 vegetable drink (V8). Blood samples were drawn before beverage ingestion and every five minutes for the first 45 minutes and 60, 90, 120 and 150 minutes after ingestion of the beverages. In addition, every time a blood was drawn, subjects recorded their feeling of thirst on an analogue scale. A urine sample was collected prior to beverage ingestion and total urine volumes were measured and analyzed 45 and 120 minutes after ingestion of each of the experimental beverages.

RESULTS: Urine output was not significant between the trials; however there was a tendency for the mean of the urine output in V8 and W to be greater than CS and SW. The same tendency for the mean of the urine output was observed between trials by time (p < 0.07). Beverages that produced higher urine volumes also produced less concentrated urine shown by lower urine specific gravity (trial x time: p = 0.006). A trial effect exists for percent change in plasma volume (p < 0.001). Further analyses using Holm-Sidak’s comparisons revealed significant differences in CS vs. W, V8 and W and between SW vs. W and V8. Thirst responses over time were different by the experimental beverage (p = 0.007), but none of the individual trials differed at any time point.

CONCLUSIONS: The CS and SW beverage induced reduction of urine output and increased plasma volume and thirst response, indicating that sodium concentration is more important than other beverage macronutrients for promoting improved hydration status. In fact the opposite effects on plasma volume, urine volume, and thirst response were observed after water ingestion. The V8 beverage induced reduction of plasma volume, and thirst response, indicating that high potassium concentration in the pre-exercise beverage can interrupt the positive effects on hydration status induced by high sodium concentration. But data showed, also, that V8 beverage before exercise should increased the ingestion of fluid during exercise and so augment the fluid balance. Supported by a grant from Campbell Soup Company.

Effect of Four Weeks of Echinacea Supplementation on Erythropoietin and Indices of Erythropoietic Status
Malcolm T. Whitehead. Northwestern State University of Louisiana, Natchitoches, LA. (Sponsor: Michael J. Webster, FACSM) Email: whiteheadm@nsula.edu

Echinacea (Echinacea purpurea) is an herbal supplement derived from a North American perennial plant (Purple Coneflower) that is primarily used as a non-specific immunostimulant. Evidence from animal and cell culture models supports the role for Echinacea as a potential mediator of erythropoiesis.

PURPOSE: The purpose of this investigation was to determine whether four weeks of oral Echinacea supplementation resulted in alterations in erythropoietin (EPO), red blood cell (RBC) count, hematocrit (HCT) or hemoglobin (Hb).

METHODS: Twenty-four healthy and recreationally active males aged 24.9 ± 2.4 yrs, height 1.7 ± 0.8 m, weight 87.8 ± 14.6 kg and 19.3 ± 6.5 % body fat were randomly assigned to either an Echinacea (ECH; n=12) or a placebo (PLA; n=12) group.

Participants were supplemented with 8000 mg·d−1 of ECH or PLA for 28 consecutive days. Blood samples were collected every 20 min and during the last 60 min, water was ingested every 20 min at the same time as the experimental beverage. Water in the last 60 min was adjusted so 100% of the fluid lost during dehydration was replaced. Blood samples were collected before dehydration and rehydration and every 20 min during rehydration. A urine sample was collected before dehydration and total urine volumes were measured and analyzed before rehydration, after rehydration, and 2 hours after rehydration.

RESULTS: Percent dehydration was similar for all four trials (-2.2±0.3, -2.2±0.4, -2.1±0.3 for W/W, W/CE, C/W, and C/CE, resp; p = 0.99, Temp/Comp). Although fluid mass ingested during hydration was similar between trials (p = 0.53), urine output showed a trend for an independent effect of temperature with cold beverages producing less urine (p = 0.07) even after correcting for body weight (10.1±3.6 vs. 9.0±3.7 ml/kg body weight; p = 0.08). Although not significant, urine volumes were higher at both temperatures after ingesting CE (764±286 and 702±127 vs. 728±192 and 613±111 ml for W/CE and C/CE vs. W/W and C/W resp). Percent retention of ingested fluids immediately and 2h after rehydration were not different by trial (p = 0.71 and 0.28, resp). Although not significant, urine specific gravity and osmolality (p = 0.005 and 0.007, resp), but none of the trials differed by trial at any time point. Urine electrolytes were not affected by beverage temperature or composition. Recovery of plasma volume, heart rate, blood pressure, rectal temperature, and rating of thirst following dehydration were not different by experimental beverage.

CONCLUSIONS: Cold beverages may decrease urine output during 2 hours of recovery (ES = 0.4), but the rate of plasma volume restoration was not affected by beverage temperature or composition. Funded by Gatorade Sports Science Institute and Betty Keenan Fund, ISU.
RESULTS: There were no significant differences in performance time between trials (W = 1.42-42 p = 13.34; 11% CHO-CAF = 13:49 ± 24:39; 6% CHO-E = 14.40 ± 14.30). Mean weight loss tended to be greatest during W trial (2.6 ± 0.7% of body weight) due to lower consumption (561 ± 321 ml vs 900ml). Weight loss exceeded 3% body weight in 1 subject during 11% CHO-CAF. During the run, mean RSF was highest for 11% CHO-CAF (3.7 ± 0.3). Lowest in W (2.7 ± 0.8) and tended to increase during both CHO trials. RPE increased throughout the run but did not differ significantly between trials. VO2 and RER did not differ between 6% CHO-E and 11% CHO-CAF. A tendency for runners to start faster in 11% CHO-CAF compared with 6% CHO-E was noted (difference for first 1.6 km = 23.5 ± 40.5 sec; p = 0.1).

CONCLUSIONS: During self-paced 21.1km treadmill time trials, consumption of a caffeinated cola beverage resulted in significantly greater ratings of stomach fullness when compared with either water or 6% CHO-E beverage. In spite of this effect, running performance time for a half-marathon did not suffer.

2259 Board #196 2:00 PM - 3:00 PM Effects of Low-Moderate doses of Caffeine on Submaximal Exercise Responses in 7-9 year old Children
Hurdling University, Searcy, AR.

Only two studies have systematically investigated the effects of caffeine during exercise in children (Barta, Acta Paediatr.,1982; Turley, Med. Sci. Sports Exerc., 2005). Both studies used relatively high levels of caffeine (4.0 and 5.0 mg/kg caffeine/kg body mass), respectively. No study has used lower doses to determine their effects on physiological responses to submaximal exercise in young children.

PURPOSE: Investigate the effects of low-moderate doses of caffeine on metabolic and cardiovascular responses to exercise in children.

METHODS: Twelve 7-9 year old children (6 girls & 6 boys) voluntarily participated in a double-blind, counter-balanced study design. Children received either a placebo (drink only-P), 1 mg/kg body mass, (CAF-1), and 3 mg/kg body mass (CAF-3) of anhydrous caffeine (mixed in cherry flavored Sprite®) on three separate days. Following a 60 minute absorption period, children rode at 25 W and then 60% VO2 max for 8 minutes each on an electronically braked cycle ergometer at 60-80 RPM while heart rate (HR), oxygen consumption, and respiratory exchange ratio (RER) were monitored continuously, and blood pressure (BP) was measured every two minutes.

RESULTS: HR was significantly (p<0.05) higher in PL vs CAF-1 and CAF-3 at all 25 W (125±12, 119±11, 120±10 bpm) and 60% VO2 max (259±14, 154±14, 154±12 bpm), respectively. There were no differences in systolic BP (SBP-mmHg) at 25 W (120±10 vs 124±10 - p=0.06) and 60% VO2 max (140±11 vs 143±11 - p=0.20), and no difference in DBP at 25 W (64±4 vs 67±7 - p=0.21) and 60% VO2 max (56±6 vs 57±6 - p=0.03) between PL vs. CAF-3, respectively. VO2 was the same at both 25 W (0.63±0.07, 0.64±0.09, 0.65±0.11 l/min) and 60% VO2 max (0.99±0.19, 1.00±0.21, 1.00±0.22 l/min) in PL, CAF-1 and CAF-3, respectively. RER was also the same at both 25 W (0.94±0.03, 0.92±0.04, 0.95±0.05) and 60% VO2 max (0.97±0.02, 0.95±0.04, 0.97±0.03) in PL, CAF-1 and CAF-3, respectively.

CONCLUSION: In young children, low (1 mg/kg body mass) doses of caffeine do not have an effect on cardiovascular or metabolic responses to submaximal exercise. Moderate (3 mg/kg body mass) doses of caffeine have no metabolic effects in young children, but there is a trend for elevated blood pressure at this dose.

2260 Board #197 3:00 PM - 4:00 PM The Physiological Effects of Caffeine Ingestion in Women During Treadmill Walking
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While the effects of caffeine ingestion on athletic performance in males have been studied extensively, there is limited previous research examining caffeine’s effects on women of average fitness levels participating in common modes of physical activity.

PURPOSE: The purpose of this study was to determine the effect of two levels of caffeine dosage on the metabolic and cardiorespiratory responses to treadmill walking in women.

METHODS: Subjects were 20 females (19-28 years of age) of average fitness, not habituated to caffeine. Each subject was randomly assigned a 3 mg/kg-dose of caffeine, 6 mg/kg-dose of caffeine, and placebo for three trials of moderate steady-state treadmill walking at 94 min·1-1 (3.5 mph). Steady-state rating of perceived exertion (RPE), heart rate (HR), respiratory exchange ratio (RER), weight-relative VO2 (%VO2max versus %VO2peak), and rate of energy expenditure (REE) were measured during each trial.

RESULTS: Repeated measures ANOVA revealed that a 6 mg/kg-dose increased VO2 (p = 0.04), REE (p = 0.3), and %VO2peak (p = 0.03), when compared to the placebo. Caffeine had no effect on RPE, HR, or RER. No significant differences were observed between the placebo trials versus the 3 mg/kg-dose trials.

CONCLUSION: Walking is an activity commonly employed by people of all ages and fitness levels to increase fitness and control body weight, and thus, any reasonable method for enhancing the experience or effectiveness of this exercise would be beneficial. While a 6 mg/kg dose of caffeine significantly increased RPE during exercise, the observed increase (~0.23 kcal·min-1) would not noticeably affect weight loss. Since caffeine had no effect on RPE, it would not be prudent for a trainer to recommend caffeine to increase a woman’s energy expenditure or to decrease perception of effort during mild exercise. These data also demonstrate that caffeine intake should not interfere with monitoring walking intensity by tracking exercise heart rate in women.

2261 Board #198 4:00 PM - 5:00 PM Training Impulse is Lower for Alpine Skiers when Consuming a Carbohydrate-Protein Gel
Joe H. Harmon, James R. Burckhard, John G. Seifert, Dave W. Bacharach, FACSM, St. Cloud State University, St. Cloud, MN.
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Recent research has shown that supplementation of carbohydrate (CHO) and protein (P) in a CHO-P gel with water is better than ingesting water alone for maintaining performance during successive bouts of exercise. Two problems exist for Alpine skiers: 1) Skiers of all ages and levels tend not to drink enough fluids during training or competition, and 2) Skiers tend not to take in adequate energy substrates during training. This leads to fatigue and a decrease in performance during successive days of training. By ingesting a CHO-P mixture athletes should be able to delay fatigue and continue to train effectively.

PURPOSE: To determine if ski performance can be maintained on four successive days of training by ingesting a CHO-P gel and water versus water alone.

METHODS: 14 well trained Alpine skiers (M=22±2.12 yrs.) trained 5 hr/day for 4 days on the Palmer glacier at Mt. Hood, OR. An acclimation day where subjects skied ~2 hr was provided prior to test days. Subjects were matched by age and ability and assigned to one of two conditions using a counter balanced design where group 1 received gels for days 1 and 2 and group 2 received gels on days 3 and 4. Each subject used a hydration pack and was required to consume 1-1.5 L of water each day with the amount of water consumed based on body mass. On the two designated gel days, subjects also consumed at least one, but not more than two CHO-P gels every hour with a range of 4-7 gels/day. Rating of perceived exertion (RPE, CR-10 scale) was recorded at the end of each session. Laps were recorded to determine total vertical distance (m) skied each session. Trimp (training impulse) was calculated as RPE x Vertical distance x number of laps. Data were analyzed using paired t-tests.

RESULTS: The distance skied was not significantly different for either group (p=0.05). Trimp was found to be significantly lower during the two CHO-P gel days compared to the water only days (p<0.05).

CONCLUSION: Distance skied is not affected by using a CHO-P gel and water versus water alone; however, the perceived effort to ski the same amount of distance when consuming only water. Further research is needed to determine if training longer than four successive days would be influenced more by a CHO-P supplement compared to water alone.

2262 Board #199 2:00 PM - 3:00 PM Effect of Bicarbonate Supplementation on the Muscular Strength
Wollner Materko, Carlos E.B. Neves, Edil L. Santos. Exercise Physiology Research Laboratory, Graduate School of Physical Education, Estácio de Sa University, Rio de Janeiro, Brazil.
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The ingestion of sodium bicarbonate (NaHCO3) in humans has been previously associated to the increase of blood lactate concentration during exercise (REQUENA et al., 2005; PRICE et al., 2003; SANTALLA et al., 2003), which was attributed to buffering, and further reducing the effects of intramuscular acidosis (ROBERGS et al., 2003; SCOT et al., 2003). The ingestion of NaHCO3 before exercise may induce to metabolic alkalosis (SWANK, ROBERTSON, 2002), to influence glucoseonmesis (ROE et al., 2003) and to enhance performance (STEPHEN et al., 2002).

PURPOSE: to examine the ergogenic effect of NaHCO3 over the muscular strength.

METHODS: Eleven experienced in resistance training healthy male subjects (23.0±2.7yrs, 83.2±6.5kg, 176.1±6.5cm, 15.3±4.5% of body fat) volunteered for this study. Subjects were randomly assigned to ingest two different solutions of sodium bicarbonate (NaHCO3; 0.3 g/kg) or sodium chloride (NaCl; 0.045g/kg).

Solutions were solved in water, and ingested 2h before a muscle strength test. Following a double-blind placebo controlled design, each volunteer accomplished a 10 repetition maximal (10RM) test on the bench press (BP) and other on the pull press (PP) according three procedures: (1) without supplement (C); (2) with bicarbonate supplementation (S); and (3) placebo (P). All tests (C, S and P) were repeated and the second test was assumed as reference. Tests repeatability was studied using Wilcoxon paired tests and the workload relative to 10RM in the BP and PP was compared
by repeated measures ANOVA with Fisher post hoc test (p = 0.05).

RESULTS: Significant differences were recorded between test and re-test for PP and BP. Concerning the BP test, no significant differences were recorded, averaging 99.7±18.0 kg (C), 103.2±17.8 kg (S) and 103.6±18.3 kg (P). Similarly, the PP result was reported as 68±10.7 kg (C) and 70.1±11.9 kg (S) and 69±10.8 kg (P), showing no significant differences.

CONCLUSION: According this experimental design the present results suggest that ingestion of NaHCO3 does not affect the muscular strength.

2263 Board #200 3:00 PM - 4:00 PM Declared Dietary Supplement Usage by British Olympians Samantha J. Stear, Gregory P. Whyte, FACSM, Richard Budgett. English Institute of Sport and Olympic Medical Institute, Harrow, United Kingdom.

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Indiscriminate use of dietary supplements by elite athletes is unwise due to potential health, contamination and doping issues. However, there is limited availability of information on supplement use amongst athletes.

PURPOSE: To determine the extent of dietary supplement usage among elite British athletes.

METHODS: Supplement use in 286 Team GB athletes was examined from data collected for the 2004 Athens Olympics as part of the pre Olympic medical check. There was complete data for 216 athletes (130 males, 86 females) from across 16 sports (archery, badminton, canoeing, cycling, diving, equestrian, gymnastics, hockey, modern pentathlon, rowing, sailing, shooting, swimming, triathlon, weightlifting and wrestling). The athletes included in the data set were means/SD (range): age; 27.4±5.3 (17.3 - 48.9) years, standard height 1.78cm (1.52 - 206cm), mass; 73.6±12.5kg (45 -105kg).

RESULTS: Over half the athletes (52.8%) declared taking supplements on their medical preparation forms with supplement use being more common in female (59.3%) than male (48.5%) athletes. Supplement use differed between sports with the highest prevalence (>75% sport’s athletes) being declared by modern pentathletes, weightlifters, swimmers, cyclists and triathletes. Athletes from three sports (archery, shooting and wrestling) did not declare any dietary supplements on their forms. Thirty two different supplements were declared with the majority of supplement users (75%) taking more than one product. The most common supplement declared by athletes was vitamin C (65% of supplement users), followed by multi vitamins and minerals, iron, protein supplements, vitamin E, Selenium and Zinc. Only 15% of supplement users declared sports drinks as a dietary supplement on their medical preparation forms.

CONCLUSIONS: Dietary supplement use is common amongst elite British athletes with supplement usage patterns varying across gender and sports. The type of supplements chosen demonstrates that athletes may be more motivated by health rather than ergogenic benefits of supplementation. Sports drinks have become such an integral part in the sporting environment that athletes no longer perceive these as dietary supplements. The use of supplements with antioxidant qualities may have been unusually elevated prior to the Athens 2004 Olympics due to advice that antioxidants may protect athletes competing in hot and/or polluted urban environments. Athletes should seek guidance from a qualified sports nutritionist before taking supplements.

2264 Board #201 4:00 PM - 5:00 PM Effect of Short-Term Use of Testosterone Enanthate on Personality and Mood in Healthy Young Males Rosanne A. Coutts, Shane Rogerson, Glen Deakin, Sonya Marshall-Garces, Rady Meir, Shi Zhou, Robert Weatherby. Southern Cross University, Lismore, Australia.

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Supported by notions that supplementation enhances mental, physical and sexual powers steroid users focus on its ability to influence emotional state, and more profoundly shape identity. The notion of anabolic steroid hormone induced changes in biological drive, causing increased anger and hostility is anecdotal but inconclusive.

PURPOSE: To quantify the existence of either Personality or Mood effects that may be observed during and following six weeks of the administration of controlled doses of testosterone enanthate.

METHODS: Eighteen males (25±4.0 yrs) were match paired and randomly assigned in a double blind manner to either a testosterone enanthate or placebo group. During a monitored training program subjects were injected once weekly for six weeks: the testosterone enanthate group with 3.5mg/kg and the placebo group with saline. Mood was measured daily using the Braden Mood Scale. Personality testing was conducted pre and post using the 16PF, with data being combined into primary and global factors. Repeated measures ANOVA analysis was conducted (SPSS 11.0).

RESULTS: An initial investigation of mood plots showed no differences between the groups for anger, depression, tension or confusion. For the testosterone group there were slight increases in Vigour from week 2 and slight reductions in Fatigue apparent immediately. For the Personality factor of Sensitivity, there was a significant time by group effect (Wilks’ Lambda = 0.569, F = 10.59, df = 1,14, p = 0.006). Changes over time for the placebo group were non significant (p = 0.812) with a significant decrease over time for the testosterone group (p = 0.001). For the factor of Dominance (Wilks’ Lambda = 0.751, F = 4.64, df = 1,14, p = 0.049), neither increases over time in the placebo nor decreases over time for the testosterone groups were significant (p = 0.558 and p = 0.378 respectively). For Vigilance Wilks’ Lambda = 0.789, F = 4.69, df = 1,14, p = 0.048, with near significance between the groups at pre with the testosterone group having higher scores (p = 0.055). There was a significant increase in Vigilance over time in the placebo group (p = 0.033), but the decrease in the testosterone group was non significant (p = 0.561).

CONCLUSION: Significant changes in Sensitivity suggest that this dosage of testosterone enanthate may influence the ability to be empathetic thus reducing sensitivity to other people’s considerations which may be an explanation for apparent aggressive behaviour observed in anabolic steroid users.

Supported by Mentorn Television Corporation. London UK

The ACSM recommends consumption of a carbohydrate-electrolyte drink when performing at least one hour of intense exercise. The source of carbohydrate for many traditional sports drinks is glucose or sucrose.

PURPOSE: The purpose of this study was to evaluate the effectiveness of a rice-based sports drink on metabolic changes accompanying 120 minutes of treadmill running.

METHODS: Fourteen trained men aged of 31.6±6.2 years (Mean ± SD), with a height of 178.7±6.1 cm and weight of 78.1±8.9 kg enrolled in this study. Percent body fat for the athletes averaged 11.9±3.5%. We randomly assigned athletes to ad librum ingestion of 3 different fluids for three 120-minute treadmill runs at 60% of VO2max, followed by a 90 minute sitting recovery period. The fluids studied consisted of a 6% carbohydrate-sucrose, glucose/fructose-based sports beverage (SG), a 4.2% carbohydrate rice-based sports beverage (R) and tap water (W). The 120-minute runs were performed for 3 consecutive weeks. A VO2max test was performed for each participant for estimation of a running speed of 60% of peak capacity. Total fluid intake and total body water status using a Xitron Bio-Impedance Analyzer were assessed pre and post-run and after recovery.

RESULTS: Average temperature and humidity during runs were 26°C (79°F) and 47% relative humidity. Mean VO2max of participants was 56.5 ± 5.4 mL/kg/1-min, which resulted in a mean 2 hour running speed of 6.8 ± 0.6 mph for the three runs. Rate of perceived exertion measured every 20 minutes during the runs was similar across time-points with R on the Borg Scale averaging 12 ± 2. Body weight decreased by 0.6 kg during the 120-minute runs, with no differences between drinks being observed (P = 0.26). Fluid consumption by the runners during the 120-minute run and recovery averaged 1.70 L and 0.63 L, respectively. No differences in consumption of the three fluids were observed during running. Although consumption was similar for SG and R (0.76 L vs. 0.61 L, P = 0.61) during recovery, the athletes consumed more SG than W during this time period (0.70 L vs. 0.52 L, P = 0.03). Furthermore, bio-impedance analysis performed during each run revealed no differences in total body water, intra-cellular water and extra-cellular water at pre-run, post-run and post-recovery time-points (all P’s ≥ 0.08).

CONCLUSION: Metabolic changes accompanying 120 minutes of running were similar during runs with SG and R beverage consumption. The athletes tested were accustomed to drinking during exercise and replenished fluid adequately with whatever beverage was provided. Future studies need to examine if similar outcomes appear in recreational runners.

This study was funded by Cera Products, Inc.

2266 Board #203 3:00 PM - 4:00 PM Vitamin C Supplementation Enhances Fat Oxidation During Walking in Obese Subjects Pamela D. Swan, FACSM, Corey Huck, Bonnie Beazhold, Carol S. Johnston, Arizona State University, Mesa, AZ.

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Previous research suggests that Vitamin C depletions modifies energy expenditure and, in particular, fat oxidation. Also, impaired fat oxidation has been implicated in the development of obesity and in failed weight loss attempts. The purpose of this study was to assess the effect of Vitamin C (VC) supplementation on fat utilization during a 60 min walk at 50% maximal oxygen consumption using a randomized, double-blind, placebo-controlled, 4-week trial in obese men and women.

METHODS: Apparently healthy obese (BMI > 30 kg/m2) men (n=4) and women (n=11) (mean age of 34 ± 11 years) on a diet and regular activity participated. Subjects were provided food for an energy restricted and vitamin C poor (~ 50% of recommended dietary allowance) diet. Subjects were instructed to perform at least one hour of exercise per day. Subjects were instructed to perform at least one hour of exercise per day.

RESULTS: After 4 weeks of diet adherence, plasma vitamin C concentrations increased in VC (0.841 ± 0.034 and 1.089 ± 0.148 mg/dL for weeks 0 and 4 respectively) and decreased in PL (0.732 ± 0.108 and 0.538 ± 0.117 mg/dL) (p=0.001 for time x group interaction).
**The Effect of Nonspecific COX Inhibitors on Serum Chemistries during Ultradistance Running**

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**PURPOSE:** To determine the effects of both ultradistance running and a nonspecific COX inhibitor on serum chemistries during a 160 km running race.

**METHODS:** Twenty nine subjects (47.9±1.4 yrs) ingested 600 mg of ibuprofen the day before, and 1200 mg during a 160 km running race. Ibuprofen was taken every ~4 hrs in 200 mg doses. Control subjects (N=25, 46.8±2.1 yrs) avoided ingestion of ibuprofen before or during the race. Blood was drawn from the antecubital space on the day before the race and immediately post-race. Serum chemistry profiles were analyzed by the clinical laboratory.

**RESULTS:** Subjects in the two groups did not differ by age, training volume, race experience, BMI, body fat, or finishing time (25.8±0.6 vs. 25.6±0.8 hr). Body weight did not change significantly from pre-race, mid-race (90 km), to post-race. Ultradistance running caused a significant increase in pre- to post-race in serum sodium (p=0.006), potassium (p=0.001), chloride (p=0.001), calcium (p=0.001), albumin (p=0.001), and globulin (p=0.001). Increases were seen in creatine kinase (p=0.001), creatinine (p=0.001), blood urea nitrogen (p=0.001), uric acid (p=0.001), glucose (p=0.001), aspartate aminotransferase (p=0.001), and alanine aminotransferase (p=0.001) as the result of the race. Ibuprofen ingestion caused a significant increase in only blood urea nitrogen (p=0.04), alanine aminotransferase (p=0.03), and aspartate aminotransferase (p=0.04), but not CKP (p=0.16).

**CONCLUSION:** These data suggest that nonspecific COX inhibitors such as ibuprofen do not alter serum electrolytes during ultradistance running. However the stress of ultradistance running does cause significant changes in serum diagnostic chemistries, and the addition of ibuprofen may elevate markers of liver and muscle damage.

**Supported by Gatorade Sports Science, and the Western States 100 Medical Board**

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**The Effects of Carbohydrate Supplementation on Leukocyte and Lymphocyte Responses to Multiple Resistance Training Bouts**

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The acute immune responses to resistance training are not well understood and most studies examining these responses have only considered one bout of exercise. To the authors knowledge there are no studies examining the immune response to two training bouts performed on the same day.

**PURPOSE:** The primary purpose of this investigation was to compare the acute immune responses between carbohydrate (CHO) and placebo (PLC) beverages that were consumed before, during, and after multiple sets of resistance exercise performed during two sessions on a given training day.

**METHODS:** Six men (mean(SEM); age: 24.3±2.1 y; height: 176.9±1.6 cm; body mass: 82.6±2.8kg) who could squat a minimum of 150% body mass participated in a randomized counterbalanced double-blind protocol separated by at least 7 days. A morning training (AM) session consisting of 5 sets of 5 repetitions of back squats (65% of 1 repetition maximum [RM]), 1-legged squats (45% of 1 RM) and speed squats (10% of 1 RM) and an afternoon session consisting of sets of 10 reps of back squats performed with 55% of 1 RM to exhaustion (PM). All sets were separated by 3 minutes of recovery. A CHO supplement consisting of 0.3 g/kg body mass1 or PLC was consumed during the AM, during 4 hours of recovery, and during the PM session. Blood samples were taken before the morning (REST) and immediately after the AM session, before, immediately after, 1 hour after, and 2 hours after the PM session.

**RESULTS:** There were no statistical differences between the CHO and PLC treatments for leukocytes, monocytes, neutrophils, eosinophils, and lymphocytes. Neutrophil, monocyte lymphocyte, and total leukocyte counts were significantly elevated immediately after the AM training session when compared to REST.
Immediately prior to the PM there was a significant elevation in total leukocyte, eosinophil, monocyte, and neutrophil counts when compared to REST. When comparing REST to the immediately post PM values the total leukocyte, eosinophil, neutrophil, monocyte, and lymphocyte counts were all significantly elevated. The total leukocyte, neutrophil, and monocyte counts were all significantly elevated 1 hour and 2 hours post PM when compared to REST.

CONCLUSION: The ingestion of CHO before, during and after multiple sets of resistance training performed during two daily sessions does not effect the total leukocyte or lymphocyte count.

2271 Board #3 8:30 AM - 9:30 AM
Immunological Parameters According to the Physical Activity Level in HIV-1 Infected Individuals
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Physical activity has been widely suggested as a strategy to improve immunological parameters, specially in groups at the immunosuppression risk (cancer patients, elderly people, HIV individuals).

METHODS: Volunteers were constituted by 37 HIV-1 infected individuals, aged from 24 to 67 years-old (x: 39.22 ± 9.41 years) of the Second Immunodeficiency Ambulatory from Hospital das Clinicas (Faculty of Medicine - USP). Clinical diagnosis of infection was of 6.01 ± 5.47 years and for the AIDS was 6.01 ± 4.02 years. All volunteers have been submitted to the high activity anti-retroviral therapy in the last 4.43 ± 3.19 years. Physical activity was determined through Baecke questionnaire. Blood samples were taken at rest, immediately after exercise, and following 2 hours of recovery, and HR were continuously monitored and recorded. In each experiment, approximately 2.3 ml of stimulated saliva was collected in Salivette for one minute at 0100, 0200, 0400, and 1200 hours on day 1 and 4, and analyzed for cortisol and s-IgA.

RESULTS: Salivary cortisol concentration on day 1 was 0.05±0.04, 0.12±0.09, 0.06±0.03, and 0.42±0.17 at HC, and 0.06±0.02, 0.09±0.05, 0.13±0.06, and 0.47±0.11 µg/dL at LC at 0100, 0200, 0400, and 1200, respectively, and the values at 1200 were higher than three previous time periods in both conditions (P<0.05) without difference between conditions (P>0.05). Cortisol on day 4 was 0.06±0.03, 0.10±0.06, 0.07±0.02, and 0.53±0.09 µg/dL at LC at each sampling time. No condition and time interactions were found in cortisol concentration on day 4. s-IgA on day 1 was 52.0±37.1 and 70.4±40.0 at HC, and 0.06±0.02, 0.09±0.05, 0.13±0.06, and 0.47±0.11 µg/dL at LC at 0100, 0200, 0400, and 1200, respectively, and the values at 1200 were higher than three previous time periods in both conditions (P<0.05) without difference between conditions (P>0.05). Cortisol on day 4 was 0.06±0.03, 0.10±0.06, 0.07±0.02, and 0.53±0.09 µg/dL at LC at each sampling time. No condition and time interactions were found in cortisol concentration on day 4. s-IgA on day 4 was 27.0±7.7 and 35.2±8.9 and 54.8±27.3 µg/dL at LC at 0100 and 0200, respectively. No condition and time interactions were found in s-IgA on day 4.

CONCLUSIONS: These data indicated that a nocturnal exercise with varying body temperature in different ambient temperatures did not influence salivary cortisol and s-IgA responses in healthy men.

2273 Board #5 8:30 AM - 9:30 AM
Effect of Nocturnal Exercise at Two Different Temperatures on Salivary Cortisol and Immunoglobulin A Responses
Jee Eun Son1, Seung Bum Lee2, Eun Jang Nam1, Hong Jin Ahn2, Joohyeong Lee1. 1Kim Chung Kew Exercise Physiology Laboratory, Kookmin University, Seoul, Republic of Korea. 2Dept. of Physical Education, Yonsei University, Seoul, Republic of Korea.
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PURPOSE: To examine the effect of nocturnal exercise at two different ambient temperatures on salivary cortisol and immunoglobulin A (s-IgA) in healthy young men.

METHODS: Five healthy collegiate men who had not smoked and had no mental or endocrine diseases (21.0±3.4 yrs, 175±8.3 cm, 70.3±7.3 kg, 10.6±1.4% body fat) participated in two separate (at least 15 days), counter-balanced, experiments. In each experiment, subjects cycled on a stationary bike for 60 min at 55% of maximal heart rate (HR) beginning at 0100 in 15 lux for four consecutive days. In one experiment, subjects cycled at 26°C raising body temperature (HC) from 35.7±0.7 at resting to 36.2±0.6°C at 60 min of exercise. In another experiment, they exercised at 17°C suppressing body temperature with cooling devices (LC) from 33.4±1.1 at resting to 33.2±0.6°C at 60 min of exercise. During the experiment, they started to sleep at 0400; woke up at 1200, and were asked to maintain normal activity level during rest of the day. During exercise, and at least 15 min after exercise, and temperature, and HR were continuously monitored and recorded. In each experiment, approximately 2.3 ml of stimulated saliva was collected in Salivette for one minute at 0100, 0200, 0400, and 1200 hours on day 1 and 4, and analyzed for cortisol and s-IgA.

RESULTS: Salivary cortisol concentration on day 1 was 52.0±37.1 and 70.4±40.0 at HC, and 0.06±0.02, 0.09±0.05, 0.13±0.06, and 0.47±0.11 µg/dL at LC at 0100, 0200, 0400, and 1200, respectively, and the values at 1200 were higher than three previous time periods in both conditions (P<0.05) without difference between conditions (P>0.05). Cortisol on day 4 was 0.06±0.03, 0.10±0.06, 0.07±0.02, and 0.53±0.09 µg/dL at LC at each sampling time. No condition and time interactions were found in cortisol concentration on day 4. s-IgA on day 1 was 52.0±37.1 and 70.4±40.0 at HC, and 0.06±0.02, 0.09±0.05, 0.13±0.06, and 0.47±0.11 µg/dL at LC at 0100, 0200, 0400, and 1200, respectively, and the values at 1200 were higher than three previous time periods in both conditions (P<0.05) without difference between conditions (P>0.05). Cortisol on day 4 was 0.06±0.03, 0.10±0.06, 0.07±0.02, and 0.53±0.09 µg/dL at LC at each sampling time. No condition and time interactions were found in s-IgA on day 4.

CONCLUSIONS: These data indicated that a nocturnal exercise with varying body temperature in different ambient temperatures did not influence salivary cortisol and s-IgA responses in healthy men.
Exercise-Induced Muscle Damage and Immune Cell Apoptosis
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Muscle damage is evident following an acute bout of downhill running (i.e., eccentrically biased exercise) at moderate intensity whereas it does not occur following running on a level grade or after a second bout of downhill running. Muscle damage increases intracellular free radicals due to the phagocytic processes of white cells. This increase in reactive oxygen species reduces oxygen radical absorbance capacity (ORAC) which may elevate the number of apoptotic cells.

**PURPOSE:** to examine the effect of muscle damaging exercise on immune cell apoptosis.

**METHODS:** Twelve moderately trained subjects (meanSE age = 22±7.07y, VO2max= 53.1±1.3 ml·kg·min⁻¹) performed three 40 min treadmill exercises at ~70% VO2max: a level running trial (L) and two downhill (-10%) running trials (DH1 and DH2). Blood samples were taken at rest and immediately (POST), 2h, 24h, and 48h following each run, and analyzed for creatine kinase (CK) activity, ORAC and apoptotic cells (%) using morphological identification. Data were analyzed using a 2-way repeated measures ANOVA with post hoc Tukey tests.

**RESULTS:** CK activity at 24h following exercise was significantly higher in DH1 than L and DH2 (P<0.01). ORAC was significantly lower at 24h in DH1 as compared to L and DH2 (P<0.01). Lymphocyte number peaked at POST and was significantly higher in DH1 and DH2. The number of neutrophils was highest in DH1 as compared to the high DH2 group (0.74 ± 0.76 vs. 8.83 ± 10.26), 4 (2.83 ± 1.59 vs. 16.44 ± 15.61), and 24h post-race (16.41 ± 8.10 vs. 47.69 ± 30.57 mg l⁻¹). Further, basal CRP concentrations correlated to post-race CRP concentrations at r (0.74, P<0.001) and 24h post-race (r = 0.55, P<0.001) and 24h post-race (r = 0.55, P<0.001). Neutrophil apoptosis in DH1 was significantly higher at 2h, 24h and 48h than in L and significantly greater at 24h and 48h than in DH2 (P<0.01).

**CONCLUSIONS:** An initial bout of downhill running for 40 min at a moderate intensity, which likely induced muscle damage, significantly increased oxidative stress and the proportion of apoptotic lymphocytes and neutrophils in the blood compared to level running or a second downhill run. This suggests that increased oxidative stress following exercise-induced muscle damage may affect the amount of apoptosis in white cells, and perhaps play a role in immune suppression.

The authors thank Dr. Helaine Alessio for her assistance with the ORAC assay.

Lymphocyte Phenotype Alterations, Pro-Inflammatory Cytokines and Acute Phase Proteins Following Repeated Bouts of Mountainous Hill-Running
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We have previously shown that a single bout of exercise elicits a preferential mobilisation and subsequent extracellular blood lymphocyte subsets expressing high levels of adhesion/activation (AA) molecules and low levels of complement regulatory proteins (Simpson et al. Med. Sci. Sports Exerc. 27, 536, 2005). Repeated bouts of exercise have the potential to accumulatively alter the trafficking of lymphocyte subsets populations in the blood compartment.

**PURPOSE:** To examine the effects of repeated bouts of mountainous hill-running on: blood lymphocyte subset counts; lymphocyte cell surface expression of glycoproteins; and plasma concentrations of TNFα and the pro-inflammatory protein CRP, IL-1α, IL-6, IL-8.

**METHODS:** Seven trained males (Age = 28 ± 4 y., VO2max = 64 ± 3 ml·kg·min⁻¹) completed four bouts of hill-running on four consecutive days. Each bout consisted of 1126m ascent/descent over a distance of 24.5km and took 2 - 2.5h to complete. Blood samples were collected before, immediately after, 1h after completion and 24h after the start of each bout. Isolated lymphocytes were assessed for cell surface expression of subset markers (CD3, CD4, CD8, CD56), AA molecules (CD18, CD53, CD54), complement regulatory proteins (CD55, CD59) and the cell surface death receptor CD95 by flow cytometry.

**RESULTS:** No statistical differences in run time or heart rate were found among the four exercise bouts. For all bouts, total lymphocyte counts and lymphocyte subset counts did not change immediately after exercise. At 1h post-exercise, CD3+, CD4+ and CD8+ lymphocytes and the CD3+%, CD4+ and CD8+ lymphocytes expressing CD10, CD16, CD54, CD55, CD95dim and CD95dim fell below the pre-exercise value after the first two bouts only. Lymphocyte subset counts and phenotypes returned to the pre-exercise values 24h after all bouts. Plasma CRP concentrations were also assessed at each time point. Both low and high CRP groups showed a significant increase in CRP over time, with the highest increase observed in the low CRP group. There was no significant difference in run time or heart rate between the two groups at any time point. Plasma IL-6 increased (P<0.001) 0 h post-race, but no differences were observed between groups. Additionally, serum CRP activity increased (P<0.001) similarly in high and low CRP groups at 0, 24 h post-race.

**CONCLUSION:** While IL-6 induces CRP synthesis, there was no evidence of association to basal or post-exercise CRP. Similar CRK and muscle soreness responses in both groups suggest that muscle damage was comparable in both low and high CRP groups. Despite similar IL-6 and CRP responses, the magnitude of the CRP response was several-fold greater in the high CRP group, suggesting that individuals with high CRP levels have enhanced CRP responses to exercise-induced muscle damage.
concentrations increased 24 h after the first bout and remained elevated throughout the subsequent bouts. No changes in plasma concentrations of TNFα or the other acute phase proteins were found.

CONCLUSION: Four consecutive days of hill-running elicited marked reductions in the number of lymphocyte subset populations expressing high levels of αβ T-cells and low levels of complement regulatory proteins. This effect occurred only after the first two exercise bouts, suggesting that a possible "carry-over" effect on lymphocyte trafficking during the subsequent exercise bouts occurred. Basal lymphocyte counts and phenotype characteristics, however, appeared to be restored in the blood compartment after 24 h of recovery despite sustained elevations in plasma CRP activity.

2279 Board #11 8:30 AM - 9:30 AM Influence Of Carbohydrate Ing кач describes on Salivary IgA, Interleukin-6, And C-Reactive Protein Following Resistance Exercise Lara A. Carlson1, Alexander Koch2, Nathaniel Robinson2, Lindsey Castrillon1, Castleton State College, Castleton, VT. 1Truman State University, Kirkville, MO. (Sponsor: Samuel Headley, FACSM) Email: lara.carlson@castleton.edu

PURPOSE: To investigate the influence of carbohydrate (CHO) supplementation on salivary IgA levels, interleukin 5 (IL-5), and C-Reactive Protein (CRP) following an acute bout of resistance exercise (RE).

METHODS: Nine resistance trained male collegiate athletes (age 21.00 ± 2.16 yr) performed a series of RE for 42.00 min (± 2.46). Four exercises of six sets of each of the following were performed: leg press, lat pull-downs, bench press, and leg curls. All exercises included two warm-up sets of 10 repetitions at 45% and 55% of 1-RM, and four sets of 10 repetitions at 65% of 1-RM. The exercises were performed with a 2:2:2 cadence followed by 1 minute of rest between sets. Following a randomized, counterbalanced order, the subjects consumed one-third a volume of either CHO or placebo (P) beverage to deliver CHO at 1 g per kg of body weight prior to, during, and immediately following the weight lifting session. Blood and saliva were collected at rest, immediately following exercise, and at 90 min postexercise. Blood and saliva were collected in tubes at rest, immediately following exercise, and at 90 min postexercise.

RESULTS: Salivary IgA levels remain fairly stable in response to RE, and CHO ingestion has no influence on post RE immune responses. The project described was supported by the Vermont Genetics Network through NIH Grant Number 1 P20 RR16462 from the BRIN program of the National Center for Research Resources. Donations were donated by the Coca-Cola Company.

2280 Board #12 9:30 AM - 10:30 AM Salivary Immunoglobulin A, Mood, and Upper Respiratory Tract Infections Among Collegiate Women Basketball Players Kathleen K. Carroll, Barbara A. Bushman, FACSM1, Drury University, Springfield, MO. 1Missouri State University, Springfield, MO. Email: kcarroll@drury.edu

Salivary immunoglobulin A (sIgA) is an immune system marker which has been shown to be affected by various types of stress, including athletic performance.

PURPOSE: To determine the effects of stress associated with post-season basketball tournament play on sIgA in women.

METHODS: Ten female collegiate basketball players provided saliva samples pre/post on five different measurement days: practice (P), regular season game (G1), regional game (G2), two national tournament games (T1, T2). Samples were obtained via the passive drool technique within 2 hr pre and 30 min post. Subjects also kept weekly records of symptoms of upper respiratory tract infections (URTI) and obtained via the passive drool technique within 2 hr pre and 30 min post. Subjects included 6 athletes from a women's NCAA Division I basketball team.

RESULTS: There was no significant interaction between measurement days and pre/post measurements (P=0.21). There was a significant main effect for measurement day (p=0.011) and for URTI symptoms (p=0.047). No other differences were noted in sIgA between measurement days. No significant interactions were found between pre-sIgA and post-sIgA and URTI symptoms nor between sIgA and any of the BMS subscales (confusion, depression, fatigue, tension, vigour) except for anger (r=0.39, P=0.0047). Tension (p=0.0000018) and fatigue (p=0.00049) BMS subscales changed significantly across the measurement days. Tension at P and G1 was significantly lower than during G2, T1, T2; tension at G2 was significantly lower than during T1, T2. Fatigue was higher at
2283  Board #15  8:30 AM - 9:30 AM  
Influence of Carbohydrate/Placbo On Immune Functions Following 2-h Cycling With or Without Rest Intervals  
David C. Nieman, FACSM,1 Dru A. Henson,2 J. Mark Davis, FACSM,2 Charles L. Dunke, FACSM,1 Alan C. Unter, FACSM,1 E. Angela Murphy1,2 Steven R. McAnulty1,2 Lisa S. McAnulty1,2 1Appalachian State University, Boone, NC; 2University of South Carolina, Columbia, SC.  
Email: niemandr@appstate.edu  
PURPOSE: The purpose of this project was to study the effect of carbohydrate compared to placebo ingestion on immune changes following 2 hours of intensive cycling with or without rest intervals.  
METHODS: Trained cyclists (N=12) functioned as their own controls during four test sessions that were separated by 2 weeks and randomized to control for an order effect. Subjects cycled for 2.0 h at ~60% Watts_cycling (C) or with 3-min rest intervals (R) interspersed every 10 min (2.6 h total time) while receiving 4 ml/kg 15 min−1 carbohydrate (6%) (Cho) or placebo (Pla) beverages (thus CCho, CPla, RCho, RPla). Blood samples were collected 30 min pre-exercise, and immediately and 1 h post-exercise. Immune and hormonal measures included determination of leukocyte subset counts, plasma IL-6, IL-10, IL-1α, IL-8, cortisol, insulin, and PEA-induced lymphocyte proliferation, and natural killer cell activity (NKCA). Blood leukocyte relative gene expression was measured for four cytokines (IL-6, IL-8, IL-10, IL-1α) using real-time quantitative RT-PCR.  
RESULTS: Exercise-induced immune and hormonal changes did not differ between C and R trials. Cho compared to Pla ingestion attenuated exercise-induced changes in blood neopterin, monocyte, T cell, and NK cell counts, plasma cortisol and insulin, plasma IL-6, IL-10, and IL-1α, and PEA-induced lymphocyte proliferation, but not NKCA (interaction effect, P=0.134). Significant time effects were measured for leukocyte IL-1α (increase), and IL-6 (decrease) mRNA content with no significant differences measured when comparing C or R exercise modes or Cho and Pla test conditions. The patterns of change in leukocyte IL-8 mRNA did not differ between Cho and Pla, but increased during C and decreased during R exercise trials (exercise mode x time interaction effect, P=0.001).  
CONCLUSIONS: Most measured immune and hormonal changes induced by intense and prolonged exercise were attenuated when cyclists ingested Cho compared to Pla beverages, but were largely unaffected when athletes were allowed to rest 3 min every 10 min of exercise.  
Supported with a grant from the Gatorade Sports Science Institute.

E-25  Free Communication/Poster – Cardiac Structure / Function: Disease States  
FRIDAY, JUNE 2, 2006 8:30 AM - 10:30 AM  
ROOM: Hall B  

2284  Board #16  9:30 AM - 10:30 AM  
Plasma Brain Natriuretic Peptide Levels in a Population of Young Athletes: Correlation with Echocardiographic Parameters  
Jurt J. Nilsson1, Michael S. Womack1, Ronald P. Pfeiffer1 1Department of Pediatrics and Urology, Boise, ID.  
Email: mjernazmi@yahoo.com (K.J. Nilsson, Biostat., Inc.)  
Plasma brain natriuretic peptide (BNP) levels have been evaluated in normal adults and children as well as in adult athletes. Several studies have documented elevation of BNP levels in patients with hypertrophic cardiomyopathy, the most common cause of sudden death in athletes < 35 years old, up to 50 times the level of controls. The levels of plasma BNP and their correlation to echocardiographic parameters have not been evaluated in adolescent athletes, a population potentially at risk for sudden death and other cardiovascular abnormalities.  
PURPOSE: To determine normal levels of plasma BNP in adolescent athletes and evaluate its correlation to cardiac parameters determined by echocardiography.  
METHODS: Plasma BNP measurement by rapid fluorescent immunoassay and limited echocardiography were performed on 30 healthy male adolescent high school football players (16.0 ± 0.1 yrs). Left ventricular (LV) mass was then calculated using the Penn-cube formula of Devereux and Reichek and divided by body surface area to determine the ratio of LV mass.  
RESULTS: Plasma BNP for this population was 11.9 ± 10.2 pg/ml. There was no correlation between BNP and ICD (r = -0.15, p = 0.44), LVWT (r = -0.04, p = 0.84), LV mass (r = 0.05, p = 0.79), or LV mass index (r = 0.11, p = 0.55).  
CONCLUSIONS: Plasma BNP levels in adolescent athletes are within the ranges of previously described normal adolescents and have no correlation to LV mass, even when corrected for body surface area.

2285  Board #17  8:30 AM - 9:30 AM  
Tolerance of the Normotensive and Hypertensive Heart to Global Ischemia and Subsequent Reperfusion  
Patricia O. Reger, Steven Kolwicz, Joseph R. Libonati. Temple University, Philadelphia, PA.  
Email: TREGER@COMCAST.NET  
PURPOSE: The purpose of this study was to examine the functional responses to global ischemia and subsequent reperfusion in young spontaneously hypertensive (SHR) and normotensive rats (WKY).  
METHODS: Hearts from female, WKY and SHR (age:8-9 wks; N=6) were isolated and heart performance was measured with a retrogradely perfused, Langendorff, isovolumic preparation (16 ml/min, 5 Hz, 2 mCaCl2). LVEDP set at 10 mmHg, 95% O2, 5% CO2. Hearts were made globally ischemic for 22 minutes and were then reperfused for 10 minutes.  
RESULTS: Absolute IW and IW/BW ratios were similar between groups. During baseline conditions, perfusion pressures and LV developed pressures (LVEDPw) were also similar between groups. There were no differences observed in the tissue dam of the time to onset of contracture or in peak contracture during ischemia (WKY: 16.9 ± 0.74 min, SHR: 15.2 ± 0.63 min, P > 0.05). Perfusion pressures tended to be greater in SHR at ten minutes of reperfusion (WKY: 159 ± 10.4 mmHg, SHR: 191 ± 2.9 mmHg, P = 0.01). Although LV end diastolic pressure (LVEDPw) was comparable between groups at 10 minutes of reperfusion, both absolute and relative LVEDPw were significantly lower in SHR (WKY: 12.1 ± 3.2 mmHg, SHR: 3.5 ± 1.4 mmHg, P < 0.05; WKY: 0.59 ± 0.01, SHR: 0.05 ± 0.01, P < 0.05).  
CONCLUSIONS: These data suggest that hearts of young SHR respond comparably to age matched WKY during ischemia, but demonstrate an impaired tolerance to subsequent reperfusion.  
This study was supported by the Mid-Atlantic AHA JRL.
RESULTS: Only LVPWs was significantly greater in OP compared with the other groups (see Table). In addition, there was a tendency (p≤0.10) for LVPWd to be greater in OP compared with OR.

CONCLUSION: These data suggest that the OP/OR model exhibits only minor changes in cardiac structure after 12 wks of developing obesity. Support by NIH HL04297 and HL64913.

RESEARCH QUERIES: Does obesity affect cardiac structure? How does exercise affect cardiac structure in obesity prone rats?

Poster Session: Echocardiographic Analysis in Obesity-Prone Rats

Echocardiographic Analysis in Obesity-Prone Rats

Joan T. Carroll, FACSM, Woonheed J. Zenebe, University of North Texas Health Science Center, Fort Worth, TX.

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The obesity prone (OP)/obesity resistant (OR) rat has been used to examine renal and oxidative mechanisms involved in development of obesity-hypertension.

PURPOSE: To determine whether the OP/OR rat also exhibited obesity-induced cardiac structural alterations.

METHODS: Male Sprague-Dawley rats (34±4 g) were assigned to normal fat diet (NFD, n=7) and high fat diet (HFD, n=17) groups. After 12 wks, rats on the HFD exhibiting greatest weight gains were referred to as OP (n=6) while rats on the HFD exhibiting lowest weight gains were referred to as OR (n=5). Under isoflurane anesthesia, two-dimensional directed M-mode echocardiographic images were obtained in the parasternal long axis at the level of the mitral valve leafllets using 12 MHz phased array transducer (Phillips HDI 5000). Left ventricular (LV) posterior wall thickness (PWTd), LV diameter (LVIDd), and septal thickness (IVSd) were taken in both systole (s) and diastole (d). HR was calculated from the R-R interval. Short axis views of the aorta were used to obtain ejection time (ET) measured from the opening to the closing of the aortic valve. Groups were compared using one-way ANOVA.

RESULTS: Only LVPWs was significantly greater in OP compared with the other groups (see Table). In addition, there was a tendency (p≤0.10) for LVPWd to be greater in OP compared with OR.

CONCLUSION: These data suggest that the OP/OR model exhibits only minor changes in cardiac structure after 12 wks of developing obesity. Support by NIH HL04297 and HL64913.

POSTER SESSIONS
E-26 Free Communication/Poster – Cardiovascular: Cell / Molecular Biology
FRIDAY, JUNE 2, 2006 8:30 AM - 10:30 AM
ROOM: Hall B

2292 Board #24 9:30 AM - 10:30 AM
The Elevation of Cardiac Hsp70 in Female Rats is Dependent on Estrus Cycle Stage
Kevin J. Milne, David B. Thorp, Carly Stephens, Thomasz Dzialoszynski, Matt Krause, Earl G. Noble. The University of Western Ontario, London, ON, ON, Canada.
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Intense exercise elevates the cardioprotective heat-shock protein, Hsp70, in the hearts of adult male rats but not females. estrogen has been linked to this gender difference. However, circulating estrogen levels vary considerably with estrus cycle stage in adult females.

PURPOSE: To determine whether Hsp70 would be elevated 24h following a bout of intense exercise in female rats at stages in the estrus cycle when estrogen levels were depressed.

METHODS: Female Sprague-Dawley rats, 56 weeks old, were monitored for estrus stage by vaginal smears. Animals were exercised (60 min continuous treadmill running at 30min/2% grade) when they were determined to be in either metaestrus, diestrus, proestrus or estrus stages of their cycle and killed 24h after the exercise bout. Non-exercised animals, matched for stage of estrus cycle, were used as controls. Blood was collected pre-death to determine hormone levels and hearts were analyzed for COX-2 protein (western blot) and activity (as measured by PGE2 and PGF2 alpha content using EIA). Cardiac levels of indacarb nitric oxide synthase protein (iNOS) content were also examined by western blot.

RESULTS: Independent of age, short-term exercise did not alter COX-2 activity or protein content within the cardiac tissue of young or old rats as compared to sedentary counterparts. Further, an up-stream mediator of COX-2 expression, iNOS, was unaltered by age or exercise.

CONCLUSIONS: These findings suggest that short-term exercise and IPC-induced physiologic stressors differ in regard to myocardial COX-2 content and activity.

Supported by HL67289 (SKP), HL074666 (ICQ)

2294 Board #26 9:30 AM - 10:30 AM
Reproducibility and Clinical Significance of Exercise-Induced Increases in Cardiac Troponins and N-terminal Pro Brain Natriuretic Peptide (NT-proBNP) in Endurance Athletes
Jürgen Scharhag1, Axel Urbansen, FACSM2, Markus Herrmann3, Günter Schneider4, Katrin Schumacher5, Michaela Haschke1, Anne Kriegl1, Tim Meyer, FACSM6, Wilfried Kindermann1. 1Institute for Sports and Preventive Medicine, Saarbrücken, Germany; 2Centre de Medecine du Sport, Clinique d’Ech, Luxembourg, Luxembourg; 3Department of Clinical Chemistry, University Clinic of Saarland, Homburg, Germany; 4Department of Radiology, University Clinic of Saarland, Homburg, Germany.
Email: j.scharhag@mx.uni-saarland.de

Purpose: Cardiac troponins I and T (cTnI, cTnT) and brain natriuretic peptide (BNP) are the accepted standards to sutorologically identify myocardial necrosis and elevated wall stress. In addition, they allow risk stratification in cardiovascular patients. However, the clinical significance of increases after strenuous endurance-exercise in obviously healthy athletes is unclear. We therefore examined the reproducibility and clinical significance of exercise-induced increases in cTnT, cTnI and NT-proBNP after two standardized endurance exercise-bouts in healthy endurance-athletes with prior competition-induced elevations of cardiac troponins (cTnI: 0.08-1.93 µg/L; cTnT: 0.01-0.56 µg/L).

METHODS: 20 male athletes (36.7 years; VO2max: 605 ± 45 ml/min/kg) completed a 1h and a 3h exercise-study (1HET; 3HET; exercise-intensities: 100%; 75% of the individual anaerobic threshold) on two different days in randomized order to determine cardiac markers before, 30min and 3h after exercise. In addition to pre- and post-exercise echocardiography including Tissue-Doppler-Imaging (TDI), delayed-enhancement magnetic-resonance-imaging (DE-MRI) was performed after 3HET to detect myocardial necrosis.

RESULTS: A minimal increase in cTnI was documented after both exercise-trials (0.02 to 0.03 µg/L; p>0.01). cTnT remained without significant changes. NT-proBNP increased by 15ng/L and 30ng/L after 1HET and 3HET, respectively (p<0.001). In contrast to cardiac troponins, increases in NT-proBNP after competition correlated with those after 1HET (R=0.88) and 3HET (R=0.82). No pathologies were demonstrated by echocardiography or DE-MRI.

CONCLUSIONS: Due to the missing reproducibility and evidence of myocardial damage, exercise-induced increases in cardiac troponins may represent a physiologic reaction under special conditions and seem to be without pathological significance in healthy athletes. The reproducible increases in NT-proBNP may modulate myocardial hypertrophy in endurance-exercise.
resULts:

levels of HSP20 are elevated in the rat left ventricle by exercise training, but it is not known whether HSP20 levels increase in response to exercise training in other chambers of the heart.

PURPOSE: To determine whether there are chamber-specific differences in HSP20 protein levels at baseline and in response to exercise training.

METHODS: Female Sprague-Dawley rats were assigned to sedentary (n=8) or exercise-trained (n=9) groups. Sedentary rats walked on a treadmill for 5 min/day and exercise-trained rats ran on a treadmill 5 days/week for 7 weeks at high-intensity. Trained rats were run at intervals between 85% and 105% of their VO2 max 3 days/week and at a constant 85% VO2 max intensity the other 2 days. Exercise duration was 20 min to 1 h/day. Rats were killed 24 hours after the last 1-hour bout of exercise and the left ventricle free wall (LV), right ventricle (RV), septum (SEP), left atrium (LA), and right atrium (RA) were dissected and frozen in liquid nitrogen. Levels of HSP20 were measured by immunoblotting using a rabbit polyclonal anti-HSP20 antibody and were detected with enhanced chemiluminescence. Levels of Hsp20 were normalized to those of glyceraldehyde-3-phosphate dehydrogenase (GAPDH).

RESULTS: After training, there was a 12% increase in RV mass, an 11% increase in both LV and LA masses, and a 31% increase in RA mass. The relative levels of HSP20 in control rats were: *UV: 1.00±0.06 (mean ± SE; normalized to GAPDH). *SEP: 1.11±0.08; *RV: 0.76±0.07, *LA: 0.68±0.05, *RA: 0.55±0.05 (*p<0.05 vs. LV and LA; RA: p>0.05 vs. LV and SEp). Levels of HSP20 protein were ~10% greater in ventricles of trained compared with sedentary rats, but were ~20% lower in atria of trained rats (p>0.05).

CONCLUSIONS: Rat heart ventricles exhibit significantly higher levels of HSP20 protein compared with atria. In response to exercise training, HSP20 levels are increased in ventricles, but decreased in atria. The training-induced increases in levels of HSP20 are not related to the magnitude of cardiac hypertrophy.

Supported by the Undergraduate Research Opportunity Program at the University of Michigan and NIH SR01-DK042876.
spironolactone (SP), an aldosterone antagonist, is effective in attenuating cardiac fibrosis, but questions remain regarding the mechanisms of action and the efficacy of aldosterone antagonism in advanced age.

**PURPOSE:** The purpose of the present study was to identify the independent and combined effects of age, aortic constriction, and aldosterone antagonism on the cardiac proteome.

**METHODS:** Female F344 rats served as untreated controls (C) or were subjected to aortic constriction (AC) at 5 (Y) or 23 (O) months of age and treated with SP (30 mg/kg/day) or vehicle (V) for 6 months, yielding the following six groups: Y-C, Y-V, Y-SP, O-C, O-V, O-SP. Left ventricle free walls (LV) were harvested and quick-frozen in liquid nitrogen and were subsequently used to generate 2-dimensional electrophoresis (2-DE) proteome maps. PDQuest software was used to analyze SYPRO Orange-stained 2-DE gels, quantify spot densities, and compare expression levels between groups. Protein spots were identified with mass spectrometry of trypsin digests. Significance Analysis of Microarrays (SAM) was used to evaluate the protein expression levels, and a false discovery rate of < 1% was used as a guideline to identify differentially expressed proteins.

**RESULTS:** Proteins differentially expressed as a function of age included Immt- Er (-25%), dihydroxipanolic acid acetyltransferase (+173%), albumin (+40 to +64%), ATP synthase mitochondrial F0 complex (+39%), isovareryl-CoA dehydrogenase (-15%), acetyl-CoA dehydrogenase (-15%), aconitase (+39%), and pyruvate dehydrogenase (-42%). Aconitase caused decreased activity of lactate dehydrogenase B (<77%) and myoglobin (+3%). Spironolactone induced changes in myosin light polypeptide 1 (-35), albumin (-23 to -35%), isovareryl-CoA dehydrogenase (-34%), malate dehydrogenase (-42%), and creatine kinase (+30%).

**CONCLUSIONS:** Aging and pressure overload are associated with a marked change in the stoichiometry of a wide range of metabolic proteins. Spironolactone treatment had mixed effects, exacerbating the age-associated decrease of some metabolic proteins, but increasing levels of other metabolic proteins.

Supported by NIH R03 AG022625 and the Undergraduate Research Opportunity Program at the University of Michigan

2300 Board #32 9:30 AM - 10:30 AM

**Gender Polymorphism and Left Ventricular Mass in Highly Trained Athletes: The RAS System**

Benrd M. Wolfarth1, Helga Daer2, Susanne Muehlbauer3, Martin Hallé1. 1University Munich, Munich, Germany; 2University Freiburg, Freiburg, Germany.

Regular physical exercise is leading to specific cardiac adaptations. In this context, structural changes including left ventricular hypertrophy are mainly depending on endurance training. Twin studies have shown, that left ventricular mass in the untrained state, as well as the adaptation of heart size to exercise is influenced by genetic factors.

**PURPOSE:** The aim of our study was to investigate the influence of three genetic polymorphisms from the renin-angiotensin system (RAS) on left ventricular mass in highly trained endurance athletes.

**METHODS:** 50 male and female athletes from different endurance sports were recruited on the basis that they had a training history of 5 years or more, a maximum oxygen uptake > 75 ml.kg-1.min-1, and in addition an athletes heart with a left ventricular mass index (LVMi) of >90 g/m2 or more. Cardiac diameters were measured by echocardiography, left ventricular mass (LVM) was calculated using Devereux’s formula. To calculate LVMi the values were corrected by body surface area. Polymerase chain reaction (PCR) was used to analyze three different polymorphisms in the genes encoding the angiotensin-converting-enzyme (ACE), the angiotensin II-type 1-receptor and the angiotensin II-type 2-receptor (AT2).

**RESULTS:** The genotype distributions for ACE and AT1 were both in Hardy-Weinberg equilibrium. No significant association was found between a single variant of the 3 tested polymorphisms and LVM or LVMi (p>0.05). Analyzing different genotype combinations we found a significantly higher LVM (p<0.05) and LVMi (p=0.01) in athletes carrying the combination ACEII-genotype and AT2G allele.

**CONCLUSIONS:** In conclusion we found no evidence for an association between one of the investigated polymorphisms itself and LVM or LVMi in our study group. Nevertheless, we found some evidence for an association between a specific combination of ACE genotype and AT2 genotype with the cardiac adaptation in endurance athletes.

2301 Board #33 8:30 AM - 9:30 AM

**Damage to Erythrocyte Membranes during Extreme Endurance Events**

Ashiri Yuan1, Ralph Beneke, FACSFM1, Renate Leithauser1, Lawrence A. Goldberg, FACSFM, Janice M. Conway-Klaassen2, Michael T. Wilson1. 1University of Essex, Colchester, United Kingdom; 2University of Nevada, Las Vegas, NV.

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The 215 km Badwater Ultramarathon course in California’s Death Valley has been described as “the world’s toughest foot race” with extreme temperatures approaching 50°C even in the shade. We have established previously that prolonged aerobic exercise causes alteration to the erythrocyte membrane proteins and leads to hemolysis. The mechanism underlying these changes was postulated to be linked to membrane protein pexonidation consequent upon the oxidation of hemoglobin. Whether this effect is reversible or permanent and cumulative is unknown.

**PURPOSE:** To investigate whether the damage to the erythrocyte membrane is cumulative during an ultramarathon.

**METHODS:** Five male runners were selectively screened for this one-stage race (n = 5; age: 51.7 ± 11.3 years and weight 74.77 ± 7.97 kg). Blood samples were collected during pre-race (T0), after the first half marathon (T1), and after completing the 1st (T2), 2nd (T3), 3rd (T4) marathon distance and at the finish (Tf). Samples were analyzed for: hemoglobin (Hb values), and membrane protein changes using the SDS-PAGE system.

**RESULTS:** The spectrin bands showed significant reduction following T0, T1, T2, and Tf when compared with T0 (p < 0.001) with maximum reduction after Tf (Tf: 14.44 ± 2.62 %; T2: 24.41 ± 5.26 %; T1: 18.34 ± 5.55 %; Tf: 15.69 ± 5.83 %). The reduction in the spectrin bands became less profound as the race proceeded. At Tf the bands were not significantly different from those seen at T0 (p > 0.05). The Hb values were shifted to the right suggesting an increase in susceptibility to hemolysis with p < 0.01 when T2 was compared with T0, T1, and Tf (T0: 96.86 ± 2.63 mosm; T1: 104.80 ± 3.15 mosm; Tf: 108.81 ± 2.50 mosm; T0: 107.39 ± 3.11 mosm). The Hb values determined at Tf and T2 did not, however, show significant changes from values found at T0.

**CONCLUSION:** Our results clearly show that membrane damage to the erythrocyte occurred during the ultramarathon. However, this alteration is not cumulative. The damage peaked at T2 and thereafter decreased. Both the spectrin bands and the Hb values recovered after Tf. These observations have led us to conclude that newer blood cells have entered the circulation. Our results are consistent with the hypothesis that older erythrocytes are more prone to metabolic damage during extreme exercise and are prematurely removed from circulation during the race.

2302 Board #34 9:30 AM - 10:30 AM

**Inflammatory Markers and Adhesion Molecules Correlate with BMI and Aerobic Fitness Levels in Irish Adolescents**


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**PURPOSE:** Atherosclerosis is an inflammatory disease that begins in childhood. Upregulation of inflammatory markers (IL-6, TNF-α, CRP) and adhesion molecules (sICAM-1 and sVCAM-1) have been identified as early events in the development of atherosclerosis. This study assessed the relationship between BMI, aerobic fitness and sICAM-1, sVCAM-1, IL-6, TNF-α, CRP and insulin resistance IR in Irish adolescents.

**METHODS:** Fourteen (5 normal weight (NW), overweight (OW) and obese (OB)) adolescents (age 16.2 ± 0.70 y) were selected from a database of 3000 adolescent boys and girls who took part in a study to assess the physical activity patterns and the health and fitness status in 15-17yr old boys and girls. Aerobic fitness level was estimated using a multi-stage fitness test. Insulin resistance (IR) was quantified using the HOMA formula.

**RESULTS:** OB had higher serum levels of sICAM-1 (290.57 ± 37.98 vs 257.03 ± 27.23 ng/ml, p<0.05), IL-6 (3.86 ± 2.19 vs 1.77 ± 0.77 pg/ml, p<0.05) and CRP (3.48 ± 2.96 vs 0.478 ± 0.40 pg/ml, p<0.05). Insulin levels were lower in OB than NW (25.43 ± 4.76 vs 39.89 ± 6.54 µg/ml, p<0.005). The VO2max values were lower in OB than NW (25.43 ± 4.76 vs 39.89 ± 6.54 µg/ml, p<0.005). VO2max was inversely correlated with BMI (r = -0.696, p< 0.001), IL-6 (r = -0.416, p = 0.008), CRP (r = -0.527, p< 0.001) and IR (r = -0.526, p< 0.001). There was a correlation between BMI and CRP (r = 0.789, p = 0.001), IL-6 (r = 0.510, p< 0.001) sICAM-1 (r = 0.450, p = 0.002) and IR (r = 0.536, p< 0.001). BMI or There was no relationship between sVCAM-1, TNF and BMI and VO2max.

**CONCLUSION:** The elevated levels of IL-6, CRP and sICAM-1 in unfit and obese adolescents may increase the risk of atherosclerosis.
they take up the calcium causing the permeability transition pore (PTP) to open and decreasing ATP production. Thus, there are at least two possible adaptations within mitochondria that could protect them during I-R. They could decrease ROS production or increase their ability to tolerate high calcium levels.

**PURPOSE:** To test the hypotheses that isolated mitochondria from hearts of endurance trained rats have increased tolerance to calcium and decreased ROS production.

**METHODS:** Male F344 rats were assigned to either a sedentary (S, n=8) or endurance trained (ET, n=11) group. Rats ran on a treadmill for 10 weeks (5-days/week, 60 min/day, 25m/min, and 6° grade). Heart mitochondria were isolated 24 hrs after the last exercise bout. Oxidative phosphorylation (OXPHOS), electron transport chain, and superoxide dismutase (SOD) were measured.

**RESULTS:** Heart mitochondria displayed similar losses of OXPHOS as indicated similar decreases in State 3 respiration and ADP/O ratio regardless of substrate and similar increases in PTP opening. State 3 respiration was unaffected by 50 μM CaCl2. H2O2 production by ET was lower than SED in the absence of calcium (323±12 vs 362±11 pmol H2O2/min/ mg protein, P=0.05) and in the presence of 50 μM CaCl2 (154±3 vs 197±7, P=0.05). Addition of rotenone, which blocks reverse flow of electrons to complex I in the electron transport chain, greatly reduced H2O2 production and eliminated differences between ET and SED. SOD and GPx were not affected by exercise, but CAT activity increased by 49% (P<0.05). However, CAT was very low compared to SOD or GPx.

**CONCLUSIONS:** Exercise training reduces ROS production in myocardial mitochondria through adaptations specific to complex 1, but does not improve mitochondrial tolerance to calcium overload.

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**E-27**

**Free Communication/Poster – Clinical Exercise Physiology I**

**FRIDAY, JUNE 2, 2006 8:30 AM - 10:30 AM**

**ROOM: Hall B**

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**2305**

**Board #57**

**8:30 AM - 9:30 AM**

**Time Course of Cardiac Function and Oxidative Stress Induced by an Acute Bout of Exercise**

Chia-Ying Lien, Karen Y. Wonders, David S. Hydock, Carole M. Schneider, FACSM, Reichard. *University of Northern Colorado, Rocky Mountain Rehabilitation Institute, Greeley, CO.*

**Sponsor:** Carole M. Schneider, FACSM

Email: chy282001@yahoo.com

Research indicates that a single, strenuous bout of exercise in previously sedentary individuals results in the production of free radicals and impaired calcium handling that persists for up to three days following the exercise bout. These alterations may negatively impact cardiac function, by compromising both systolic and diastolic function.

**PURPOSE:** The purpose of this study was to examine the effects of an acute bout of exercise on cardiac function immediately, 24-hours, 48-hours, and 72-hours following the exercise bout. A secondary purpose was to delineate possible mechanisms to explain these alterations in cardiac function.

**METHODS:** Forty male Sprague-Dawley rats completed an acute bout of exercise on a motorized treadmill at a speed of 25 m/min and a 5% grade for 60 minutes. Upon completion of the exercise bout, rats were randomized into four groups and were sacrificed immediately (IMM), 24-hours (24h), 48-hours (48h), and 72-hours (72h) after the acute bout. A fifth group consisted of rats who did not perform the exercise bout, which served as controls (CON, n=10). At the scheduled time of sacrifice, hearts were isolated and perfused by the Langendorf method for determination of LV function.

**RESULTS:** LV function was negatively impacted following the exercise bout. LVDP decreased during the first 48 hours. Forty-eight hours after the exercise bout, LVDP decreased from control levels by 41%, dP/dt+ increased by 60%, and LVFS experienced a 39% decrease (p<0.05). At 72 hours post exercise, cardiac function had returned to within control levels. Lipid peroxidation demonstrated a similar trend. MDA progressively increased from 386±27 pmol/mg protein prior to exercise, up to 530±43 pmol/mg protein 24 hours post-exercise. As was the case with cardiac function, baseline levels of MDA returned to control levels by 72 hours post-exercise.

**CONCLUSION:** These data indicate that a single, strenuous bout of exercise performed by previously sedentary rats may impair cardiac function for up to 48 hours following the bout. This decrement to cardiac function is associated with increases in lipid peroxidation.

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**2306**

**Board #38**

**9:30 AM - 10:30 AM**

**Training Differentially Affects Infarct Scar and Viable Myocardium Extracellular Matrix Properties**

D Paul Thomas, FACSM, Chris M. Yengo, Scott D. Zimmerman, Richard J. McCormick. *University of Wyoming, Laramie, WY.*

**Email:** cymn@uwyo.edu

**PURPOSE:** This study evaluated the effects of exercise training on connective tissue properties (percent collagen (%COL), and concentration of the non-reducible collagen crosslink, hydroxylysylpyridinoline (HLP)) regionally in the heart post-infarction (MI).

**METHODS:** Infarcts (mean ± 2% of left ventricle (LV)) were surgically induced in young adult male rats that were randomly assigned to either trained (MI-TR; treadmill exercise up to 22 min, 6 days/week for 10 wk) or sedentary (MI-SED) groups, and compared to sham-surgery sedentary controls (SHAM).

**RESULTS:** Septum (LSV), viable free-wall (LVF), right ventricle (RV) and scar all responded differently to MI, changes which in the case of LVF, RV and scar were most pronounced in LVF. MI caused a significant attenuation by training (26 ± 1 vs. 21 ± 2%, P<0.05), while the increase in [HLP] was unaffected (1.01 ± 0.22 vs. 0.84 ± 0.14 mol HLP/mg collagen). In LVF, while training had no effect on the dramatic increase in %COL seen with MI (MI-SED 7.17 ± 0.18%, MI-TR 7.61 ± 0.22%, SHAM 5.6 ± .24%, P<0.001), it normalized the increase in [HLP] (MI-SED 13 ± 0.03 vs. MI-TR 27 ± 0.02, SHAM 52.0 ± 5.05 mol HLP/mg collagen). In LVF, %COL showed a smaller but significant increase (P<0.05) in both MI groups compared to SHAM, while [HLP] was unaffected. In RV, while %COL was unaffected by MI, [HLP] increased dramatically (SHAM 0.41 ± 0.4 mol HLP/mg collagen, MI-SED 1.08 ± 1.1 (P<0.001), an increase which was completely prevented by training (MI-TR 0.25 ± 0.02 mol HLP/mg collagen).

**CONCLUSIONS:** Because reduced HP crosslinking is associated with increased chamber distensibility, the findings in LVF may explain the improved heart function seen following exercise in post-MI patients. However this does not seem to occur in the infarct scar itself which could have potentially deleterious effects leading to aneurism.

Supported by AHA grants 920622AS and 9306226S to DPT and RJM
resulting in weakened muscles of the involved joints, immobility, and weight gain.

Objective: The purpose of this study was to determine whether overweight individuals with knee OA who completed a 24-week home-based walking and strength training exercise program would significantly increase walking distance, walking speed and quadriceps strength, and decrease body fatness and body weight.

METHODS: Fifty-six sedentary subjects (50 men 6 women), mean age of 68 ± 8 years, with a diagnosis of knee OA by radiographic changes of Kellgren-Lawrence grade 2-4, and Body Mass Index (BMI) greater than 27 (34 ± 6) participated in a balanced, home-based Polestriding/walking program combined with isometric/isotonic strength training. BMI, body composition using a dual-chamber plethysmograph, isometric leg strength using a cable tensiometer (index leg), 6-minute walk speed (m/sec) and distance (m), and perceived physical function via the Western Ontario and McMaster University (WOMAC) were measured at baseline and 24 weeks.

RESULTS: Subjects increased walking speed (1.23 ± 0.29 vs. 1.39 ± 0.33 m/s, p<0.005), distance covered in 6 minutes (444 ± 107 vs. 590 ± 119 m, p<0.005) and leg strength (90.8 ± 32.5 vs. 106.4 ± 30.0 lbs, p<0.005). Modest changes were observed in body composition; body fat percent was reduced (39% ± 8 vs. 37% ± 8, p=0.05), pounds were lost (227 ± 43 vs. 22 2 ± 42 lbs, p<0.001), and BMI decreased (34.6 ± 3 ± 33 vs. 4 kg/m², p<0.009). Significant improvements occurred in all domains of the WOMAC score (p<0.001).

CONCLUSIONS: Combined walking and resistance training exercise increases walking speed, walking distance, quadriceps strength, and perceived physical function and reduces body fatness and weight in the overweight elderly with knee OA. Supported by Department of Veterans Affairs Merit Review Grant #E2823-R

2308 Board #40 9:30 AM - 10:30 AM Effects of Body Weight Squats on Balance and Upright Mobility in Participants with Incomplete SCI

Daniel Estape, Patrick L. Jacobs, FACSIM, Richard Lopez. Florida International University, Miami, FL. (Sponsor: Patrick Jacobs, FACSIM)

Email: jlopezgr@fiu.edu

BACKGROUND: Few exercise interventions have been designed to improve the lower body strength of individuals with incomplete spinal cord injury (SCI). Such improvements could improve balance and upright mobility.

OBJECTIVE: To determine the effects of a 6-week resistance training program using body weight squats (BWS) on measures of balance and upright mobility in participants with SCI.

Design and Setting: A test-retest design with one within subjects’ factor was utilized. Testing and training occurred in an exercise facility used by participants with SCI.

Participants: Three males and one female with incomplete SCI participated in the study. Two of the males and the female were classified as ASIA functional category C and the other male was classified as functional category D.

Intervention: Participants trained 3d/wk for 6 weeks using 3 sets of 10 reps of BWS.

Outcome Measures: The three outcome measures included a modified Timed Up and Go Test (mTUG), the Berg Balance Scale, and the Sit to Stand Test.

RESULTS: All participants completed the training, attending a minimum of twice per week, without injury or complaint of pain. Each participant demonstrated marked improvements across the three outcome measures. The large inter-participant heterogeneity in functional ability necessitated that the investigators compare the pre- intervention scores to the post- intervention scores for each of the participants individually. Participant 1, who was unable to take a single step in the mTUG test, was able to take several steps with the use of a walker on the poster. His score on the Berg Balance test improved from 7 to 19 and on the Sit to Stand test he was able to rise from his chair at a much lower starting angle and with much less dependence on the use of his arms. Participant 2 improved his time on the mTUG test by 31 seconds (25% improvement). His score on the Berg Balance test improved from 11 to 14. Participant 3 improved her time on the mTUG test by 12 seconds (14% improvement). On the Berg Balance test her score improved from 12 to 21 on the poster. On the Sit to Stand test she was able to rise out of her chair relying much less (18% improvement) on the use of her arms. Participant 4 improved his time on the mTUG test by 18 seconds (20% improvement). His score on the Berg Balance test improved from 25 to 43. On the Sit to Stand test he improved from initially having to rise from the chair using his arms to rising from his chair with the assistance of another individual without any arm assistance.

CONCLUSION: Resistance training using BWS can improve lower body strength in individuals with incomplete SCI which in turn can improve their balance and upright mobility.

2309 Board #41 8:30 AM - 9:30 AM Preoperative Measures of Strength, Pain, and Function as Predictors of Functional Outcomes in TKA Patients Post-Surgery

Tiev Miller1, Crystal Simpson2, Karen Frost1, Robert Toppi1, Ann Swank1, FACSIM1, Peter Quesada1, Debra Boardley1. 1University of Louisville, Louisville, KY; 2University of Toledo, Toledo, OH.

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BACKGROUND: Total knee arthroplasty (TKA) involves replacement of a diseased knee joint with a prosthetic device and commonly involves prolonged postoperative rehabilitation. Deficits in strength and physical function commonly persist following the model of prehabilitation predicts that changes in postoperative physical function is related to the patient’s preoperative perceived functioning, strength and pain. Thus, this model hypothesizes that greater perceived functioning and strength and less pain prior to TKA will result in greater physical functioning following TKA.

PURPOSE: The purpose of this study is to determine if preoperative perceived functioning, strength and pain predicts post-operative physical functioning in TKA patients.

METHODS: 24 subjects completed perceived functioning, strength and pain assessments 1 week prior to their TKA. Strength measures were obtained using a Biodyne Isokinetic Dynamometer and expressed as peak torque/body weight (PT/BW) for knee flexion/extension. Pain was measured using subscales of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The WOMAC was also employed to measure perceived functioning. Two measures of physical functioning were assessed among the participants 4 weeks following their TKA. These assessments included the distance covered in a 6 min. walk and the number of sit to stand repetitions from a chair in 30 sec. Measures of perceived functioning, strength, and pain 1 week prior to surgery were correlated (p<0.001) with physical functioning 4 weeks postoperatively. These variables were then entered into stepwise linear regressions in order to identify significant predictors of the two measures of physical functioning.

RESULTS: Distance covered in 6 minutes was predicted by greater PT/BW during extension of the operated knee and higher perceived function, accounting for 40.7% of the total variance in six minute walking distance (p<.001). Number of chair raises performed in 30 seconds was predicted by greater PT/BW during flexion of the involved knee and pain, accounting for 39% of the total variance for chair raises in 30 sec. (p<.001).

CONCLUSIONS: Physical functioning after TKA can be predicted from preoperative measures of knee strength, pain and perceived function. Walking distance and gait speed were predicted by strength and perceived function; and the number of chair raises was predicted by pain and strength. These findings support the model of prehabilitation indicating higher perceived functioning, strength and lower preoperative pain predictively predicts greater physical functioning postoperatively among TKA patients.

2310 Board #42 9:30 AM - 10:30 AM Cigarette Smoking Exacerbates Exercise-Induced Oxidative Stress in Young Healthy Men and Women

Andrea K. Creasy, Webb A. Smith, Robert A. McMahan, Richard J. Bloomer. University of Memphis, Memphis, TN. (Sponsor: Larry Weiss, FACSIM)

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Both cigarette smoking and strenuous physical work are associated with increased oxidative stress. To date, no investigation has determined if exercise-induced oxidative stress is greater in subjects who are regular cigarette smokers.

PURPOSE: To compare oxidative stress biomarkers before and following strenuous acute exercise in smokers and nonsmokers.

METHODS: 22 healthy male and female smokers (n=9, age: 27±7, BMI: 26.0±4.4 kg/m², VO₂ max: 30.2±3.8 ml·kg·min⁻¹; smoking rate: 16±12 cigs/day; mean±SD) and nonsmokers (n=14, age: 25±2, BMI: 25.1±3.7 kg/m², VO₂ max: 31.8±1.5 ml·kg·min⁻¹) performed a graded exercise test (GXT) to exhaustion (Bruce treadmill protocol) while expired gases were continuously monitored for determination of VO₂ max, Heart rate, perceived exertion, and blood lactate were measured before and following the GXT. Plasma protein carboxyls (PC) and malondialdehyde (MDA) were measured as biomarkers of oxidative stress.

RESULTS: No statistical differences were noted between smokers and nonsmokers for total exercise time (596±54 vs. 614±99 sec), max heart rate (192±5 vs. 196±2 bpm), max perceived exertion (17.5±0.56 vs. 18.6±0.38), or post exercise blood lactate (7.3±0.7 vs. 7.7±0.9 mmol·L⁻¹), respectively. A time main effect was noted for PC (P<0.003), with values increasing 62% from pre to post exercise for smokers (from 0.608 to 0.110 nmol·mg protein⁻¹) and 42% for nonsmokers (from 0.053 to 0.075 nmol·mg protein⁻¹). An interaction was noted for MDA (P=0.02), where values increased 26% from pre to post exercise for smokers (from 0.675 to 0.851 mmol·L⁻¹) and were relatively unchanged for nonsmokers (from 0.833 to 0.809 mmol·L⁻¹).

Additionally, the correlation between MDA values and the average number of cigarettes smoked per day approached statistical significance (P=0.068, or r=0.466).

CONCLUSIONS: These findings indicate that young, otherwise healthy cigarette smokers experience an exaggerated oxidative stress response to strenuous physical work as compared to nonsmokers of similar age. These findings may have clinical implications related to the development of disease associated with chronic cigarette smoking. Future investigations should focus on older, more established smokers. Supported by a Faculty Research Grant, The University of Memphis
MetHoDs: exercise can affect physical and emotional well-being, it may improve overall QOL and may furthermore promote enhanced physical and emotional well-being. If aerobic Exercise has been shown to be an effective tool in reducing cancer related side effects, Breast cancer survivors often experience physical and psychological side effects.

Supported by NIH grant HL66262 and equipment grants from Life Fitness.

Results:

Adult women (n = 50, age 35-65 yrs, BMI 31.7±5.2 kg/m²) from the DREW study were randomized to either control or one of three exercise groups for 6-months. The three exercise groups consisted of low (4 kcal/kg/wk), moderate (8 KKW), or high (12 KKW) doses of moderate intensity (heart rate at 50% of V̇Ȯ2max) aerobic exercise. Participants with diabetes at baseline were excluded and none of the women developed diabetes during the intervention period. Prevalence of pre-diabetes (100% FG ≤126 mg/dL) was calculated for each group at baseline and follow-up.

After adjusting for age, baseline FG, and BMI change at follow-up, there was a significant decrease in FG (±SE) in the 8 KKW and 12 KKW groups (Figure). Adjusting for cardiorespiratory fitness did not change the statistical significance. For Fasting Glucose across exercise groups was not significant. At follow-up, the prevalence of pre-diabetes decreased in each exercise group with statistically significant decreases in the 8 KKW and 12 KKW groups. Change in pre-diabetes prevalence was +1.2% in control; -5.2% in 4 KKW; -10.8% in 8 KKW; and 14.7% in 12 KKW.

CONCLUSION: Accumulating 8 KKW and 12 KKW of moderate intensity physical activity significantly reduces FG in initially sedentary postmenopausal women.

Supported by NIH grant HL60626 and equipment grants from Life Fitness.

MetHoDs: Effect of Exercise Training and Dietary Restriction on Whole Blood Fluidity in Obese Middle-aged Women

Twenty-two survivors of breast cancer (43-79 years of age, at least one 10 years) were randomized to either a control or one of three exercise groups for 6-months. The three exercise groups consisted of low (4 kcal/kg/wk), moderate (8 KKW), or high (12 KKW) doses of moderate intensity (heart rate at 50% of V̇Ȯ2max) aerobic exercise. Participants with diabetes at baseline were excluded and none of the women developed diabetes during the intervention period.

Prevalence of pre-diabetes (100% FG ≤126 mg/dL) was calculated for each group at baseline and follow-up.

After adjusting for age, baseline FG, and BMI change at follow-up, there was a significant decrease in FG (±SE) in the 8 KKW and 12 KKW groups (Figure). Adjusting for cardiorespiratory fitness did not change the statistical significance. For Fasting Glucose across exercise groups was not significant. At follow-up, the prevalence of pre-diabetes decreased in each exercise group with statistically significant decreases in the 8 KKW and 12 KKW groups. Change in pre-diabetes prevalence was +1.2% in control; -5.2% in 4 KKW; -10.8% in 8 KKW; and 14.7% in 12 KKW.

CONCLUSION: Accumulating 8 KKW and 12 KKW of moderate intensity physical activity significantly reduces FG in initially sedentary postmenopausal women.

CoNCLUsIoN: These results indicate that dietary restriction may alter whole blood fluidity in obese middle-aged women.

MetHoDs: Physiological and Clinical Responses of Systematic Aquatic Physical Activity Sessions in Stroke Patients

Jorge E. Franchella, FACSM1, Marcela Inés Abascal2, National University of San Martín, Buenos Aires, Argentina. Email: jfranchella@masvida.com

Purpose: Stroke represents a leading cause of morbidity and mortality especially among elderly people, and therefore the need for effective preventive strategies is imperative. It had been reported a protective effect of physical activity on stroke patients. This study was conducted to examine the physiological and clinical responses during a systematic aquatic physical activity sessions in stroke patients. Symptoms like fainting had occurred during activities and could be related to hypothermia after one hour activity, or blood pressure regulation disturbances.

Methods: We conducted a study in a swimming pool with a constant temperature of 33°C. This activity is part of the Therapy Aquatic Activity Program developed at National Rehabilitation Center, 5 male and 12 women Ages 53 to 73 years old. Average: 62.59±7 with 2 to 10 years stroke evolution, developed a physical activity session during 1 hour twice a week. Before, during and after the sessions we measured Cardiac Frequency (CF), Blood pressure, and body temperature.

Results: Cardiac frequency increased more than 35% from initial levels, excepting three patients who reached 50%. Systolic Blood pressure, diastolic Blood pressure, and heart rate significantly increased (P<0.05).

CoNCLUsIoN: These observations strengthen the evidence that physical activity
should be part of a secondary prevention strategy in stroke patients. Aquatic sessions are a proper way to introduce the patients healthy physical activity lifestyle habits, and are safe enough to be settled as the starting point.

### 2316 Board #48 9:30 AM - 10:30 AM

**Aerobic Exercise Decreases Depression and Anxiety in Breast Cancer Survivors**

Katherine Kemble, Tim R. Burnham, University of Washington, Seattle, WA. Central Washington University, Ellensburg, WA. (Sponsor: Scott O. Roberts, FACSM)

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Breast cancer has a profound impact on women's health. There are many psychosocial effects including depression, anxiety, anger, and confusion. Depression and anxiety are common symptoms of survivors living with cancer and can adversely affect wellbeing and rehabilitation.

**PURPOSE:** The purpose of this study was to test the effect of low to moderate intensity aerobic exercise on depression and anxiety in women who have completed treatment for breast cancer.

**METHODS:** Twenty-two survivors of breast cancer (43-79 years of age, at least one month post-treatment) were randomly assigned to either an exercise group (n=12) or a control group (n=10). The exercise group participated in 30-50% heart rate reserve aerobic exercise program three times a week for ten weeks. The control group did not participate in the exercise program. The Linear Analogue Self-Assessment (LASA) Scale was administered to subjects prior to the onset and at the conclusion of the ten weeks of exercise. This scale provides a measure of emotional distress and specifically includes measures of anxiety, confusion, depression, energy, and anger.

**RESULTS:** Statistical analysis revealed a significant improvement depression (p = .005), anxiety (p = .03), confusion (p = .04), and anger (p = .02) in the exercise group compared to the control group (p = .001). There was no statistical difference between the groups on the measure of energy (p = .19). More specifically, depression decreased in the exercise group (23.0 ± 5.4 to 2.5 ± 1.1) and increased in the control group (7.6 ± 2.5 to 13.2 ± 6.1). Anxiety decreased in the exercise group (31.5 ± 7.5 to 4.25 ± 1.6) and stayed the same in the control group (15.9 ± 6.8). Confusion decreased in the exercise group (21.0 ± 5.1 to 6.3 ± 4.0) and increased in the control group (6.7 ± 2.0 to 10.7 ± 6.2). Anger decreased in the exercise group (14.3 ± 6.2 to 4.0 ± 2.5) and increased in the control group (4.6 ± 1.4 to 13.9 ± 7.3).

**CONCLUSIONS:** This aerobic exercise program was effective in reducing depression, anxiety, confusion, and anger in this group of breast cancer survivors. Guidelines for an exercise intervention are already in place for chronic diseases such as diabetes and cardiovascular disease but no guidelines are in place for cancer survivors. Low to moderate intensity exercise is a safe, beneficial, efficient, and cost-effective tool for improving depression and anxiety in breast cancer survivors.

### 2317 Board #49 8:30 AM - 9:30 AM

**Response to Exercise and Cognitive Behavioral Intervention in Overweight Breast Cancer Survivors**

Kari Mefford, Cheryl Rock, Bilge Pakiz, Jeanne Nichols, FACSM. 1San Diego State University, San Diego, CA. 2University of California, San Diego, San Diego, CA.

Overweight or obesity is an established negative prognostic factor in breast cancer. Co-morbidities associated with obesity, including CVD and type 2 diabetes, may negatively impact quality of life and survival in this population.

**PURPOSE:** To describe the effect of an exercise and cognitive behavioral therapy (CBT) intervention on risk factors for recurrence of breast cancer, and risks for other chronic diseases associated with obesity.

**METHODS:** Overweight or obese women (N=85, mean BMI=31.1 ± 4.5 kg/m²) were randomly assigned to a once weekly, 16 wk intervention or wait-list control group. The intervention incorporated elements of CBT for obesity, addressing body image and self-acceptance, as well as moderate to vigorous structured exercise (1 d/wk) and home exercise at least 2 d/wk. Body weight, total and regional body fat (by DXA), waist and hip circumference, and blood lipids were assessed at baseline and following 16 weeks of intervention.

**RESULTS:** Sixty-nine women completed the intervention. Univariate analysis showed significant differences in weight change (5.8 ± 3.4 vs. -0.32 ± 4.2 kg, p = 0.001), change in BMI (2.1 ± 1.3 vs. 0.11 ± 1.5 kg²/m², p = 0.001) and percent change in percent fat (-4.5 ± 3.7 vs. -0.9 ± 2.3%, p = 0.001), percent trunk fat (-2.9 ± 2.3 vs. 0.60 ± 2.1%, p = 0.001), percent leg fat (-2.1 ± 1.4 vs. 0.1 ± 1.3%, p = 0.001), waist circumference (2.8 ± 2.5 vs. -0.96 ± 3.0 in, p = 0.001), and hip circumference (-2.2 ± 1.5 vs. -0.66 ± 2.9 in, p = 0.017) between intervention and control groups. Changes in total serum cholesterol (-0.0 ± 24.9 vs. 8.0 ± 30.2 mg/dl, p = 0.015) and triglyceride (-14.2 ± 54.4 vs. 15.8 ± 59.3 mg/dl, p = 0.04) also were significantly different between groups at 16 weeks.

**CONCLUSION:** Risk factors related to breast cancer recurrence, as well as the risk factors for CVD and type 2 diabetes, were favorably altered following 16 weeks of CBT and moderate to vigorous physical activity in overweight breast cancer survivors.

### 2318 Board #50 9:30 AM - 10:30 AM

**Impacted Type 2 Diabetes Patient Outcomes and Projected Cost Savings Following Supervised Exercise Training**

René J. Murphy, Ian Feltheim, Shelley MacDougall, Bev Harris, Susan Miles, Jonathon R. Fowles. 1Acadia University, Wolfville, NS, Canada. 2Valley Regional Hospital, Kentville, NS, Canada. (Sponsor: Francois Traude, FACSM)

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Physical activity has long been a primary intervention to manage type 2 diabetes.

**PURPOSE:** Because type 2 diabetes outpatients do not always follow the recommendation by health care professionals to exercise, this project followed 8 outpatients referred to the Diabetes Education Centre (DEC) by their primary care physician who agreed to participate in a kinesthesiologist-directed exercise training program offered at the Hospital for 11 months.

**METHODS:** 2 males and 6 females (60.9 ± 10.4 years; 93.7 ± 25.9 kg; 162.3 ± 10.1 cm; means ± SD) completed testing before, after 3 months and after 11 months of training. They exercised in a supervised setting (combination of up to 25 minutes of aerobic, up to 25 minutes of resistance and 10 minutes of flexibility exercises) twice a week for ~11 months.

**RESULTS:** Compared to baseline measures, early (i.e. 3 months) significant findings included improvements in aerobic capacity assessed using a submaximal step test (11.6%, grip strength (14%), push-ups participation (23%), as well as functional capacity assessed using the sit-to-stand tests (56, 15 and 14%). Long term effects (i.e. 11 months) also included significant decreases in systolic blood pressure from 131 ± 122 mmHg and decreases in sum of 2 and sum of 5 skinfolds by 16 and 12% respectively. There were no significant changes in blood work including lipid profile however hemoglobin A1C exhibited a clinically relevant decrease from 7.1% to 6.1% after 11 months of intervention in this group. Collectively, these improvements in patient outcomes have been associated with improvements in quality of life and cost savings. Based on the observed changes in hemoglobin A1C and blood pressure alone and using the data of Palmer et al. (Current Medical Research and Opinion, 2004; 20, 533-558), we can conservatively project a lifetime cost savings of ~$11000 US per patient. The cost of providing the kinesthesiologist-directed exercise training will offset part of these savings; however, indirect costs of physical inactivity would also be reduced by a program of this type. Future research should identify the long-term adherence parameters required to maintain the observed patient outcomes and further delineate the cost-savings analysis.

**CONCLUSIONS:** The results of this project suggest the addition of a kinesthesiologist to the multidisciplinary health care team in a DEC will have significant long term health benefits for type 2 diabetes outpatients and can contribute to reducing health care costs in this population.

Supported by the Nova Scotia Health Research Foundation, Eastern Kings Memorial Health Foundation and Thera-Band.

### 2319 Board #51 8:30 AM - 9:30 AM

**Can Assistive Device Influence Walking in Mobility Impaired Elderly?**

Sandrine Tissier, Mary Wolfe, Elizabeth J. Protas, FACSM. 1Univ. of Texas Medical Branch, Galveston, TX. 2Innovative Health Solutions, League City, TX.

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falls are the most common cause of injury in the elderly. Assistive devices are often used by patients at risk for falls, but the ability of these devices to prevent falls is questionable. A new assistive device, the Walkabout (WA), was designed to prevent falls.

**PURPOSE:** To compare walking characteristics of elders with mobility impairments while using the usual assistive device or the new device, and to determine if walking impairment influenced walking with a walker.

**METHODS:** 19 subjects, 80.1 years old (± 8.5), usual gait speed (S) = 0.85 m.s⁻¹ and/or distance walked (D) in 5 minutes <305 m. The average usual gait speed of these subjects was 0.76 (+/- .2) m/s and endurance was 190 (+/- 78) m in 5 minutes. Gait parameters (fastest gait speed, step length, cadence) and walking ability (5-minute walk test and oxygen consumption) were tested under two conditions: usual walking or the WA.

**RESULTS:** The use of the WA did not impair the gait parameters and walking ability, such as S (1.1 vs 1.2 m/s), step length (54 cm), D (190 vs 203 m) Cadence was significantly faster (118 vs 120 steps) with the WA, but the energy cost of walking compared to usual condition of walking was similar (0.2 ml.kg.m⁻¹). Subjects who were both slow walkers and had limited endurance, significantly improved G by 10% with the WA. Improvement in S (p = 0.01) and D was more pronounced (p = 0.03) with WA when endurance was <200m.

**CONCLUSIONS:** Among mobility impaired elders improvements in gait speed and distance walked in 5 minutes may depend on the amount of velocity or endurance impairment. These results address the importance of assessing the impairment of the potential user for optimal walker prescription.

This project was supported by Small Business Technology Transfer Research, NIH, (1R41 AG02247-01A1)

#1362-1849-WEDNESDAY, MAY 31 | #1350-2288-THURSDAY, JUNE 1 | #2269-2726-FRIDAY, JUNE 2 | #2727-2915-SATURDAY, JUNE 3
CoNCLUsIoN: hematologic parameters measured. Furthermore the aspirin dosage administered in this samples were drawn at the completion of baseline and at 60 and 120-minutes of 120-minutes, or until core temperature (Tre) was ≤ 35°C. Antecubital venous blood were moved into an environmental chamber where they remained seated and still for (ASA-L: 81 mg effect. It impairs thrombin generation and decreases platelet aggregation cell count, plasma cholesterol). Aspirin ingestion, on the other hand, has the opposite acute cold exposure changes occur in many factors that cause the acceleration of the the potential to alter hemostatic parameters that have been linked with what has been 2321

E-28 Free Communication/Poster – Cold Stress FRIDAY, JUNE 2, 2006 8:30 AM - 10:30 AM ROOM: Hall B 2321 Board #53 8:30 AM - 9:30 AM Effects Of Aspirin On Hematologic Responses Of Males During Acute Cold Exposure Ronald Otterstetter1, Leigh Murray2, Michael Kalinski, FACSFM, Ellen L. Glickman, FACSFM. 1The University of Akron, Akron, OH. 2Kent State University, Kent, OH.

INTRODUCTION: Cold exposure and aspirin have been shown to have an effect on hemostatic functions (i.e., blood coagulation) in humans. Acute cold exposure has the potential to alter hemostatic parameters that have been linked with what has been termed a hypercoagulable state. Research has demonstrated that during or following acu cold exposure changes occur in many factors that cause the acceleration of the thrombosis process (i.e. increases in plasma fibrinogen, Factor VII, thrombin, red cell count, plasma cholesterol). Aspirin ingestion, on the other hand, has the opposite effect. It impairs thrombin generation and decreases platelet aggregation.

PURPOSE: To examine the effect of aspirin ingestion on hematologic responses during exposure to 12°C air for a period of 120-minutes.

METHODS: Seven (7) young males were fed a placebo (PL), a low dose of aspirin (ASA-L: 81 mg d-1) or a high dose of aspirin (ASA-H: 650 mg d-1) for one week prior to each experimental trial. Following a baseline period (30-minutes), subjects were moved into an environmental chamber where they remained seated and still for 120-minutes, or until core temperature (Tre) was ≤35°C. Antecubital venous blood samples were drawn at the completion of baseline and at 60 and 120-minutes of exposure for measurement of selected hematologic markers.

RESULTS: ANOVA revealed no significant (p>0.05) differences between the treatments in any of the hematologic measures.

CONCLUSION: These data demonstrate that aspirin had no significant effect on the physiologic changes induced by acute cold exposure with respect to the hematologic parameters measured. Furthermore the aspirin dosage administered in this experimental protocol did not provide a protective effect against thrombotic events.

Effect of Varying Doses of Aspirin on Energy Substrate Utilization During Acute Cold Exposure Greg Farrell1, Leigh Murray2, Ronald Otterstetter2, Heather Elos2, Ellen L. Glickman, FACSFM. 1Kent State University, Kent, OH. 2The University of Akron, Akron, OH.

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INTRODUCTION: An increase in shivering thermogenesis typically occurs during cold exposure and requires energy substrates to be utilized. The experimental literature on the effects of aspirin ingestion on energy substrate utilization during cold exposure is equivocal. High levels of aspirin have been shown to uncouple oxidative phosphorylation which results in a failure to produce high-energy phosphates. As a consequence aspirin ingestion may contribute to the stimulation of gluconeogenesis, glycolysis, and lipolysis.

PURPOSE: The goal of the present investigation was to determine if the ingestion of varying dosages of aspirin vs. placebo will alter substrate utilization during acute cold exposure (ACE).

METHODS: Seven males (26.1± 2.4 y) underwent pre-experimental testing to determine VO2max and body composition. Subjects underwent 3 trials in which they were required to ingest for one week prior to all trials: a capsule which was filled with cellulose (PLA), 81 mg.day-1 of aspirin (ASA-L), and 650 mg.day-1 of aspirin (ASA-H). Each trial consisted of 120 min of exposure to 12oC air and 120 min of recovery in 25oC air. Blood samples were obtained at 0, 60, and 120-minutes and analyzed for blood coagulation markers and clotting times.

RESULTS: ANOVA revealed a main effect for treatment for prothrombin time (p < 0.001) and fibrinogen levels (p = 0.025), with low-dose aspirin demonstrating slower clotting times and lower levels of fibrinogen. In addition, there was a treatment x time interaction for prothrombin time (p < 0.001).

CONCLUSION: Based on these data, the lower dose of aspirin slowed clotting time and decreased fibrinogen levels which may therefore contribute to a decrease in coagulation during the recovery period following ACE.
**S424 Vol. 38 No. 5 Supplement**

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Furthermore, it is well known that humans respond to an acute systemic administration of aspirin with a reduction in core temperature (i.e., anti-pyretic).

**PURPOSE:** Therefore, the goal of the present investigation was to determine if the ingestion of varying dosages of aspirin vs. a placebo would alter the individuals perception of cold during acute cold exposure (ACE) vs. the recovery phase (or, re-warming) following acute cold exposure (ACE-REC).

**METHODS:** Seven males (26.1± 2.4 y) underwent pre-experimental testing to determine VO2max and body composition. Subjects underwent 3 trials in which they were required to ingest for one week prior to all trials: a capsule which was filled with cellulose (PLA), 81 mg·day-1 of aspirin (ASA-I), and 650 mg·day-1 of aspirin (ASA-II). Each trial consisted of 120 min of exposure to 126°C (ACE) and 120 min of recovery in 25°C (ACE-REC). The Gagge Thermal Sensation Scale (1967) vs. the Modified Thermal Sensation Scale (1994) were employed to discern thermal perception at rest during ACE and ACE-REC.

**RESULTS:** ANOVA revealed that during ACE the Gagge Scale and the Modified Gagge Scale both demonstrated a main effect for time (p<0.05). However, the Gagge Scale demonstrated a main effect for treatment (p<0.006) whereby, the ASA-I differed from the ASA-II.

**CONCLUSIONS:** From these data it appears that there was a differential response in thermal perception in ACE-REC that was elucidated via the Gagge Thermal Sensation Scale that was not elucidated via the Modified Thermal Sensation Scale.

2325 **Board #57**

8:30 AM - 9:30 AM

**Differences in the Expression of MHC Isoforms in Single Muscle Fibers After A 18 wk Cold Adaptation in Hamsters**

Sadayoshi Taguchi, FACSM, M1wa Nishimori2, Shin Nohara2, Shinya Masuda1, Masayuki Yawaza2, Takashi Hashimoto2, 1Kyoto University (emeritus Prof.), Kyoto, Japan, 2Kyoto University, Kyoto, Japan. 1Boholod University, Sendai, Japan. 2Univ of Calif, Berkeley, Berkeley, CA.

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**PURPOSE:** The purpose of this study was to determine alterations in the expression of MHC isoforms in single muscle fibers after a 18 wk cold exposure in hamsters.

**METHODS:** Ten Golden hamsters (Mesocrietus auratus), aged 15~17 weeks were randomly assigned to two groups: control group (n=5, CO) and cold exposed group (n=5, CE). The CE group was exposed to cold temperature at 5°C±1 for 18 weeks housed for 18 weeks at 22°C±2. Electrophoretic analyses were performed in single muscle fibers of the vastus intermedius (VI) muscle (n=50 per muscle) as well as in whole VI muscle.

**RESULTS:** Significant increases in body weight, heart weight, heart rate and body temperature were observed in CE group compared to CO group. Interestingly, blood glucose was significantly lowered in CE as compared to CO (42±18.6 vs. 97±22 mg/dL). MHC type IIA disappeared completely in whole muscle (VI) in CE whereas CO possessed 20% in type IIA. However, CE showed significant changes in MHC type IIX and IIB as compared to CO. As for single fiber analyses, co-expression of MHC type IIA and IIX was significantly increased in CO, but type IIX and IIB was significantly highly co-expressed in CE, suggesting that type IIX is a dominant isoform in CE.

**CONCLUSIONS:** It is plausible that the transformed MHC isoform type IIX is a muscle adaptation to cold environment, yields metabolic efficiency.

2326 **Board #58**

9:30 AM - 10:30 AM

**Prediction of Time to Shivering in Resting Subjects during Mild Cold Transients**

David W. DeGroot, W. Larry Kenney, FACSM. Penn State Univ, University Park, PA.

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The initial response to cold stress consists of vasoconstriction (VC) to conserve metabolic heat, followed by shivering thermogenesis when heat conservation is no longer sufficient to maintain core temperature (Tc). However, the individual characteristics that influence heat conservation mechanisms are unclear.

**PURPOSE:** To determine individual characteristics that influence heat conservation and time to shivering.

**METHODS:** 85 subjects (43 men, 42 women) of varying age (18-89 years), body mass (44-104 kg), adiposity (10-43 %fat), and lean limb muscle mass (Dxa; 5.0-9.5 kg·m²) sat at rest during a cooling transient protocol in which dry bulb temperature was progressively decreased. The protocol was terminated at the onset of visible shivering. Esophageal and skin temperatures and red blood cell flux (class-Doppler flowmetry) were measured continuously, and O2 consumption and CO2 production were measured every 10 min. Cutaneous vascular conductance (CVC) was calculated and expressed as a percent of baseline (4 flux/MAP, CVC basal). Tissue insulation (I), heat debt and metabolic heat production were calculated using standard equations. Stepwise regression analysis was conducted to determine the individual characteristics predictive of time to shivering.

**RESULTS:** Limb muscle mass and CVCbasal were significant predictors of time to shivering (r²=.28, p<0.001). The addition of the change in I, from baseline (IΔ) improved the prediction equation (r²=.37, p<0.001). Adiposity, expressed as either %fat, limb fat mass relative to height or body fat mass relative to height, did not improve prediction. The final prediction equation was: to shiver = 85.9 + 2.99% fat muscle mass - .51°CVCbasal + 275% Age. Age was not a significant predictor of time to shivering threshold, but was correlated with CVCbasal (r=-.41, p<0.001).

**CONCLUSIONS:** The combination of a high limb muscle mass and effective skin VC (basal adiposity) predicts effective passive heat conservation and delay of the need to increase heat production via shivering. Supported by NIH Grant R01 AG07004-15 and NIA Grant T32-AG00048.

2327 **Board #59**

8:30 AM - 9:30 AM

**Physiological Case Study During a Week-Long, 539 km Cross Country Ski Event**

Steven E. Gaskill, FACSM. University of Montana, Missoula, MT.

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Understanding the stresses during extended duration work in important in many occupations and is a focus of much of the work done in the Human Performance Laboratory at the University of Montana. During the spring of 2005, a 53 year old, 86.4 kg, male was monitored during a week long, 539 km, classic technique cross country ski tour across Finland near the Arctic Circle.

**PURPOSE:** This study was designed to test the viability of the Mini Mitter Vital Sense and Actical monitors under extreme cold temperatures and to evaluate the physiological stress during extended work in cold weather.

**METHODS:** Heart rate (Polar S10i), core and ambient temperature (Vital Sense) and movement (Actical) and location (GPS, Garmin) were monitored 24 hours a day during the weeklong event. Weight and fatigue measures (resting, submaximal and recovery HR) were collected each morning and evening. Energy expenditure was estimated from both the Actical data and from pre-event correlations between HR and energy expenditure.

**RESULTS:** The average daily distance was 77.8 ± 8.3 km • day−1 (range 49 - 90 km) with ambient air temperatures ranging from -41°C to +3°C (mean= -8.1 ± 9.6°C). Average daily skiing energy expenditure was 4599 ± 623 kcal and non-skiing energy expenditure was 1615 ± 218 kcal (daily average ~6215 ± 418 kcal) estimated from HR data. The actical energy expenditure data was 11% less, estimating 5531 ± 513 kcal. Average skiing speed was 4.54 min/km (204 m • min−1). Core temp during skiing dropped over the week from 37.76°C to 37.24°C while ambient temperature increased from -7°C to 2.1°C (r = -.063). Body weight dropped 2.86 ± 0.3 kg each day during skiing. Pre-breakfast weight dropped 2.27 km over the week of skiing. The step test heart rates showed a gradual rise in the sum of resting, exercise and recovery values though the 4th day both in the morning and after skiing, then recovery following the 5th (49km) day and increased during the final 2 long (76 and 82 km) days. Sleep averaged 9.9 ± 1.3 hours • night−1.

**CONCLUSIONS:** The instrumentation worked well in spite of the very cold weather. The GPS battery failed several times over the course of week, but a back-up system worked well. The physiological data showed that fatigue was accumulating, but as little as one moderately easy day could improve recovery. Core temperature decreased as fatigue increased but remained within normal values.

E-29 Free Communication/Poster – Fitness, Activity, and Risk Factors

FRIDAY, JUNE 2, 2006 8:30 AM - 10:30 AM

ROOM: Hall B

2328 **Board #60**

9:30 AM - 10:30 AM

**Smoking Increases Triglyceride and Glucose Levels in Fire Fighters and Police Officers**

April Short, Wade Womack, Stephen F. Crouse, FACSM, John S. Green, FACSM. Texas A&M University, College Station, TX. (Sponsor: John S. Green, FACSM)

Email: jsgreen@tamu.edu

It has been purported that smoking increases levels of total cholesterol (TC), LDL-cholesterol (LDL), and triglycerides (TG) while reducing levels of HDL-cholesterol (HDL). (Nekl, 2002).

**PURPOSE:** To evaluate the influence of smoking status on these and other biomarkers of heart disease risk in fire fighters and police officers.

**METHODS:** Subjects were 225 fire fighters and police officers (mean age=38.3 yrs, mean body fat percentage=22.4). All subjects were employed by a moderate sized municipality (pop. 55,000) and underwent an annual health survey accompanied by physiologic testing. These assessments included smoking status as well as measurements of TC, HDL, LDL, TRIG, and fasting blood glucose (GLUC). All blood samples were analyzed in a CLIA accredited laboratory.

**RESULTS:** One hundred fifty two (67.3%) had never smoked (NS), 55 (24.3%) had previously smoked (PS), and 19 (8.4%) were current smokers (CS). When our sample was compared to current smoking statistics from the Center for Disease Control,
14.6% fewer police officers and fire fighters were CS vs. the average of US adults ages 18 and over. Physiologic data were analyzed using an analysis of variance with comparisonwise Type I error rates presented as actual calculated p-values.

**RESULTS:** indicated that TRIG values tended to be higher in CS (175.6 ± 126.2 mg/dL) vs. PS (119.5 ± 69.4 mg/dL) and NS (134.4 ± 87.7 mg/dL) p = .052. Further, GLUC values in CS (107.2 ± 45.4 mg/dL) were higher than NS (92.0 ± 14.0), but not different from PS (99.2 ± 29.9) p = .007. No other differences were found among the biomarkers tested.

**CONCLUSIONS:** smoking tends to raise TRIG and GLUC values in fire fighters and police officers in moderate sized municipalities.

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**CoNCLUsIoNs:**

**resULts:**

**MetHoDs:**

CI 95%: 0.36, 4.76), p=0.679). When the sample was stratified by sex, the risk of between the risk index of colorectal cancer and physical activity level (POR=1.31, 27% had a university degree. The average risk index for men was 20.17, and for physical activity and the colorectal cancer risk index (66%), males=43 (40%); mean age = 58.7 yrs living in a rural municipality of Puerto classified as insufficiently active (<600 MET-min/wk) and sufficiently active (>600

**PUrPose:**

To explore the relation between baseline CRF, various measures of adiposity and cancer mortality in men.

**METHODS:**

38,410 men (mean age 43.8 ± 9.9 years) who were without known cancer, underwent a comprehensive preventive health examination at the Cooper Clinic between 1970-2001. Clinical measures included Body Mass Index (BMI), waist circumference (WC), percent body fat (%fat), and CRF from a maximal treadmill exercise test. Participants were divided into quartiles of BMI, WC, and %fat. Mortality surveillance was completed through December 31, 2003. Hazard ratios were computed with Cox regression analysis.

**RESULTS:**

During a mean follow-up period of 17.2 years, 1,037 cancer deaths occurred. Following adjustment for age, examination year, baseline health status and smoking status, hazard ratios across incremental BMI quartiles were 1.0, 1.07, 1.13, and 1.46; those of WC were 1.0, 0.98, 1.03, and 1.56; those of %fat were 1.0, 1.12, 1.09, and 1.31; and those of CRF were 1.0, 0.83, 0.75, and 0.61 (trend P<0.01 for each). Further adjustment for CRF eliminated the cancer mortality risk associated with %fat, and attenuated the risk associated with BMI and WC. Adjustment of CRF for adiposity measures had little effect on mortality risk. Restricting analyses to only men with greater than 3 years of follow-up did not materially change the results reported above.

**CONCLUSIONS:** Higher levels of CRF are associated with lower cancer mortality risk in men, independent of several adiposity measures. These findings underscore the importance of CRF in addition to adiposity, as a determinant of cancer mortality in men. Supported by NIH grants AG086945 and HL62568

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**Board #62**

3:00 AM - 3:30 AM

**Colorectal Cancer Risk Index and Physical Activity in Hispanic Adults Living in a Rural Area of Puerto Rico**

Mariela Torres-Cintron1, Farah A. Ramirez-Marrero, FACSFM, Cruz M. Nazario1, Erick Suarez1. University of Puerto Rico - Medical Sciences Campus, San Juan, Puerto Rico. University of Puerto Rico - Rio Piedras Campus, San Juan, Puerto Rico. (Sponsor: Carlos J. Crespo, FACS FM)

**Email:** framirez@caribe.net

**PURPOSE:** Colorectal cancer is the second leading cause of cancer mortality in Puerto Rico. The purpose of this study was to estimate the association between physical activity and colorectal cancer risk in a group of Hispanic adults living in a rural area of Puerto Rico.

**METHODS:** A colorectal cancer risk index was developed based on the presence of known risk factors. Risk points were assigned according to the strength of the causal association of the risk factors and summed. Population average of colorectal cancer risk was obtained from the prevalence of risk factors using the PR-BRFSS and the prevalence of risk factors of the study population. Physical activity level was determined using the International Physical Activity Questionnaire. Participants were classified as insufficiently active (<600 MET-min/wk) and sufficiently active (>600 MET-min/wk), or as highly active (>1500 MET-min/wk) and not highly active (<1500 MET-min/wk).

**RESULTS:** Personal interviews were performed on 126 participants [Female=83 (66%), male=43 (40%); mean age = 58.7 yrs living in a rural municipality of Puerto Rico. A logistic regression analysis was used to evaluate the association between physical activity and the colorectal cancer risk index.

**RESULTS:** Forty-two percent of the participants did not complete high school, while 27% had a university degree. The average risk index for men was 20.17, and for women 20.84. Forty-two percent had a high colorectal cancer risk index, and 90% were classified as sufficient activity. No statistical significant association was found between the risk index of colorectal cancer and physical activity level (POR=1.31, 95% CI 0.95–1.86, p=0.679). When the sample was stratified by sex, the risk of colorectal cancer appeared to be reduced only in sufficiently active men (POR=0.68, CI 95%: 0.065, 8.25), however, this association was not statistically significant (p=0.61). The risk index of colorectal cancer also appeared to be reduced only in highly active men (POR=0.66, CI 95%: 0.17, 2.64). However, the association was also not statistically significant (p=0.58).

**CONCLUSIONS:** A 30% excess risk of colorectal cancer was observed in insufficiently active Hispanic men but not in women. Further analysis of these associations is warranted. Supported in part by: NIH/NCI P20 CA069257.
even after adjustment for demographic covariates. After adjusting for presence of reoccurring pain, functional limitation and number of chronic conditions, PA level was no longer significantly associated with sleep impairment.

CONCLUSION: PA may have beneficial effects on sleep impairment among adults with chronic conditions. The role of pain and functional limitation in this relationship needs further investigation.

2333 Board #65
8:30 AM - 9:30 AM
Symptomatic Limitations Affecting The Prescription Of Exercise For Fibromyalgia Patients
Koulla M. Parpa, Colleen B. Brown, Barry S. Brown, ACSM. University of Arkansas, Fayetteville, AR.

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Understanding the symptoms of fibromyalgia is particularly helpful in prescribing exercise programs for this unique population. Sleep, fatigue levels, weather, emotional as well as physical stress can have profound effects on fibromyalgia patients and may be good indicators of how well this population can tolerate exercise. Aerobic exercise has been shown to improve fitness, quality of sleep, and reduce tender point counts. The key question is how do you get those people that are experiencing constant pain and fatigue to get started and stick to an exercise program?

PURPOSE: This study was undertaken to determine the most common symptoms that can limit the ability of fibromyalgia patients to participate in exercise programs.

METHODS: Nine organizations volunteered to participate in this study. A total of 1079 employees completed the self-administered fibromyalgia questionnaire. The frequency and severity of the symptoms were assessed using a 5-point Likert scale.

Symptomatic data were obtained from both FM patients and non-FM population. Participants identified factors that precipitate pain, hours of sleep, morning tiredness and pain in different musculoskeletal areas.

RESULTS: One thousand and seventy nine responses were analyzed out of which 3.9% were identified as being diagnosed with fibromyalgia. Participants scored significantly higher (p<0.001) on the appearance of all symptoms including painful tender points and significantly (p<0.001) lower on the hours of sleep. Ninety three percent of fibros reported that changing weather and fatigue aggravate pain. Other factors that trigger pain included movement/overuse (reported by 85.7% of fibros), emotional stress (reported by 83.3% of fibros) and cold weather (reported by 81% of fibros). In addition, 95.2% of fibros reported sleep disturbances and morning tiredness.

CONCLUSIONS: It seems clear that, given the myriad and variety of symptoms, it is important for those in the health care professionals and patients to work together to establish an individualized exercise program (each fibro is different). Our results demonstrate that changing weather, fatigue, overuse, emotional stress, cold weather and sleep can worsen FM symptoms and therefore limit their ability to exercise. Based on our results we would not recommend exercising just before bed as this may interfere with sleep. Stretching exercises can be very helpful to decrease muscle stiffness and pain. A low or non-impact aerobic exercise is probably the best way to start an exercise program.

2334 Board #66
9:30 AM - 10:30 AM
Incidence of High Normal Blood Pressure and Hypertension in Ninth Grade Physical Education Students
Kazanna C. Hames, Melissa Jensen, Keith Pound, Desmond Stahl, Alex Bumpus, Tim Steeper, Irvin Faria, ACSM, Roberto Quintana. California State University, Sacramento, Sacramento, CA.

The prevalence of high blood pressure in adolescence is increasing with the number of adolescents at risk for obesity or overweight. Due to the known relationship between high blood pressure and increased risk of coronary artery disease (CAD) and stroke, this is an obvious health concern for adolescent children.

PURPOSE: To characterize the incidence of high normal blood pressure and hypertension in a large population of ninth grade, physical education students.

METHODS: 884 ninth grade, physical education students (14 ± 1 yrs) participated. Blood pressure was initially recorded with an automated device (Omron, HEM-907XL). If the initial automated reading was above 120/80 mmHg, then a manual reading was taken.

Blood pressure was initially recorded with an automated device (Omron, HEM-907XL). If the initial automated reading was above 120/80 mmHg, then a manual reading was taken. Physical characteristics and risk for CAD were measured, including age, height, weight, percent body fat, predicted oxygen uptake (PO2), blood pressure (BP), total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL), blood glucose (BG), family history, smoking status, physical activity level, and body mass index (BMI). Risk for CAD was determined for all participants as the number of risk factors based on the ACSM guidelines. Then, using the ACSM risk stratification, each person was given a score if they were at low risk, two for moderate risk, and three for high risk, so that analysis could be performed (ACSM, 2000).

RESULTS: Individual t-tests for all variables were performed and no significant differences in high normal blood pressure or hypertension were found between the pre- and post-menopausal women.

PURPOSE: Hypoadiponectinemia predisposes to the development of hypertension in men. A negative correlation between adiponectin and blood pressure has been observed in nondiabetic adolescent females. However, it is not clear whether the significant relationship between adiponectin and blood pressure remains independent of the menopausal status in women. The purpose of the study was to determine how plasma adiponectin was related to blood pressure in both pre- and post-menopausal women.

METHODS: By using the standardized procedures, we analyzed body fatness, cardiorespiratory fitness, blood pressures, fasting glucose, insulin, HOMA2, adiponectin, leptin, resistin, and lipoprotein-lipids in pre-menopausal women (n=58, aged 44.1±7.0 yrs) and post-menopausal women (n=50, aged 58.7±5.9 yrs).

RESULTS: Independent t-tests for the group comparison showed that the post-menopausal women had significantly higher values in waist circumference (p=0.015), triglyceride (p=0.032), total cholesterol (p=0.004), and low-density lipoprotein cholesterol (p=0.005), but a lower cardio-respiratory fitness (p=0.008) than the pre-menopausal women. Spearman correlation analyses showed that plasma adiponectin was negatively related to body weight (r=-0.279), waist circumference (r=-0.267), percent body fat (r=-0.301), insulin (r=-0.320), SBP (r=-0.314), DBP (r=-0.314) and HOMA2 (r=-0.282) in the pre-menopausal women, while it was negatively related to body weight (r=-0.284), waist circumference (r=-0.320), fasting glucose (r=0.359), insulin (r=0.276), and HOMA2 (r=0.347) in the post-menopausal women.

Of particular, stepwise linear regression analyses showed that age, percent body fat, and adiponectin were independent predictors for the individual variation of SBP in the pre-menopausal women (r=0.316), while age and BMI were independent predictors of SBP in the post-menopausal women (r=0.295).

CONCLUSION: The current findings suggest that the relationships of hypoadiponectinemia with the metabolic syndrome markers, especially blood pressures, appear to be different between the pre- and post-menopausal women.
differences (p<0.05) were found between the FATH and NATH groups. When comparing the risk for CAD, the FATH had slightly less risk, although not a significant difference compared to the NATH. The FATH total risk was an average of 0.92 ± 1.12, while the NATH average was 1.00 ± 1.13 risk factors.

CONCLUSION: The results collected from a cohort of pre and postmenopausal women indicated that vigorous physical activity in young adulthood does not decrease the risk of CAD in the future. Benefits gained from physical activity in young adulthood did not appear to result in a reduced risk for CAD later in life.

2337 Board #69 8:30 AM - 9:30 AM Health Risks In A Sample Of Deer Hunters: BMI, Blood Pressure And Physical Activity
Stephen LoRusso, Saint Francis University, Loretto, PA.

The energy cost of large game hunting, such as deer, is METs, representing a moderate to heavy energy expenditure. Two studies 3,4 have examined the cardiac demands of deer hunting, and both have reported significant increases in cardiac demand during actual and simulated deer hunting activities when compared to maximal treadmill exercise. Further, subjects with known coronary artery disease, displayed electrocardiogram changes during these activities. 1To our knowledge, to date, no studies have described any general health measures of deer hunters with the goal of determining level of health risk in this population.

PURPOSE: To determine a health risk profile of deer hunters.

METHODS: 91 male and 8 female attendees at a local hunting and fishing show were surveyed. Data collected included height and weight for body mass index calculation (BMI), and blood pressure, level of physical activity, type of hunting activities participated in, and prescursion preparatory physical activities.

RESULTS: BMI’s and systolic blood pressures indicated that males were heavier and had higher systolic pressures than females. Most subjects were either overweight or obese, with only 14% with a normal BMI, 50% overweight, 23% obese class I, 7% class II, and 6% class III. Systolic blood pressures were elevated, with 8% normotensive, 59% prehypertensive, 23% in stage I hypertension, and 6% in stage II hypertension. No recent vigorous (33%), moderate (24%) or walking (9%) activity was reported by respondents in the previous 7 days, while at least 3 days’ activity at these levels was reported, respectively, by 51, 54 and 78% of participants. Pre-season preparatory activity was reported by 35% of respondents, including 12.5% in the under-40 age group and 43% in the 40-72 age group.

CONCLUSIONS: These data indicate that this sample of individuals have at least 2 modifiable risk factors for developing cardiovascular disease and may be at risk for developing cardiovascular complications during deer hunting.

2338 Board #70 9:30 AM - 10:30 AM Quantification of Heart Disease Risk Perception: A Pilot Study in Heart Patients
John S. Green, FACSM1, Steve Martin2, Thomas Meade3, Kathy L. Hill1, Stephen F. Crouse, FACSM1, 1Texas A&M Univ. College Station, TX; 2Scott & White Clinic, College Station, TX; 3Sam Houston State University, Huntsville, TX.

We have previously described and quantified heart disease risk perception in a large cohort of college students (Green, et al, 2003). 

PURPOSE: to attempt describe and quantify heart disease risk perception in a sample of patients suffering from coronary heart disease.

METHODS: The perception instrument was composed of a series of 40 questions in which the subjects were asked to rate their perception of causality between contemporary heart disease risk markers and a heart attack. Subjects were coronary heart disease patients from a local clinic. They were instructed to rate their perception of the strength of causality of each relationship on a scale of 0 to 10. If they did not understand a term used in the question or were unfamiliar with a particular causal relationship, they were instructed to mark an “X” in the rating blank as opposed to making a guess.

RESULTS: The strongest perceived risks were for “obesity causing hypertension” (mean rating: 8.58), “physical inactivity causing obesity” (mean rating: 8.52), and for “high fat foods causing high LDL cholesterol” (mean rating: 8.42). Other pertinent findings include the fact that 97% of the patients were familiar with the 8 most commonly publicized risk markers as purported by the ACSM and AHA. The mean causality rating for these factors was 7.58 with “high cholesterol causing a heart attack” receiving the highest rating (mean rating: 8.28) and “age causing a heart attack” receiving the lowest rating (mean rating: 6.17). Also, 75% of the male patients and 33% of the female patients did not perceive that menopause was associated with coronary disease in women.

CONCLUSION: coronary artery disease patients do not accurately perceive all of their risk for further heart related maladies.
significantly associated with the CVD risk factors. These results warrant the need for dietary interventions to prevent and/or reduce the risk factors for CVD in this specific population.

Supported by grant from Moores School of Music, University of Houston (PI, JAB).

2341 Board #73 8:30 AM - 9:30 AM
The Prevalence of Cardiovascular Risk Factors among Cardiac and Non-cardiac Hospital Admissions
Patrick Dunn, Kinberly Petry, Janelle Hardisty, Scott Conard, John Reneau, Ross Arena, FACSM; 2Las Colonias Medical Center; Irving, TX. Virginia Commonwealth University, Richmond, VA. Email: raarena@vcu.edu

A number of modifiable cardiovascular (CV) risk factors exist and have proven to be effective therapeutic targets. Individuals admitted to the hospital with a suspected CV condition likely have a number of risk factors that increase the likelihood of CV disease. The CV risk profile for subjects admitted for the hospital for a non-CV condition has not been extensively examined.

PURPOSE: To compare CV risk factor characteristics between individuals admitted to the hospital for a suspected CV condition to individuals admitted for a non-CV condition.

METHODS: This analysis was performed on 708 patients admitted for either CV (n=189, 88 male/101 female) or non-CV (n=519, 195 male/326 female) maladies from July 2004 to June 2005 at Las Colonias Medical Center. Unpaired t-testing was used to compare key variables between groups. All statistical tests with a p-value <0.05 were considered significant.

RESULTS: The following data is reported CV vs. non-CV group: While age was significantly lower [64.5 ± 16.9 vs. 56.6 ± 18.8, years, p<0.05] and body mass index [23.5 ± 15.0 vs. 29.8 ± 10.1, kg/m², p<0.05] was significantly higher in the non-CV group, systolic blood pressure [135.6 ± 11.7 vs. 133.5 ± 10.0, mmHg], total cholesterol [182.6 ± 36.4 vs. 190.0 ± 46.4, mg/dL], high density lipoprotein [47.7 ± 13.3 vs. 53.9 ± 16.0, mg/dL] and triglycerides [176.1 ± 81.8 vs. 155.7 ± 124.8, mg/dL] were similar between groups (p>0.05). The percentage of subjects with individual CV risk factors in each group is listed in Table 1.

CONCLUSION: The results of the present study indicate individuals admitted to the hospital for a non-CV condition have a strikingly similar CV risk factor profile compared to those individuals admitted to the hospital for a suspected CV condition. Assessment of modifiable CV risk factors in individuals being treated for non-CV conditions may therefore be warranted.

2342 Board #74 9:30 AM - 10:30 AM
Absence of Age-Related Increases in the Risk of Lifestyle-Related Diseases in Male Rowers
Kiyoshi Sarada, Motohiko Miyachi, Chiyoko Usui, Masae Miyata, Hiroshi Kawano, Izumi Tabata, FACSM, Mitsuhiro Higachi, FACSM; 1Institute for Biomedical Engineering, Waseda University, Tokyo, Japan; 2National Institute of Health and Nutrition, Tokyo, Japan; 3Graduate School of Human Sciences, Waseda University; Tokyo, Japan; 4Faculty of Sport Sciences, Waseda University; Tokyo, Japan. Email: spashiro@hotmail.com

It is well known that rowing exercise is composed of aerobic and resistance exercises, which enhances muscle function and/or cardiopulmonary fitness. However, there is little information on effects of rowing on risk factors of metabolic syndrome, osteoporosis, and sarcopenia. We hypothesized that increases in their risks and body composition with age are either absent or attenuated in those who perform habitual rowing.

PURPOSE: The present cross-sectional study was aimed to determine the relation between habitual rowing, aging, and their risk factors.

METHODS: Healthy Japanese men (n=95) aged 19-70 yrs participated in this study, and were either divided by 4 groups; 26 young rowers (YR), 24 senior rowers (SR), 23 sedentary young controls (YC), and 22 senior controls (SC). Total cholesterol, LDL-cholesterol, HDL-cholesterol, triglycerides, glucose, and HbA1c were measured in all subjects. Total and regional lean soft tissue and fat masses and bone mineral density (BMD) were measured using Dual-energy X-ray absorptiometry (DXA). We measured VO2peak during an incremental cycle ergometer exercise in YC and SC, and during increased rowing exercise in YR and SR.

RESULTS: The HDL-cholesterol in SR (67 ± 13.4 mg/dL) was significantly higher than in SC (59.2 ± 11.9 mg/dL, P<0.05). Furthermore, HDL-cholesterol in SR was equal to in YR (66.1 ± 10.8 mg/dL). Arm, leg, and trunk lean soft tissue mass in SR (5.6 ± 0.8 kg, 18.2 ± 1.8 kg, 27.3 ± 3.2 kg, respectively) were significantly higher than in SC (5.1 ± 0.4 kg, 16.3 ± 1.7 kg, P<0.05). BMI in SR was also significantly higher than in SC (in ribs, lumbar spine, and pelvic segments, P<0.05). VO2peak in SR (35.0 ± 6.5 ml/kg/min) was significantly higher than in SC (29.1 ± 3.1 ml/kg/min, P<0.05). Handgrip strength in SC (38.9 ± 5.3 kg) was 21% significantly lower in YC (49.9 ± 9.9 kg), however, there was no difference between VR (46.1 ± 7.6 kg) and SR (47.7 ± 6.6 kg) in rowers.

CONCLUSIONS: The age-related increases in the risk factors of metabolic syndrome, osteoporosis, and sarcopenia are absent in rowing-trained men. These results suggest that a habitual rowing exercise may favorably influence the prevention of lifestyle-related diseases in middle-aged and old rowers.

2343 Board #75 8:30 AM - 9:30 AM
Comparison of Lifetime vs. Recent Recreational Activity in Predicting All-Cause Mortality
Jonathan N. Myers, FACSM, Ssw Hay Tan, Joshua Abella, Nayana Abrol, Sneha Kashore, Vidyadri Sridhar, Victor Froelicher, FACSM, VA Palo Alto HCS, Palo Alto, CA. Email: drj993@aol.com

PURPOSE: Adulthood energy expenditure from recreational activity has long been known to have a cardiovascular protective effect and is associated with longevity. However, studies are inconsistent in terms of whether lifetime or recent recreational activity pattern more powerfully predicts outcome. The aim of this study was to compare energy expenditure from lifetime (adulthood) and recent (last year) recreational activity in terms of predicting all-cause mortality.

METHODS: 1,241 subjects (mean age 57 years) completed a detailed questionnaire on adulthood (25 years of age to current) and recent (the year prior to evaluation) physical activity patterns. The questionnaire was modified from the Harvard Alumni Health Study and included the duration, type, and intensity of recreational activities as well as estimates of occupational energy expenditure. The mean follow up was 6.5 years.

RESULTS: There were 187 deaths during the follow-up. Lifetime recreational activity (in kcals/week) was significantly associated with all-cause mortality (p=0.008) but activity in the past year was not (p=0.42). A stepwise decrease in relative risk for mortality was observed as patients expended more energy during adulthood recreational activities.

CONCLUSIONS: Although lifetime activity patterns would likely be limited by recollection and recent activity would include the effect of concurrent illness, we nevertheless found that lifetime activity patterns more powerfully predict mortality than recent activity patterns.

2344 Board #76 9:30 AM - 10:30 AM
What is the Relationship between Physical activity and Cardiovascular Risk Factors in Adults Women?
Aylton J. Figueira Junior, Luciene D. Alvarez, Denise O. Alonso, University of Sao Caetano do Sul, Sao Caetano do Sul - Sao Paulo, Brazil. Email: aylton.figueira@imes.br

Physical activity is considered an important lifestyle behavior towards health promotion and cardiovascular diseases prevention risk factors.

PURPOSE: This paper aimed to determine the relationship between physical activity level and chronic disease prevalence in adults living in a high-density population area from developing country.

METHODS: We evaluated 590 adults (28.4±7.31 years old) with 63.82±13.19 kg (body weight); 1.63±0.07 m (body height) and BMI 23.85±8.28 kg/m². Physical activity level (PAL) was assessed through International Physical Activity Questionnaire-IPAQ (2001). IPAQ allows the PAL classification in sedentary (S), insufficient active (IA), active (A), and very active (VA) by association of intensity and activities duration. Lifestyle was determined by Health and Risk Prevalence Survey (2004), that characterizes daily activities at workplace, home and during leisure time, as well cardiovascular risk factors (RF) as hypertension, smoking, obesity and physical activity behavior. Blood pressure, serum cholesterol, diabetes, triglycerides were measured. Pearson Linear Single Factor Correlation was used (SPSS 13.0) to assess PAL and RF prevalence association as follows below:

<table>
<thead>
<tr>
<th>Duration x RF</th>
<th>Intensity</th>
<th>RF</th>
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<tr>
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<tr>
<td>0.05</td>
<td>Moderate</td>
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<tr>
<td>0.68*</td>
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<tr>
<td>0.09</td>
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</table>

RESULTS: We found that most the groups kept seat for 6±1.2±1.18 hours. Light and moderate intensities represented 22% of total time at workplace. On the
other hand cardiovascular risk factors were 45.5% (sedentary); obesity (39.9%) and 28.2% for hypertension. Also 60.79% of the sample presented 1-3 other cardiovascular risk factors and 33.51% presented 4-8 risks. Active group performed moderate physical exercise for 31.3 min; 2.8 times/w. In conclusion, fatness, not fitness, seems important for adiponectin levels, and increased adiponectin levels are associated with decreases in the body weight and waist circumference. In contrast, it did not correlate with changes in most CVD risk factors. Factors other than exercise may play a larger role in altering them.

| Table 1. Mean Baseline Characteristics and Changes from Baseline Values (6) |
|-----------------------------|-----|---------|---------|---------|-----|
|                           | 1st Quartile Group | 2nd Quartile Group | 3rd Quartile Group | 4th Quartile Group |
| Mean ± SD                   | 26.2 ± 0.36       | 26.7 ± 0.89       | 26.4 ± 0.79       | 26.8 ± 0.95       |
| Waist Circumference (cm)    | 86.6 ± 3.2        | 82.2 ± 3.5        | 80.8 ± 5.2        | 81.4 ± 5.6        |
| SBP (mmHg)                  | 139.6 ± 1.7       | 140.5 ± 1.9       | 138.3 ± 1.7       | 138.2 ± 1.8       |
| LDL-C (mg/dl)               | 34.2 ± 2.1        | 39.7 ± 2.1        | 36.8 ± 4.9        | 29.6 ± 5.8        |
| BMI                         | 72.2 ± 0.0        | 75.2 ± 0.0        | 76.1 ± 0.0        | 73.4 ± 0.4        |

Maximum oxygen uptake (VO2max) as an index of cardiorespiratory fitness, is inversely related to morbidity-mortality and to some other public health problems. PURPOSE: This study focused on verifying the association between VO2max and coronary risk factors (total cholesterol (TC), LDL-cholesterol (LDL), HDL-cholesterol (HDL), triglycerides (TG), fasting glycemic index (GI) and systolic blood pressure (SBP)) in Brazilian military subjects aged over 40.

METHODS: The sample included 3851 military men, from 16 Brazilian cities, aged 44.8±4.01 yrs (Mean±SD), weighing 78.9±11.60 Kg and measuring 170.2±7.3 cm height. Anthropometric variables were measured with an accuracy of 100g and 0.5cm, respectively. Blood samples were collected after 12 hours fasting and then homogenized and centrifuged at 3000 rpm. Biochemical variables were measured by enzymatic method. Prior to SBP assessment, subjects remained sitting in upright position for 5 minutes. Data were recorded from both arms, considering the highest value. VO2max was indirectly estimated through Cooper 12 minutes test, and subjects were classified according to ACSM aerobic fitness patterns. The following values were considered as risk factors: TC ≥ 240 mg/dL, LDL ≥ 40 mg/dL, LDL ≥ 160mg/dL, TG ≥ 200mg/dL, fasting glycemia ≥ 110mg/dL, e PAS ≥ 140mmHg. Based on VO2max results, the sample was divided in Group1 (subjects with VO2max classified as good and excellent) and Group2 (subjects with weak and extremely weak VO2max). After this division, Odds Ratio (p<0.05) were calculated for each risk factor to verify subjects’ chances in showing unfavorable risk factor values.

RESULTS: Related to Group1, Group2 subjects showed increased risk for: TC (1,25; CI=1.01-1.67), LDL (1,68; CI=1,28-2.19), TG (1,66; CI=1,23-2.25); GLI (2,42; CI=1,36-4,33) and SBP (1,93; CI=1,46-2,55). No significant result was found in relation to LDL.

CONCLUSIONS: Data suggest that VO2max can effectively predict subjects’ chance of developing unfavorable lipid profile, glycemic profile and systolic blood pressure levels, among Brazilian military subjects aged over 40.

2348
Board #80 9:30 AM - 10:30 AM
Exercise Training to Reverse the Detrimental Effects of Physical Inactivity on Cardiovascular Risk
Jennifer L. Robbins1, Cris A. Slenz, FACSM1, Josepha T. Houndi , Brian D. Duscha1, Jennifer S. McCarthey2, William E. Kraus3, Duke University, Durham, NC, 2East Carolina University, Greenville, NC.

Physical inactivity is associated with increased risk of numerous chronic diseases and decreased longevity. Although exercise is known to enhance health and wellness, the extent to which one can reverse the debilitating effects of physical inactivity is unknown.

PURPOSE: Explore whether the negative effects that occur while being inactive can be reversed with a similar period of exercise training in a middle-aged and overweight population.

METHODS: Fifty-three subjects randomized to the inactive control group of the STRRIDE study elected to participate and be randomized into one of three exercise regimens upon completion of the six-month sedentary control period. Thirty-three of these subjects completed the following six months of sedentary-state exercise after a brief ramp period and served as the study population. Change scores in 17 variables were assessed during both the sedentary control and exercise periods.

RESULTS: Minimal waist, time to exhaustion, visceral fat, and the metabolic syndrome score (as assessed by the current revised ATP III criteria) significantly deteriorated during the six month inactive period. Body mass, minimal waist, relative peak VO2, time to exhaustion, LDL, LDL size, visceral fat, fasting insulin, HOMA, and insulin sensitivity significantly improved during the six months of exercise that followed. Thirteen of the 17 measured variables either completely reverted to baseline or improved beyond their baseline levels in a favorable direction post exercise.
training. Significant negative correlations were found between the change scores assessed during the inactive and exercise periods for body mass, minimal waist, LDL, triglycerides, SAT, VAT, fasting insulin, HOMA, and ATP III score.

CONCLUSION: Many of the detrimental effects of physical inactivity can be reversed with a similar period of exercise training. In addition, we observed that individuals who experienced the greatest decline while inactive appeared to obtain the largest improvements during the exercise regimen that followed.

Supported by NIH Grant HL-57354

2349 Board #81
8:30 AM - 9:30 AM
The Effects of an Acute Bout of Exercise on the Blood Lipids of Male Cigarette Smokers
Michael R. Kushnick,1 Brittany C. Waltz,2 Andrew D. Timothy,3 Bryant A. Stamford, FACSM,4 Robert J. Moffatt,1 Ohio University, Athens, OH. 1Hanover College, Hanover, IN. 2Florida State University, Tallahassee, FL.

A single bout of exercise has been shown to positively alter blood lipids in healthy, non-smoking men. However, since cigarette smoking negatively alters blood lipids, the positive effects of exercise on blood lipid has not been documented.

PURPOSE: Examine the effects of treadmill walking to expend 600kcal at 65% VO2peak on the blood lipids of male cigarette smokers (<10 cigarettes/day for ≥6months).

METHODS: Five cigarette smokers (SMK) who were 21±2yrs old, 76.9±9.3kg in weight, 1.8±0.1m tall, 14.3±5.1% body fat and had a VO2peak of 44.4±9.0ml/kg/min and five non-smokers (NS) who were 23±2yrs old, 85.9±13kg in weight, 1.8±0.1m tall, 19.9±5.2% body fat and had a VO2peak of 42.6±2.9ml/kg/min volunteered for this study. Each subject randomly completed two trials: a no exercise control trial (CON) and a 60kcal treadmill walk at 65% VO2peak (EXER). Body composition was determined with air plethysmography and VO2peak with open-circuit spirometry utilizing the Bruce treadmill protocol. Venipuncture was performed at baseline, 24, and 48hrs post-exercise of each trial for collection of fasting blood for the determination of lipids and LDL particle size. SMK continued to smoke on their regular schedules, but had ≥1 cigarette w/in one hour of each sampling period.

RESULTS: There were no group differences in descriptive data. Additionally, there were no differences between baseline CON and EXER data, nor in data over CON trial within each group. There were no differences in total cholesterol (TC), HDL-C, LDL-C or LDL particle size between groups at baseline EXER. NS had higher HDL-C (15.0±1.8 vs 7.6±3.5mg/dL) and lower triglycerides (TG; 84.6±10.9 vs 114.0±25.6mg/dL) as compared to SMK at baseline EXER. HDL-C increased at 24hrs post-exercise by 7.6% (46.0±6.3 to 49.8±9.3mg/dL) in NS, and 10.1% (43.5±5.0 to 48.3±6.1mg/dL) in SMK. HDL-C C825T gene polymorphism, a substitution of cytosine (C) for thymine (T) at the 34th position of the GNB3 cDNA, activates a cryptic splice site

2350 Board #82
9:30 AM - 10:30 AM
Delayed Cholesterol Analysis Negatively Affects Test Results
Kate C. Barnett, Katie Snodgrass, Dave Keizer, John G. Seifert, Dave W. Bacharach, FACSM, St. Cloud State University, St. Cloud, MN. (Sponsor: Dave W. Bacharach, FACSM)

Email: kathleenb4004@cloudstate.edu

Total cholesterol screening is a common health screening tool often performed along with fitness assessments due to the fact that elevated total cholesterol is a risk factor for cardiovascular disease. New recommendations for total cholesterol are below 200mg/dL. During health fairs where there are not scheduled appointments for subjects or when testing large numbers of subjects, the analysis of blood samples is often delayed. Manufacturers of testing strips warn that after blood is dispensed onto the reagent patch of the strip, the specimen must be inserted into the Reflotron machine within 15 seconds. This warning is often overlooked due to volume of tests.

PURPOSE: The purpose of this study was to determine the degree of change in cholesterol test results when strips were allowed to incubate at room temperature for varying amounts of time.

METHODS: Each of nine Roche Reflotron Cholesterol strips was saturated with 30 microliters of blood from the same blood sample. The strips remained in ambient conditions from zero to twelve minutes prior to being inserted into the Reflotron at 1.5-minute increments.

RESULTS: It was found that the cholesterol readings decreased linearly over time. The R² value was found to be 0.98. After twelve minutes, the total cholesterol readings decreased by 17.5%, with an average decrease of 2.2 mg/dL per minute. The slope of the regression line relating the cholesterol levels to time was found to be -2.53.

The results of this study demonstrated a linear decay due to enzymatic activity on the testing strips over time.

CONCLUSIONS: Cholesterol readings are affected greatly over time. A negative linear relationship exists between time blood is allowed to remain on the reagent patch of the strip and cholesterol readings. When using cholesterol strips to test total cholesterol levels, health professionals should analyze the test strips immediately after blood is dispensed on the strip.

2351 Board #83
8:30 AM - 9:30 AM
Cardiorespiratory Fitness and Coronary Artery Calcium in Young Adults: The Cardia Study
Chong D. Lee,1 David R. Jacobs,2 Carlos Irizarriren,3 Stephen Sidney4
1University of Louisville, Louisville, KY. 2University of Minnesota, Minneapolis, MN. 3Kaiser Permanente Medical Care Program, Oakland, CA

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Whether cardiorespiratory fitness relates to early coronary artery calcium remains unknown.

PURPOSE: We investigated the relation of cardiorespiratory fitness to coronary artery calcium (CAC) in 2398 African-American and White young adults from the Coronary Artery Risk Development in Young Adults (CARDIA) Study.

METHODS: We measured coronary calcium scores in 2001-2002 (year 15) using electron-beam or multi-detector computed tomography, and cardiorespiratory fitness was measured in 1985-1986 (baseline) using a maximal exercise test on a treadmill. Coronary calcium scores were classified as present (non-zero) or absent (zero), while cardiorespiratory fitness was classified as low fit (lowest sex-specific quartile), moderately fit (the 2nd and 3rd quartiles), and high fit (the highest quartile).

RESULTS: After adjustment for age, sex, race, clinical center, and education, baseline cardiorespiratory fitness levels were inversely associated with prevalence of CAC in young adults (p for trend <0.001). These associations persisted after additional adjustment for cigarette smoking, alcohol intake, systolic blood pressure, diabetes mellitus, and antihypertensive medication use (p for trend = 0.01). The odds ratios of having CAC for persons in the moderately and highly fit individuals were 0.77 (95% CI: 0.54-1.09) and 0.65 (95% CI: 0.35-0.88), respectively, as compared with the low-fit individuals. We observed similar associations in nonsmokers (p for trend = 0.04). Highly fit nonsmokers had a 45% (95% CI: 0.31, 0.97) and moderately fit nonsmokers had a 32% (95% CI: 0.44, 1.07) lower odds of having CAC, respectively, as compared with low-fit nonsmokers. These associations were attenuated and nonsignificant within current smokers. They were also attenuated by further adjustment for high-density lipoprotein and total cholesterol levels, triglycerides, and fasting insulin, suggesting that these may be intermediary factors between fitness and CAC.

CONCLUSIONS: High levels of cardiorespiratory fitness were associated with a lower risk of developing coronary calcium in African-American and White young adults. Supported by grant HL-53539 and by contracts HC-48048, HC-48048, HC-48049 and HC-48050 from the National Heart, Lung, and Blood Institute.

2352 Board #84
9:30 AM - 10:30 AM
Effect of a 12-wk Aerobic Exercise Program on Obesity Indices, Cardiopulmonary Fitness, and Metabolic Syndrome Markers Across the GN03 C825T Gene Polymorphism in Mid-Life Korean Women
Jiyoung Lee, Soohyun Park, Daeyeong Kim, Taekyoung Han, Shinho Lee, Donghyun Kim, Youngbae Lee, Hyeryun Hong, Eunhye Lee, Aeran Im, Yejin Hong, Seonae Shin, Euesoo Ann, Hyunmik Kang, Sungkyunkwan University, Suwon, Republic of Korea

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The C825T gene polymorphism, a substitution of cysteine (C) for thymine (T) at the nucleotide 825 of G-protein β3 subunit (GNB3) cDNA, activates a cryptic splice site that results in alternative splicing of exon 9, leading to deletion of 41 amino acids in the β3 subunit of GTP-binding proteins. In cross-sectional human studies, the 825T allele of the GNB3 polymorphism has been associated with hypertension and obesity in black Africans and Caucasians.

PURPOSE: The purpose of the present study was to investigate whether the GNB3 genotypes modulated the effect of a 12-wk aerobic exercise program on obesity indices, cardiopulmonary fitness, and metabolic syndrome markers in mid-life Korean women.

METHODS: A total of 51 abdominally obese women (waist circumference >80cm) aged 45-65 yrs were invited to participate in this study. Following an overnight fast, obesity indices (i.e., body mass index, percent body fat, waist circumference), cardiopulmonary fitness was determined during the treadmill exercise testing. Fasting glucose and lipoprotein-lipids (TC, HDLC, LDLC, TG), leptin, adiponectin were determined by using the commercial analysis kits. A 75g of oral glucose tolerance test (OGTT) were performed by using the standardized procedure. Then, all the subjects participated in a dance sports program for 12 weeks (2 hrs/day, 3 times/week). Following the dance sports program, the
same measurements performed at the baseline were conducted.

RESULTS: Two-way ANOVA analyses showed that the 12-wk aerobic exercise program resulted in significant improvements in all the measured variables (time effects only) except for SBP, DBP, and TC, while the degrees of the improvements were not dependent upon the GNB3 genotypes (no significant time by genotype interaction). However, both the CT heterozygotes and CC homozygotes tended to have greater reductions in area under curve during the OGGT than the TT homozygotes.

CONCLUSIONS: The current findings suggest that the degree to which exercise training improves insulin sensitivity (i.e., improved glucose tolerance) may be partially modulated by the GNB3 genotype.

2353
Board #85
8:30 AM - 9:30 AM
Influence of Brachial Artery Flow-Mediated Dilation on Estimated VO$_{2}$peak and CS-PFP Scores in Elderly Men
Michael A. Welsch, Devon A. Dobrosielski, Arturo A. Arce, Jennifer Fabre, Robert H. Wood, S. Michal Jaruzelski, Louisiana State University, Baton Rouge, LA, Louisiana State University Health Sciences Center, New Orleans, LA. (Sponsor: Arnold Nelson, FACSM)

Email: mwelsch@lsu.edu

The probability that an individual is able to live independently decreases sharply below the threshold score of 57 units on the Continuous-Stage Physical-Functional Performance (CS-PFP) test. Previous work has shown that the CS-PFP 10 threshold score is associated with a maximal oxygen uptake (VO$_{2}$max) of approximately 20 ml/kg/min. We hypothesized that a decrease in cardiorespiratory performance is in part a function of a decline in vascular reactivity, which may contribute to a declining score on the CS-PFP 10.

PURPOSE: To examine the influence of brachial artery flow-mediated dilation (BAFMD) and estimated VO$_{2}$max on CS-PFP 10 classifications.

METHODS: Thirty-eight men (Age: 85.1±13.1 yrs) from the Louisiana Healthy Aging Study were used for these analyses. Subjects were classified based on their performance on the CS-PFP 10 test (Class I: score<25; Class II: score between 26-57; and Class III: score>57). Brachial artery diameters were assessed before and after 5 minutes of forearm occlusion, using high-resolution ultrasonography. Estimated VO$_{2}$peak was based on the maximal walking distance (m) achieved on a 6-min walk test.

RESULTS: BAFMD (r = 0.49, p < 0.01), estimated VO$_{2}$peak (r = 0.88, p < 0.01), and Age (r = -0.62, p < 0.01) were significantly associated with the CS-PFP 10 score. Moreover, BAFMD was associated with estimated VO$_{2}$peak (r = 0.37, p < 0.05). BAFMD for Class III was significantly higher (BAFMD: 2.74±2.36%) than Class I (BAFMD: 0.98±1.24%) but not different from Class II (1.82±1.08%). Estimated VO$_{2}$peak was also significantly higher (p<0.05) for Class III (19.07±2.03ml/kg/min) compared to Class I (10.02±2.09ml/kg/min) and II (14.97±2.37ml/kg/min).

CONCLUSION: These findings confirm associations between BAFMD, estimated VO$_{2}$peak, Age and the CS-PFP 10 score. Moreover, significant differences in BAFMD and estimated VO$_{2}$peak between the CS-PFP 10 classes, suggests the drop in CS-PFP 10 scores may be a consequence of a decline in cardiorespiratory performance with age, and in part due to a decrease in vascular reactivity. This research was supported by a grant from the Louisiana Board of Regents through the Millennium Trust Health Excellence Fund [HEF(2001-06)-02], and by a grant from the National Institute on Aging (1 R01 AG20026).

2354
Board #86
9:30 AM - 10:30 AM
Long- but not Short-Term Multifactorial Intervention Improves Endothelial Dysfunction in Patients with Diabetes Mellitus Type 2 and Coronary Artery Disease
Josef Niebauer, Sebastian Sixl, Thomas Peschel, Holger Thiele, Gerhard Schuler.
Paracelsus University Salzburg, Salzburg, Austria.

Contribution for the GMR (1) ASKAG, Leipzig, Germany.

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We set out to assess the impact of 4 weeks in-hospital and further 5 months ambulatory multifactorial intervention program on changes of coronary risk factors and endothelial dysfunction of coronary arteries in patients with diabetes mellitus type 2 (DM) and coronary artery disease (CAD).

METHODS: Participants with DM+CAD were randomized to either a multifactorial risk factor intervention program (I), which focused on high-intensity exercise training (6x15 min bicycle/day, 5 days / week) during a 4-week in-hospital phase, followed by 30 min exercise/day, 5 days / week during a further 5 months home-based exercise phase, or a control group (C) in which usual care was rendered by patients’ private physicians. Changes in diameter of coronary arteries in response to intracoronary infusion of increasing concentrations of acetylcholine (0.072, 0.72, 7.2, 72 g/min) was assessed by quantitative coronary angiography and mean peak flow velocity by Doppler velocimetry.

RESULTS: At baseline there were no significant differences between groups in the parameters studied (p>0.05). After 4 weeks and 6 months there was significant improvement in I with regard to body weight, triglycerides, HbA1c, and maximal work capacity (all at p<0.05), whereas there were no differences observed in C (all p>0.05). Invasive measurements of endothelial function were not different at baseline and 4 weeks but showed significant improvement after 6 months in I (all at p<0.05) but not C. After 6 months but not after 4 weeks there was significant improvement in the diameter of epicardial coronary arteries and mean peak flow velocity both after acetylcholine or adenosine infusion in I (all at p<0.05), whereas in C values remained essentially unchanged.

CONCLUSIONS: There was significant improvement in the risk factor profile of patients with DM+CAD after 4 weeks and 6 months. Although 4 weeks of intervention were too short to induce significant changes in endothelial function, beneficial changes became apparent at 6 months. The ability of the endothelium to restore its function only after prolonged intervention may be explained by the advanced disease progression which is typical for diabetics and responsible for patients’ worse prognosis.
CONCLUSIONS: We conclude that moderate and high levels of physical activity are associated with reduced risk of peripheral artery disease in U.S. men and women.

2357 Board #89 8:30 AM - 9:30 AM
Aerobic Exercise and Cholesterol in Adults with Type 2 Diabetes: A Meta-Analysis
George A. Kelley, FACSM®, Kristi S. Kelley®, Zung Vu Tran, FACSM®. West Virginia University, Morgantown, WV.

PURPOSE: Conduct a meta-analysis of randomized controlled trials in order to examine the effects of aerobic exercise ≥ 2 weeks on lipids and lipoproteins in adults with Type 2 diabetes.

METHODS: Studies were included if fasting total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), ratio of TC to HDL-C (TC/HDL-C), and triglycerides (TG) were assessed. A secondary outcome was glycated hemoglobin (HbA₁c).

RESULTS: Five studies representing 157 males and females (80 exercise, 77 control) were available for pooling. Using resampling procedures appropriate for small meta-analyses, random-effects modeling resulted in non-significant improvements of 2%, 2%, 0%, and 4%, respectively, for TC (M ± SEM, 4.7 ± 3.9 mg/dL, 95% BC 7.9 to 0.5 mg/dL), HDL-C (1.1 ± 1.7 mg/dL, 95% BC: 1.5 to 4.2 mg/dL), LDL-C (-4.2 ± 3.3 mg/dL, 95% BC: -9.7 to 0.0001 mg/dL), TC/HDL-C (0.3 ± 0.2%, 95% BC: -0.8 to 0.04) and TG (6.8 ± 7.6 mg/dL, 95% BC: -1.61 to 1.9 mg/dL). A statistically significant reduction was observed for HbA₁c, a secondary outcome of this study (0.6 ± 0.2%, 95% BC: 1.2 to 0.2).

CONCLUSIONS: Aerobic exercise does not improve TC, HDL-C, LDL-C, TC/HDL-C or TG in adults with Type 2 diabetes but does improve glycemic control as assessed by HbA₁c. Supported by NIH-NHLBI Grant RO1 HL069002.

2358 Board #90 9:30 AM - 10:30 AM
Daily Physical Activity and Plasma Lipid Concentrations in Early Pregnancy
Seonae Yeon, Nick Rafael, Kathy Bishop. University of Michigan, Ann Arbor, MI. (Sponsor: Robert Kinningham, FACSM)

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Maternal plasma lipids are elevated during pregnancy. Early pregnancy dyslipidemia is associated with an increased risk of preeclampsia. Physical activity improves lipid profiles in non-pregnant adults.

PURPOSE: To determine the relationship between lipid profiles of pregnant women at risk for preeclampsia and their daily physical activity levels.

METHODS: The sample for this analysis was drawn from participants of the ongoing study designed to determine the effect of regular exercise on the incidence of preeclampsia. The study sample is comprised of 70 sedentary pregnant women with a past medical history of preeclampsia. From structured questionnaires and medical records, we obtained information including maternal age, ethnicity, education, height and weight and physical activity at 18 weeks gestation (at the time of blood collection). Plasma lipid concentrations were measured enzymatically by standardized assays. Daily physical activity levels were classified into 3 groups: leisure time physical activity (LTPA), domestic activity (DA) and occupational activity (OA). Protocols were approved by the IRB at each institution.

RESULTS: Study sample (n=70) was comprised of mainly Caucasian (80%) and 60% had at least college education (age: 31.2 ± 3.8). Women with high OA level had 18.0% higher concentration of HDL cholesterol than women with low OA level (73.5 ± 9.0 vs. 62.3 ± 4.7 mg/dL, p=0.046). Remainder lipid categories were not significantly correlated with any other physical activities. A significant increase in the odds of having high HDL concentration (≥63.5 mg/dL) was observed among women with high OA level compared to women with low OA level (OR=4.87, 95% CI 1.06 to 22.38).

CONCLUSION: These analyses suggest that women with a sedentary lifestyle but physically involved work life may have a favorable cholesterol profile in early pregnancy. Further studies are needed to examine the overall physical activity during pregnancy and risk of preeclampsia. (Funded by RO1 NR05002; NIH)

2359 Board #91 8:30 AM - 9:30 AM
The Association between Leisure Physical Activity and Lipoprotein Subclasses in 40–49 Year Old Men
Kristi L. Storti, Kelley K. Pettee, Aiman El-Saied, Tomoko Takamnya, Akira Sekikawa, Andrea M. Kriska, FACSM. University of Pittsburgh, Pittsburgh, PA.

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Participation in physical activity has been shown to be beneficially related to traditional lipid measures. Recent advances in technology have produced new techniques that have the ability to measure specific lipoprotein subclasses; however evidence regarding the association between physical activity and these lipoprotein subclasses is limited. It has been suggested that the amount of cholesterol carried inside lipoprotein subclasses is highly variable among individuals with the same measured cholesterol. Individual lipoprotein subclasses can now be differentiated by this new technique.

PURPOSE: To determine the association between leisure physical activity and both traditional lipid measures and lipoprotein subclasses in middle-aged Caucasian and African American men.

METHODS: A population-based sample of 216 randomly-selected Caucasian and African American men aged 40–49 (mean age 44.8 ± 2.9, 17.1 % African American) was examined. Physical activity was assessed using a validated past six-month, interviewer-administered questionnaire. Traditional lipid measures were obtained from fasting blood samples analyzed at the Department of Epidemiology’s Heinz Laboratory. Lipoprotein subclasses were measured with nuclear magnetic resonance (NMR) spectroscopy. Multivariate linear regression models were created to examine the association between physical activity and both traditional lipid measures and lipoprotein subclasses. Each model was adjusted for potential confounding factors.

RESULTS: After adjusting for age, BMI, race, and lipid lowering drug usage, physical activity was not significantly related to traditional lipid measures with the exception of triglycerides (p = 0.03). However, physical activity was significantly related to many important lipoprotein subclasses. More specifically, large LDL (p<0.002), medium LDL (p<0.02), small LDL (p<0.04), and very small LDL particle number (p<0.04), triglycerides (p<0.01) and VLDL triglycerides (p<0.02) decreased as physical activity increased.

CONCLUSIONS: Physical activity was not associated with traditional lipid measures with the exception of triglycerides. However using newer techniques, such as NMR, many more important associations were noted that otherwise would not have been evident using traditional measures. As more precise techniques are being used, the relationship between physical activity and blood lipids is becoming more evident, reaffirming the importance of a physically active lifestyle. Supported by: RO1HL068200

2360 Board #92 9:30 AM - 10:30 AM
The Relationship Between Leisure Physical Activity, Lipoprotein Sub-Classes, and Hormone Therapy in Postmenopausal Women

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After menopause, women experience increased risk of cardiovascular disease, due in part to worsening lipid profiles. Participation in physical activity and hormone therapy can favorably alter the lipid profile.

PURPOSE: To determine the association of physical activity and lipoprotein subclasses in post-menopausal women on and off hormone therapy (HT).

METHODS: Subjects for this cross-sectional analysis included 485 postmenopausal (mean age 56.9 ± 2.9 years) Caucasian and African-American women from the Woman On the Move through Activity and Nutrition (WOMAN) study. Based on self-report, women were grouped as HT users or non-users. Physical activity was collected using a validated past year, interviewer administered questionnaire. Lipoprotein sub-classes were measured with nuclear magnetic resonance (NMR) spectroscopy. Multivariate linear regression models were constructed to examine the association between physical activity and lipoprotein subclasses after adjustment for potential confounders. An interaction term was added to the regression models to determine HT stratification. Multivariate linear regression models and linear tests for trend were used to further explore this relationship by HT use.

RESULTS: HT users (n=286) were younger (p<0.008), less likely to be African American (p<0.0001), reported higher leisure physical activity (p=0.01), and had higher HDL (p=0.004), large VLDL (p=0.0499), and medium HDL (p=0.0001) levels, had a larger mean HDL size (p<0.01), and less small and medium HDL (p=0.01) and small VLDL (p=0.002) levels than non users (n=196). Physical activity was significantly related to many lipoprotein subclasses such as HDL, large HDL particle number, total VLDL particle number, triglycerides, and VLDL triglycerides, regardless of HT use. In contrast, some relationships were found to vary significantly by HT use. In non-users, HDL size (p=0.01) and LDL size (p=0.007) increased and LDL particle number (p=0.01), medium (p=0.003), small (p<0.003) and very small LDL (p=0.004) decreased as physical activity increased. This relationship was not found in HT users.

CONCLUSIONS: Physical activity was significantly related to many lipoprotein subclasses regardless of HT. However, for a substantial number of subclasses, the relationship was found only in non-HT users. As more postmenopausal women choose to forego or discontinue HT, participation in leisure physical activity for reducing lipid levels, among other health benefits, is recommended. Supported by NIH Grant: R01HL066468

#1362-1849-WEDNESDAY, MAY 31 | #1350-2268-THURSDAY, JUNE 1 | #2269-2726-FRIDAY, JUNE 2 | #2727-2915 - SATURDAY, JUNE 3
Fatness and Fat Distribution, particularly WC and WHR. Sex- and race-associated (Adjusted R squared=.30 vs. .24). Also, the best predictor for DBP in females and AI, WHR was the best predictor of DBP in males and AI. WC was the variance in DBP. However, predictors of blood pressure varied by sex and race, and SBP and DBP for the sample, accounting for 21.0% of the variance in SBP and 24.5% of (p<0.05). All fatness and fat distribution indices were significantly and positively related results: A meta-analysis of Walking and Cardiovascular Risk: A Meta-Analysis of MetHoDs: A cross-sectional study was undertaken of 176 adults (61 males, 115 females; 38.1% AL, 61.9% C), ages 18-71, mean age 40.9 years, SD=12.0 years, who were employed by the Coeur d’Alene Casino at the time of the study. Body mass, stature, subcutaneous and triceps skinfolds (SKF), waist circumference (WC) and hip circumference, and resting SBP and DBP were measured according to standardized procedures. BMI, Sum of SKF (SUMSKF), waist:hip ratio (WHR), and subcutaneous:triceps skinfold ratio (SUB:TRI) were derived. RESULTS: Significant sex differences were found for all variables except BMI and hip circumference, with greater values for males than females (p<0.05). In contrast, only two significant race differences were found, with AL having greater WC and WHR than C (p<0.05). All fatness and fat distribution indices were significantly and positively related to SBP and DBP for the sample (r= 0.65, p<0.05). WC was the best predictor of both SBP and DBP for the sample, accounting for 21.0% of the variance in SBP and 24.5% of the variance in DBP. However, predictors of blood pressure varied by sex and race, and included indices of both fatness and fat distribution. WC was the best predictor of SBP in females and C, while WHR was the best predictor of SBP in males and AI. WC was also the best predictor of DBP in females and AI. WHR was the best predictor of DBP in males, and BMI was the best predictor of DBP in C. SBP was better predicted than DBP (Adjusted R squared= -30 vs. 24). CONCLUSIONS: Regular health screenings of adults should include measures of both fatness and fat distribution, particularly WC and WHR. Sex- and race-associated differences should also be considered in identifying or predicting chronic disease risk. (Funded by the Robert Wood Johnson Foundation, Grant # 42950)
metabolic profile was at least 37.0 and 42.1 ml*kg\(^{-1}\)*min\(^{-1}\) in girls and boys, respectively.

**CONCLUSION:** CRF is a useful measure to identify the presence or absence of a favourable metabolic profile in children, and a hypothetical CRF level required for a favourable metabolic profile has been suggested.

2365 **Board #97** 8:30 AM - 9:30 AM

**Physical Activity and Cardiovascular Risk Factors in African American Girls**

Barbara S. McClanahan, Jennifer Lanctot,1 Michelle Stockton,2 Deborah L. Slawson,2 Robert C. Klesges,1 Lisa Klesges,1 George Rulya5 1University of Memphis, Memphis, TN; 2Mayo Clinic College of Medicine, Rochester, MN.

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Chronic diseases, long prevalent among adults, are now emerging in much younger populations. Lack of physical activity is a contributing factor to the high prevalence of obesity and an independent risk factor for cardiovascular disease. However, little is known about relationships between physical activity and cardiovascular risk factors in youth. African American girls appear to be at particular risk for the consequences of inactive lifestyles as they report high rates of inactivity and obesity.

**PURPOSE:** The purpose of this study was to explore the relationship between physical activity levels and selected cardiovascular risk factors in African American girls.

**METHODS:** This study included 303 African American girls between 8 and 10 years of age participating in a baseline assessment of a weight gain prevention intervention. Minutes of moderate to vigorous (≥ 3001 counts/min) physical activity was objectively measured with an accelerometer (MTI Actigraph) and averaged for three days. The counts recorded between the hours of 7:00am to 10:59pm were used for analysis and the log transformation was performed which resulted in a normal distribution. Paper-pencil questionnaires were used to collect demographic information. Self-assessed maturational status ( Tanner) and measured body mass index (BMI), systolic and diastolic blood pressure, mean arterial pressures (MAP) and resting heart rate (RHR) were determined using standardized protocols.

**RESULTS:** The following thirteen independent variables were entered into a linear regression: parent’s income, parent’s highest education, total number of children in the household, number of media items in the household, girl’s age, Tanner, percent body fat (BIA), BMI percentile based on the CDC charts according to age and gender, systolic blood pressure, diastolic blood pressure, RHR, and MAP. Multicollinearity was not present as indicated by the largest variation inflation factor being 2.9. A model including all independent variables explained 25.4% of the total variance in moderate to vigorous activity. Five variables explained significant variability in activity including BMI percentile (β = .195), RHR (β = .185), age (β = -.170), income (β = .170), and children in the home (β = .130).

**CONCLUSION:** Older girls, those at higher BMI and higher RHR were less physically active than their respective counterparts after controlling for other covariates in the model. Greater household income and more children in the household were related to higher physical activity levels. Activity levels were not related to covariates in the model. Greater household income and more children in the household were associated with higher physical activity levels. Activity levels were not related to covariates in the model. Greater household income and more children in the household were associated with higher physical activity levels. Activity levels were not related to covariates in the model. Greater household income and more children in the household were associated with higher physical activity levels.
multivariable models, when compared with 695 men with both HR characteristics normal, the relative risks (RRs) for CVD and CHD death in 355 men with only one adverse characteristic were 1.8 (95% CI 0.8-4.0; p=0.17) and 3.3 (9.0-11.4; p=0.06). In 91 men with both adverse characteristics the corresponding RRs for CVD and CHD death were 1.1 (1.8-10.4; p=0.001) and 3.1 (7.3-43.9; p=0.001).

CONCLUSION: In middle-aged men without prior coronary heart disease, an exaggerated HR increase at the beginning of an exercise test and a blunted HR rise at the latter half of the test together is a stronger predictor for premature CVD mortality than either of these adverse HR characteristics alone.

2369 Board #101 8:30 AM - 9:30 AM Influence of Exercise and Non-exercise Physical Activity on Mortality in Chinese Women
Charles E. Matthews, FACSM1, Adriana Jung1, Xiao-Ou Shu1, Honglan Li, Gong Yang1, Gu Li1, Yu-Tang Gao1, Wei Zheng1. 1Vanderbilt University Medical Center, Nashville, TN. 2Shanghai Cancer Institute, Shanghai, China.

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PURPOSE: To describe the effect of both exercise and non-exercise physical activity on risk for mortality among Chinese women.

METHODS: The Shanghai Women’s Health Study (CA70867) is a prospective cohort study that enrolled 74,842 women between 1997 and 2000. The cohort has been followed for an average of 5.7 years via in-person follow-up and linkage with vital disease registries (>2% lost to follow-up). At baseline, in-person interviews were conducted to gather relevant exposure information (demographics, health behaviors, medical and weight history). Physical activity patterns were characterized in terms of exercise participation (adolescence [13-19 yrs], adulthood [last 5 yrs]), active transport (walking, cycling), household chores, stair climbing, and by type of occupation. An index of non-exercise activity (active transport, household, stair climbing) energy expenditure was calculated. Proportional hazards models were used to estimate hazard ratios and 95% confidence intervals (HR [95% CI]) and adjust for relevant covariates. Only women with no history of heart disease, stroke, or cancer at baseline were enrolled (N=67,480).

RESULTS: Women aged 51.7 (SD=8.8) yrs at baseline contributed 384,889 person-years (PY) of observation and deaths from all-cause deaths (n=1,108), cardiovascular disease (n=199), cancer (n=545), and other causes (n=1,264) were recorded during follow-up. Examination of exercise participation in each life-period, in mutually exclusive categories, revealed that exercise only in adolescence (HR=0.79 [0.62-0.99]), only in adulthood (HR=0.82 [0.70-0.97], and in both life-periods (HR=0.66 [0.52-0.83]) reduced risk for all-cause mortality, compared to women that reported no exercise. Increasing levels of non-exercise activities, by quartile (Q), were associated with reduced risk of all-cause mortality (Q1-referee; HR=0.80 [0.69-0.94]; HR=0.64 [0.54-0.76]; HR=0.66 [0.56-0.79]). Occupational activity estimated from job codes was not associated with all-cause mortality. Exclusion of deaths occurring early in follow-up (first 2 yrs) did not substantively alter these results. The strongest effect of activity was noted for cancer and other causes of death, and there was no clear effect on cardiovascular mortality, which was predominantly derived from stroke in this analysis.

CONCLUSIONS: Both exercise and common non-exercise activities (e.g., walking, cycling, and household chores) were associated with reduced risk for early mortality. The present findings support current health promotion efforts that encourage the public to increase their non-exercise activity levels.

2370 Board #102 9:30 AM - 10:30 AM Chronic Respiratory Questionnaire as a Predictor of Exercise Participation in Individuals with COPD
Shruti K. Nagaria, W. Jack Rejeski, Katie Wickley-Krupel, Michael J. Berry, FACSM, Wake Forest University, Winston-Salem, NC.

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The Chronic Respiratory Questionnaire (CRQ) is a well-established and a widely used measure of health-related quality of life (HRQOL) for individuals with pulmonary diseases including Chronic Obstructive Pulmonary Disease (COPD). Although regular exercise participation has been shown to improve CRQ scores in COPD patients, relatively little is known about the relationship between CRQ scores and exercise related behavior including outcomes such as attendance and volume of exercise.

PURPOSE: To examine the relationship of CRQ scores to both attendance at scheduled center-based visits (exercise adherence) and to the average distances walked (volume of exercise) during training in individuals with COPD while statistically controlling for age, number of comorbidities, and pulmonary function.

METHODS: Seventy-four participants (age = 67.0 ± 9.9 years; height = 1.72 ± 0.09m; weight = 83.4 ± 22.5 kg) with COPD completed the CRQ (mean total score = 13.9 ± 3.4) and a pulmonary function test to determine their forced expiratory volume in one second (FEV1) as a percentage of predicted values (52.8 ± 18.8%). Participants then started an exercise program where they were expected to complete a total of 36 exercise sessions over a 3-month period with walking as the primary aerobic activity. Participants were asked to record the distance they walked during each exercise session.

RESULTS: Regression analyses and partial correlations were performed while controlling for age, number of comorbidities, and FEV1. Total CRQ scores were found to be positively correlated, r = 0.261, p = 0.03 with adherence of the participants to the exercise program. Total CRQ scores were also found to be positively correlated, r = 0.442, p < 0.01 with the volume of exercise performed by the participants during the exercise sessions.

CONCLUSION: Total score of the CRQ significantly and independently predicts exercise adherence and the volume of exercise performed by individuals with COPD in a 3-month training program. Individuals with higher CRQ scores were more adherent to exercise training and performed higher volumes of exercise than those with lower scores. These results underscore the role of psychological factors in understanding exercise behavior of individuals with COPD.

Supported by NIH Grants HL 53575 and AG 10484

2371 Board #103 8:30 AM - 9:30 AM Relationship Between Fitness, Insulin Resistance, and Vascular Reactivity to Mental Challenge in Young Females
Young J. Park, Justin R. Jones, Yati N. Boutcher, Gail E. Trapp, Stephen H. Boutcher, FACSM. University of New South Wales, Sydney, Australia.

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Previous research has shown that obese individuals possess blunted limb blood flow response (LBFR) to mental challenge. However, if reduced forearm LBFR is also present in non-obese women possessing insulin resistance (IR) is undetermined.

PURPOSE: To examine the relationship between insulin resistance and LBFR in IR (n=7) and normal insulin resistance (NI) women (n=11).

METHODS: Subjects (22±0.9 yr) had peak oxygen uptake, body composition (DEXA), blood lipids, and diet assessed. Insulin resistance (HOMA) and cardiovascular response (cardiac output, blood pressure) to a 5-min Stroop mental challenge were also measured on separate occasions. Women, decreased=3 mmHg, p < 0.05 for Men

RESULTS: No significant differences in peak oxygen uptake, body composition, blood lipids, and diet existed between the IR and IN groups. Also both groups demonstrated similar cardiac output and blood pressure response to Stroop. In contrast, IR women (n=7) had a 3 mmHg: Men, decrease=3 mmHg, p < 0.05; Women, decrease=5.2 lbs., p < 0.05; obese subjects: Men, decrease=7.3 lbs., p < 0.05; Women, decrease=7 mmHg, p < 0.05) lower LBFR (change from baseline to Stroop) compared to IN women (1±0.2 ml.100 ml tissue min–1) had significantly (P<0.05) lower LBFR (change from baseline to Stroop) compared to IN women (1±0.2 ml.100 ml tissue min–1).

CONCLUSIONS: Despite similar peak oxygen uptake, body composition, and blood lipids, young adult females who were insulin resistant possessed significantly reduced LBFR to mental challenge compared to normal insulin resistant young women.

2372 Board #104 9:30 AM - 10:30 AM Effect of Gender on Responsiveness of Systolic and Diastolic Blood Pressure to Therapeutic Lifestyle Changes
Kirk D. Hendrickson1, Laurence S. Sproll1, Richard D. Salmen1, George C. Faircloth1, Kim R. Gordon1, Neil F. Gordon, FACSM1, Barry A. Franklin, FACSM1, Adam delong3. 1William Beaumont Hospital, Royal Oak, MI. 2Emory University School of Medicine, Atlanta, GA. 3Interventive Coordinating Center, Savannah, GA.

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BACKGROUND: Emerging data have displayed important gender-based differences in the response to cardiovascular disease therapies. Although national clinical guidelines promulgate therapeutic lifestyle changes (TLC) as a cornerstone in the prevention and management of prehypertension and hypertension in both men and women, scarce comprehensive data are available on the effect of gender on blood pressure (BP) responses to TLC.

PURPOSE: To determine the gender specific effect of TLC on BP responses, we evaluated BP responses to TLC in men and women.

METHODS: In this study, we compared the clinical effectiveness of TLC in 2,144 consecutive men (n=543; age=47±10 years) and women (n=1,601; age=46±10 years) who were not taking antihypertensive medication. Subjects were evaluated at baseline and after approximately 12 weeks of participation in a community-based lifestyle management program. TLC included exercise training, nutrition, weight management, stress management, and smoking cessation interventions. All subjects remained off antihypertensive medications throughout the study.

RESULTS: Body weight decreased to a greater degree (p<0.05) with TLC in men versus women (all subjects: Men, decrease=5.2 lbs., p<0.05; Women, decrease=3.7 lbs., p<0.05; obese subjects: Men, decrease=7.3 lbs., p<0.05; Women, decrease=5.4 lbs., p<0.05). In contrast, systolic BP (all subjects: Men, decrease=5 mmHg, p<0.05; Women, decrease=6 mmHg, p<0.05; subjects with a baseline value ≥120 mmHg): Men, decrease=7 mmHg, p<0.05; Women, decrease=10 mmHg, p<0.05) and, to a lesser degree, diastolic BP (all subjects: Men, decrease=3 mmHg, p<0.05; Women, decrease=3 mmHg, p<0.05; subjects with a baseline value ≥80 mmHg): Men, decrease=6 mmHg, p<0.05; Women, decrease=7 mmHg, p<0.05) tended to be reduced to a greater degree in TLC in women versus men (p<0.05 for Men versus women except for diastolic BP, all subjects). Similarly, the prevalence of

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#1362-1849-WEDNESDAY, MAY 31 #1850-2288-THURSDAY, JUNE 1 #2269-2726-FRIDAY, JUNE 2 #2272-2915 - SATURDAY, JUNE 3
Prevalence of tinea pedis among athletes suggests a need for primary prevention, and improved athletic performance.

### E-30 Free Communication/Poster – Medical Concerns

**FRIDAY, JUNE 2, 2006 8:30 AM - 10:30 AM**

**ROOM: Hall B**

**Board #105** 8:30 AM - 9:30 AM

**The Prevalence of Tinea Pedis in Professional and College Soccer Players Versus Non-athletes**

Tiffany L. Pickup, Brian B. Adams, FACS in. University of Cincinnati College of Medicine; Department of Dermatology, Cincinnati, OH.

Some of the most common injuries afflicting the athlete affect the skin. Tinea pedis can have detrimental results on athletic participation and sports performance, yet very few studies have examined the epidemiology of tinea pedis and no studies have occurred in the United States. Furthermore no studies have examined the comparative prevalence of tinea pedis in professional and college athletes. Lastly, very little is known about the differences between college male and female athletes in terms of tinea pedis.

**PURPOSE:** To determine and compare the prevalence of tinea pedis and associated risk factors among professional soccer players, college soccer players, and non-athletes.

**METHODS:** Soccer athletes from a local professional men’s team and both the NCAA women’s and men’s teams from a local division 1 college anonymously answered questions relating to several risk factors for tinea pedis including age, gender, race, history of tinea pedis, previous treatment, and hygiene habits. A dermatologist examined all the athletes’ feet and scraped suspicious lesions for potassium hydroxide examination and culture. The investigators repeated the same questions and examinations for a group of non-athletes that acted as a control.

**RESULTS:** The prevalence of tinea pedis was 69% (N=11 of 16) in professional soccer players, 69% (N=11 of 16) in male NCAA soccer players and 43% (N=6 of 14) in female NCAA soccer players. Non-athletes (with a prevalence of 10%) possessed significantly less tinea pedis (p < 0.001). Athletes were 5.7 times more likely to develop tinea pedis compared to non-athletes (p < 0.001) and males were 2.5 times more likely than females to develop tinea pedis (p < 0.01). Additionally the presence of tinea pedis during this study was associated with an athlete’s history of tinea pedis (p = 0.02).

**CONCLUSIONS:** Athletes experience a significantly greater prevalence of tinea pedis, though there are no statistical differences between college and professional athletes. The high prevalence of tinea pedis among athletes suggests a need for primary prevention. Interventions such as coach and athlete education, increased attention to hygiene, and routine use of topical antifungals in the locker rooms may mitigate this epidemic; further controlled studies are warranted.

**Board #106** 9:30 AM - 10:30 AM

**Weight Loss Practices of College Wrestlers: A 5-Year Follow-Up**

Robert A. Oppliger, FACS in. James R. Scott 2, Alan C. Utter, FACS in. 1 Appalachian State University, Boone, NC. 2 University of Washington, Gig Harbor, WA.

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In 1998, the NCAA made significant changes in rules to curtail excessive weight cutting among wrestlers.

**PURPOSE:** To survey weight loss behaviors among college wrestlers.

**METHODS:** We surveyed 712 wrestlers from 36 schools including 14 Division I, 8 Division II, and 14 Division III. The retrospective survey covered the 2003-04 competitive year and included items from a similar tool administered in 1999.

**RESULTS:** Excluding heavyweights (n=29), the primary methods of weight loss used frequently (≥2 times/week) were increased exercise (78.8%), gradual dieting (71.3%) and restricting food (45.6%). Unhealthy behaviors including restricting fluids (30.4%) and fasting (9.8%) were also employed. Banned behaviors including use of a heated wrestling room (47.4%), rubber/plastic suit (9.0%), and saunas (8.4%) were prevalent. These results show few differences compared to the 1999 survey.

**CONCLUSION:** Weight loss behaviors have changed little in five years and still include unsafe and illegal practices.
Results: The initial values during RE-period values of T-group and C-group were on Day3 in Ex-period and the PAIN values both than those of C-group (p<0.05%). In 3 days of the Ex-period, all PAIN values in T-group, increased significantly on Day3 in Ex-period to Day5 in RE-period for 7 days after exercise periods. CK values of T-group, increased significantly on Day3 in Ex-period to Day5 in RE-period and 13 items (11-72%)

Conclusions: This study reveals various levels of compliance in meeting AHA recommendations to screen for sudden cardiac death and suggests athletes at risk for sudden cardiac death may not be identified prior to participating in athletics.

Methods: The Missouri and Kansas High School Athletic Associations were contacted to obtain a list of high schools in their respective states. A letter was then sent to the athletic director of the forty three 4A, 5A and 6A schools within a 25- mile radius of Kansas City requesting a copy of the school’s PPE form. Returned forms were analyzed to determine the presence or absence of the 18 different recommendations designated by the AHA for inclusion in the pre-participation screening. Percent compliance for each school was then assessed.

Results: Forty two of the 43 schools returned a copy of the PPE for a 98% response rate. Missouri schools used five different PPE forms; one standard form was used in Kansas. The Kansas form contained 12 of the 18 items (67%) suggested for inclusion in the pre-participation evaluation, while the five Missouri forms contained between 2 and 13 items (11-72%).

Conclusion: The result of this investigation suggests that hot-pack treatment for 7 days after exercise periods enlarges the size of blood vessels, increases the circulations of the blood and decreases the pain.

Purpose: To determine how well the pre-participation evaluation (PPE) forms used by the larger high schools in the Kansas City Metropolitan area identify athletes at risk for sudden cardiac death as based on the AHA recommendations.

Methods: The Missouri and Kansas High School Athletic Associations were contacted to obtain a list of high schools in their respective states. A letter was then sent to the athletic director of the forty three 4A, 5A and 6A schools within a 25-mile radius of Kansas City requesting a copy of the school’s PPE form. Returned forms were analyzed to determine the presence or absence of the 18 different recommendations designated by the AHA for inclusion in the pre-participation screening. Percent compliance for each school was then assessed.

Results: Forty two of the 43 schools returned a copy of the PPE for a 98% response rate. Missouri schools used five different PPE forms; one standard form was used in Kansas. The Kansas form contained 12 of the 18 items (67%) suggested for inclusion in the pre-participation evaluation, while the five Missouri forms contained between 2 and 13 items (11-72%).

Conclusion: This study reveals various levels of compliance in meeting AHA recommendations to screen for sudden cardiac death and suggests athletes at risk for sudden cardiac death may not be identified prior to participating in athletics.

Purpose: To evaluate the cognitive sequelae following a first concussion in a group of university-level female soccer players, 7 to 9 months after the injury.

Methods: A group of first time concussed athletes was compared to a group of age-matched team-mates who never experienced a concussion. Paper-pencil and computerized tasks were used to assess different aspects of neuropsychological functions.

Results: Short- and long-term verbal memory, selective visual attention, and sustained attention were normal. In contrast, executive functions were impaired.

Conclusion: Results of this study suggest that frontal lobe executive functions are most vulnerable to a sports-related concussion and are still affected over half a year post-injury.
SUBJECTS: The mean age of those 10 subjects was 24.2 years, the mean height was 182.2 cm, and the mean weight was 77.3 kg.

METHODS: This study had 3 group: control group, bracing group, and taping group and each subjects was repeated measure applied on the dominant leg by using the Kin-Com isokinetic dynamometer. In 15 degrees plantar-flexion tested and compared the different of absolute error of angle from middle angle and terminal angle under inversion/eversion movement. One-way ANOVA was used to analyzing the different of absolute error of angle on the three groups.

RESULTS: The results of this study indicated the following things: there was revealed that a significant difference between the control group and bracing group, and control group and taping group on both the middle angle and terminal angle (p<.05); there was no difference between bracing and taping group on the middle angle and terminal angle (p>.05). Among different groups: there was a significant difference between middle angle and terminal angle in control group; there was no difference between middle angle and terminal angle in tapping group and bracing group. At terminal angle, the passive tension of ankle lateral ligament under inversion movement between different groups was indicated that: the more passive tension of ankle lateral ligament, the less absolute error of angle on control group and bracing group.

CONCLUSIONS: on taping group, no matter how passive tension changes, the absolute error of angle stayed stable. This study demonstrated that ankle brace and taping improve proprioceptive function in healthy subjects.

2382 Board #114 9:30 AM - 10:30 AM

Effect of Weight Loss on Exercise Capacity and Erythropoietin in Weight-Grade Women Player According to the Helicobacter Pylori Infection

Dae-young Kim, Dong-hee Kim, Young-bok Yoon, Younab Kim, Hayan Lee, Myoun-Young, Hee-won Kim. Chonnam National University, Gwangju, Republic of Korea.

PURPOSE: This study was to investigate the effect of weight loss on exercise capacity and erythropoietin.

METHODS: The subjects for this study were divided into 2 groups: Helicobacter pylori infection group(n=18, HPIG), Helicobacter pylori non infection group(n=16, HPNIG) for 3 weeks. The method of weight loss(5-7% of each subjects) performed exercise, diet and sauna. The change of exercise capacity such as VO2_max, peak power, mean power and erythropoietin were measured before and after weight loss(1st week, 2nd week and 3rd week respectively). Data analysis were independent t-test and ANCOVA.

RESULTS: 1. VO2_max, peak power and mean power were shown tendency of increasing in two groups after 3 weeks of weight loss, but there were no significant difference. 2. Erythropoietin was shown a case of increasing in two groups after 3 weeks of weight loss, but after 3 weeks only HPIG had been increased as significant difference. Also, erythropoietin was significantly higher in HPIG than that of HPNIG after 3 weeks of weight loss.

CONCLUSIONS: These data suggest that Helicobacter pylori has emerged as a new cause of iron deficiency anemia. That is, Helicobacter pylori may have a role in causing anemia in weight grade players. Therefore, screening for Helicobacter pylori should be extended to cover the players who had iron deficiency anemia.

2383 Board #115 8:30 AM - 9:30 AM

Results of a Clinical Surveillance on Collagen Hydrolysate Consumption in Osteoarthritis

Winfried Brauner, Anke Ziesing, Dietmar Alp. "Johann Wolfgang Goethe-University, Department of Sports Medicine, Frankfurt, Germany. "Olympic Center Rhein-Ruhr, Essen, Germany."

Osteoarthritis (OA) is a degenerative joint disease characterized by gradual destruction of articular cartilage. Often called “wear-and-tear arthritis” or “old person’s arthritis,” OA tends to get worse as a person gets older. This means that OA is more likely to occur in large joints such as the hip, knee, and back. Often called “wear-and-tear arthritis” or “old person’s arthritis,” OA is a very common condition that affects millions of people around the world. However, the specific effects of OA on neuromuscular activation and joint kinematics and kinetics during sport-specific movements have not been clearly identified.

PURPOSE: To determine the effects of OA on lower extremity muscle activation, kinematics and kinetics in young women during a 40-cm drop-jump task.

METHODS: Fifteen women (age, 24.6 ± 2.6) participated in this study. Measurements were collected during non-fatigued and fatigued sessions. For both sessions 11 retroreflective markers and surface pre-amplified electrodes were applied to the dominant lower extremity. Each participant performed a warm-up protocol and two practice trials before the five measured trials. The jump consisted of dropping on one foot from a 40-cm box and immediately performing a maximal vertical jump after landing on the force plate. The fatigued session was similar to the non-fatigued session except for the addition of a Wingate Anaerobic protocol before the fatigued trials. Participants performed the fatigued session’s drop-jumps immediately following the fatigue protocol with less than 30 seconds rest between trials. Time synchronized initial contact and peak landing kinematics and kinetics were measured using five digital cameras (60 Hz) and a force plate (1000 Hz). Surface electromyographic (SEMG) recordings from the gluteus maximus, quadriceps and hamstrings were collected at 1000 Hz using a computerized telemetry unit time-synchronized to the force plate and video. Quadriceps/hamstrings co-contraction ratios and glutes, quadriceps and hamstrings muscle activity were quantified by utilizing a functional normalization procedure.

RESULTS: Multivariate analysis of variance with session as a repeated measure showed no statistically significant differences for initial contact or peak joint angles for the pelvis, hip and knee. No differences were found for peak ground reaction forces, initial contact or peak knee joint moments. SEMG multivariate analysis revealed no statistically significant differences between sessions for any muscle or co-contraction ratio.

CONCLUSION: The fatigue induced by the fatigue protocol used was not sufficient to produce changes which would most likely affect lower extremity joint stability or altered neuromuscular activation. In addition, it might be possible that landing from a jump is not affected by fatigue or other predisposing factors causing anterior cruciate ligament injuries in athletic women during the onset of fatigue were not evident from the drop-jump task.

2385 Board #117 8:30 AM - 9:30 AM

Fluctuations of Center-of-Pressure during Upright Postures by Tai Chi Style Comparison with Normal Postures

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Standing erectly with two legs is most basic motion for humans. Especially, standing posture for Tai Chi is very important.

PURPOSE: We investigated the distinction between Tai Chi and normal standing for humans from center-of-pressure (COP) fluctuations in open eyes and closed eyes conditions.

METHODS: Ten healthy young students participated in this study. They were coached Tai Chi for 8 weeks by an Tai Chi expert before this experiment. They stood barefoot...
with their eyes open (fixed on a point in front of them) or close for one minute. COP were calculated from vertical ground reaction force detected from four sensors on force platform (Kistler) at 1000Hz. Some analyzed data were used for comparison to two types of standings, which were COP trajectories, Romberg quotient (eye close/eye open), power spectral density of COP fluctuations by mutual entropy method, long correlation by detrended fluctuation analysis (DFA) and approximate entropy (ApEn).

RESULTS: There was significant difference of the COP trajectories in all conditions. Standard deviations of COP in direction of left and right in Tai Chi standings were smaller than normal standings. There were significant differences in Romberg quotient between Tai Chi and normal. Power spectral density of COP fluctuations in the direction of left and right were lower at eye close than eye open over 0.2Hz. ApEn in direction of left and right was larger in Tai Chi than normal. On the other hand ApEn in direction of before and behind larger in eye close than eye open.

CONCLUSIONS: The distinctive attributes of Tai Chi upright posture against normal were indicated from some COP fluctuation parameters in this study.

**2386 Board #118**

**9:30 AM - 10:30 AM**

**Force Variability, Aging and Muscle Weakness**

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**PURPOSE:** To examine the relationship between strength and the magnitude and time sequence of force variability in young adults.

**METHODS:** Young and older adults produced isometric force via index finger abduction to a visually presented target corresponding to a constant force level of 5% MVC. The fatigue protocol resulted in significant fatigue of the gluteus medius (GM) and rectus femoris (RF) muscles. During the post-fatigued SLS, there was significantly more activation from the MH (p<0.001) and LH (p=0.030) as compared to the pre-fatigued trial. Following fatigue, there was greater variability in the EMG median frequency difference between the pre and post-fatigued SLSs. For each state of fatigue, center of pressure (COP) measurements were evaluated using rank test (alpha = 0.05) was used to determine differences between non-fatigued and fatigued conditions for EMG and COP variables.

**RESULTS:** The fatigue protocol resulted in significant fatigue of the gluteus medius (p<0.001) and rectus femoris muscles (p<0.015). In the post-fatigued SLS, there was significantly more activation from the MH as compared to the pre-fatigued trial. Following fatigue, there was greater variability in the COP measurements for both the medial/lateral (p<0.001) and anterior/posterior directions (p=0.045). Furthermore, the fatigue trial resulted in greater COP excursion in the anterior/posterior directions (p<0.045), with the mean COP position moving from the posterior to anterior position following fatigue.
CONCLUSION: This investigation showed that with isolated hip muscle fatigue, subjects compensated with anterior translation of their COP, as well as increased activity of the hamstrings. Previously, it has been shown that an anterior COP position increases anterior tibial translation. Therefore, the results of this investigation may have important training implications for knee injury prevention.

2390 Board #122 9:30 AM - 10:30 AM
Activation of Muscle Spindles Increases Force Fluctuations in the Knee Extensor Muscles
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Vibration of a tendon causes reflex excitation of the corresponding motor unit pool via activation of muscle spindle afferents. Chronic tendon vibration increases force fluctuations in the first dorsal interosseus muscle and decreases fluctuation in the plantarflexor muscles. The effect of tendon vibration on force fluctuations has not been examined in the knee extensor (KE) muscles.

PURPOSE: To determine the effect of muscle spindle afferent activation on the variability of force in the KE muscles of young healthy subjects.

METHODS: Healthy, young adults (N=17; 23 ± 3 yrs) underwent assessment of maximum voluntary contraction (MVC) force, tonic vibration reflex (TVR) force, and force fluctuations during constant-force (CF) contractions of the KE muscles. The vibratory stimulus to the patellar tendon was 110 Hz with 1mm displacement and was applied with a constant force of 10 N. With the subject relaxed, two TVR trials each lasting 30 s were performed. In random order, CF trials were performed with (VIB) or without (NOVIB) vibration at target forces of 2.5%, 30%, and 65% MVC. For the NOVIB condition the vibratory stimulus began immediately before acquisition of the target force. The pressure of the vibrator on the tendon was similar between VIB and NOVIB conditions. KE force was measured during the TVR at 15 and 30 s. For CF trials, the standard deviation (SD) and coefficient of variation (SD/mean force, CV) of force was calculated from segments of data 8-12 s in length. Visual feedback was not provided during the CF task; low frequency (DC drift of the output signal >0.5 Hz) force fluctuations from the target was removed before the SD and CV were measured.

RESULTS: TVR: The TVR force at 15s and 30 s was 0.88 ± 0.23% (> zero, P=0.002) and 1.35 ± 0.33% MVC (>15, P<0.005), respectively. Constant-force trials: VIB significantly increased the mean force by 0.33%MVC for the 2.5% MVC target force and decreased the mean force by 1.4% MVC and 3.7% MVC for the 30% and 65% MVC trials. The CV of force was greater for VIB compared with NOVIB conditions for the 2.5% (2.56 ± 0.16% vs 1.99 ± 0.16%) but not the 30% (1.97 ± 0.14% vs 1.88 ± 0.16%) or 65% (2.75 ± 0.26% vs 2.46 ± 0.18%) MVC target forces. The 15 and 30 s TVR force was not correlated with the change in CV of force due to vibration. Across target forces, the VIB condition tended (P=0.086) to increase the CV of force more for men (N=6) compared with men (N=9).

CONCLUSION: The acute excitatory effects of tendon vibration increased the variability of the output of knee extensor motor neurons. Therefore, feedback from muscle spindles is a contributor to the variability of low force contractions with the knee extensors.

Supported by NIH AG19171 to BLT.

2391 Board #123 8:30 AM - 9:30 AM
Fatigue Effects on an Up-Down Repetitive Jump Landing Task in Young Women
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Neuromuscular fatigue may affect jumping and landing mechanics which could increase the risk of anterior cruciate ligament injury in athletic women. However, the evidence of fatigue contributing to injury is limited and mainly based on epidemiological data and field observations.

PURPOSE: To evaluate the effects of fatigue on lower extremity muscle activity during a repetitive up-down hop task in young women.

METHODS: Fifteen women (age; 24.6 ± 2.6) participated in this investigation. Measurements were collected during non-fatigued and fatigued sessions. Surface electrodes were applied on the dominant leg over the muscle bellies of the gluteus maximus, quadriceps and hamstrings after standard skin cleaning procedure. A standardized warm-up protocol was implemented prior to performing the up-down hop task. Two practice trials preceded the measurement trials. The up-down hop task consisted of ten consecutive single-legged jumps using a 20-cm step. The averaged normalized surface electromyographic activity (SEMG) of the middle six jumps was calculated from segments of data 8-12 s in length. The fatigue session was similar to the non-fatigued session except each participant performed a Wingate Anaerobic Protocol prior to the hopping task to produce lower extremity fatigue. During the fatigue session, the test was performed immediately after the participant finished the fatigue protocol to prevent any recovery. Two measurement trials were performed less than a minute apart but only the first one was included for analysis based on previous pilot data reliability (ICC, >0.77).

Data were collected using a computerized telemetry system synchronized with a force plate. The rectified SEMG values were then filtered and normalized utilizing a functional normalization procedure. Normalized data of the three muscle groups and quadriceps/hamstring co-contraction ratio were compared between sessions. The quadriceps/hamstring co-contraction ratio was calculated by dividing the normalized muscle SEMG values of the quadriceps and hamstrings recordings.

RESULTS: Multivariate analysis of variance with session as a repeated measure was performed for quadriceps/hamstring co-contraction ratio, and normalized gluteus, quadriceps and hamstring muscle activity. No statistically significant differences were found for any of the variables between sessions (F(2,34) = 0.5, P = 0.843).

CONCLUSION: It appears that the fatigue protocol did not induce sufficient fatigue to influence changes in muscle activity. There could be other predisposing factors causing anterior cruciate ligament injuries in athletic women during the onset of fatigue not evident in the up-down hop task.

2392 Board #124 9:30 AM - 10:30 AM
Enhancing Human Balance Control by Apply Random Vibrations to the Ankle Tendons
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Somatosensory function declines with age, and such changes have been associated with postural instability. Recently, it has been shown that input noise can enhance somatosensory and motor function.

PURPOSE: The goal of this study was to investigate whether subsensory mechanical noise applied to the ankles via randomly vibrating wraps can be used to improve balance control in young and elderly subjects.

METHODS: Two quiet standing experiments were performed. Experiment 1 investigated the application of four different amplitudes of noise to find the noise level that produced the largest reduction in postural sway in twelve healthy young subjects. Experiment 2 tested further the effect of this optimal noise level on balance control in a sample of fifteen healthy young and fifteen healthy elderly subjects. To characterize balance during quiet standing, five traditional sway parameters, five sway parameters that have been shown to be predictive of falls, and three random-walk sway parameters were computed for the noise and control (no noise) trials, respectively, for each subject.

RESULTS: In Experiment 1, four of the five traditional sway parameters indicated that the optimal level of mechanical noise was 75% of the sensory threshold for the subjects tested. In Experiment 2, application of this optimal level of noise (75% of sensory threshold) resulted in a reduction in 12 of the 13 sway parameters in the young subjects and all of the sway parameters in the elderly subjects. To characterize balance during quiet standing, free to follow traditional sway parameters, five sway parameters that have been shown to be predictive of falls, and three random-walk sway parameters were computed for the noise and control (no noise) trials, respectively, for each subject.

CONCLUSION: These findings suggest that noise-based devices, such as randomly vibrating ankle wraps, could ameliorate age-related impairments in balance control. Supported by NIH Grant HD37880, AG08812 and HD40035.

2393 Board #125 8:30 AM - 9:30 AM
Contribution of Lumbo-Pelvic Hip Muscle Performance to Maximal Hop Distance
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INTRODUCTION: Recently, greater emphasis has been placed on training the “core” of the body to enhance sport performance. Support for this paradigm is primarily provided by empirical evidence.

PURPOSE: The purpose of this study was to investigate the relationship between trunk and hip muscle performance and maximal single leg hop distance.

METHODS: Twenty-one recreational athletes (8 males, 14 females; mean age = 22 years) participated in this study. Subjects first performed a warm-up on a stationary bike, and then performed three trials of a maximal forward single leg hop on each leg. Subjects were required to start and land on the test leg, but were not required to hold the landing position. The farthest distance hopped was used for analysis. Subjects then participated in trunk and hip muscle performance testing. Trunk testing was grouped into isometric (McGill 60° hold, Biering-Sorensen test, and side-bend) and isotonic (abdominal crunch and back extension) tests, and the groups were randomly performed before or after hip testing. Isometric trunk tests were performed to fatigue, and isotonic
trunk tests were performed for maximal repetitions in one minute. Subjects performed three trials of a maximal voluntary isometric contraction (MVIC) for each hip muscle group (extension, abduction and external rotation) while seated on an isokinetic dynamometer (Biodex System 3). Peak torque was normalized to body weight. Separate stepwise regression analyses were performed using muscle performance measures as independent variables and maximal hip distance as the dependent variable. Statistical significance was set at p < 0.05.

RESULTS: The right leg was the dominant leg (leg used for kicking) in all subjects. The mean hop distance was not different between sides (right = 145 cm, left = 148 cm, z = -0.49, p = 0.63). For the right leg, a combination of hip external rotation MVIC, Biering-Sorensen test and McGill hold explained 64% of the variance in maximal hop distance (standardized betas of 0.54, -0.13, 0.37, respectively). For the left leg, hip external rotation was the only significant predictor of performance, explaining 60% of the variance in maximal hop distance (standardized beta = 0.54).

CONCLUSIONS: Hip external rotation strength was a common predictor of maximal hop distance for both legs. For the dominant leg, greater abdominal endurance was associated with higher hop distance, whereas greater trunk extensor endurance was associated with lower hop distance. The results thus support the hypothesis that trunk and hip muscle performance can influence single leg hop distance. Supported by the University of Florida Research Opportunity Fund.

2394 Board #128
9:30 AM - 10:30 AM
Influence of Stance and Support Surface Variations on Soleus Presynaptic Inhibition
JoEllen M. Sefton1, Charlie A. Hicks-Little1, David M. Koeceiz1, Mitchell L. Cordova2, ‘The University of North Carolina at Charlotte, Charlotte, NC. ‘Indiana University, Bloomington, IN. Email: jsefton@email.uncc.edu

Presynaptic inhibition (PI) is instrumental in enabling the nervous system to respond to environmental changes. Subjects who demonstrate little change in PI of the soleus muscle have been shown to have a decreased ability to adapt to environmental changes (i.e. uneven surface conditions). Little research has been done to examine changes in PI during various surface and stance conditions.

PURPOSE: this study utilized H-reflex measures to examine extrinsic PI in the soleus muscle during single- and double-legged stance, under stable and unstable surface conditions. Design & Settings: A 2 x 2 fully repeated measures design was employed with leg (single vs. double) and support surface (foam, no foam) serving as the independent variables. Subjects: Ten healthy subjects (age = 23 ± 1.7 yr, mass = 75 ± 26.6 kg, ht = 172 ± 8.5 cm) with no known acute or chronic neurological or lower extremity musculoskeletal injury 6 months prior to the study served as volunteers. Measurements: The tibial nerve was stimulated using an extrinsic PI conditioning protocol. The ratio of the unconditioned H-reflex amplitude to the conditioned H-reflex amplitude represented extrinsic PI. All subjects completed a total of 7 trials for the conditioned and unconditioned soleus H-reflex response for each treatment.

RESULTS: No interaction was found between leg and surface condition on soleus PI (P>0.05). Main effects testing revealed that a significant increase in soleus PI for the single-legged stance compared the double-legged stance (P<0.001). Surface variation did not affect soleus PI (P>0.05).

CONCLUSIONS: The increase in soleus PI during a single-legged stance suggests inhibition from the tibial nerve pool may aid in maintaining upright stance during less stable positions. Moreover, maintenance of upright stance on an unstable foam surface does not appear to influence extrinsic PI modulation of the soleus muscle.

2395 Board #127
8:30 AM - 9:30 AM
Effect of Random Interval Modulation on Fatigue during Electrical Stimulation
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During sustained voluntary contractions, the variability in motor unit interspike intervals (ISIs) increases with fatigue. The presence of ISI variability may be an adaptive mechanism to prevent force loss during sustained contractions and could be used in FES systems to prevent fatigue.

PURPOSE: To investigate whether the presence of variability in a constant frequency stimulation protocol reduces force loss over time compared to constant frequency stimulation.

METHODS: Six healthy individuals participated in two 3-minute fatigue protocols of the tibial nerves elicited by supramaximal stimulation of the median nerve. One protocol consisted of a constant 30Hz train (ISI = 33.33ms) and the other consisted of a 30Hz train with an ISI variability of ±20%. In the variable train, the stochastic pulses were uniformly distributed from 24 to 40ms with a mean of 33.33ms. Each subject’s thumb was positioned against a transducer that measured force in the flexion and adduction directions. Resultant torques were calculated off-line. A short, 3s 30Hz train was delivered before each fatigue protocol to determine the consistency in the experimental setup. The torques during these test trains were compared with paired t-tests. A two-way repeated measures ANOVA with Tukey’s post hoc analysis was used to compare torques and M-wave amplitudes pre-fatigue and between the two stimulation protocols.

RESULTS: There was no significant difference between the short train torques on the two test days (constant: 2.22 ± 0.20 Nm, variable: 2.18 ± 0.17 Nm, p = 0.42). The initial and final torques were not significantly different between fatigue protocols, but both protocols induced a significant reduction in torque (constant: 2.46 ± 0.33 Nm to 0.63 ± 0.13 Nm, p = 0.002, variable: 2.76 ± 0.51 Nm to 0.59 ± 0.08 Nm, p < 0.001).

There was no significant difference in the overall torque-time integral between the two conditions (constant: 228.42 ± 37.37 Nm·s and variable: 226.86 ± 30.90 Nm·s) frequency trains (p = 0.86). There was a significant reduction in the amplitude of the M-wave in both fatigue tests (constant: 13.01 ± 2.67 mV to 7.20 ± 1.79 mV, p < 0.001, variable: 12.42 ± 2.63 to 3.85 mV, p < 0.001).

CONCLUSION: In able-bodied individuals, incorporating a uniform distribution of ISIs into a constant frequency train does not prevent force loss during electrical stimulation.

2396 Board #129
9:30 AM - 10:30 AM
Presynaptic Inhibition Relative to Test Reflex Size: Effects of a Voluntary Contraction
Christopher T. Robertson1, Koichi Kitano2, Masaaki Tsuura1, David M. Koeceiz1, ‘Indiana University, Bloomington, IN. ‘Osaka University of Health and Sport Sciences, Osaka, Japan. Email: ctrobert@indiana.edu

The amplitude of the H-reflex can be suppressed by both (EPI) and intrinsic (IPI) presynaptic factors associated with the discharge of terminals of different sensory nerves. Unfortunately, in human experimental paradigms, the relative influences of EPI and IPI on suppression of the H-reflex are hard to differentiate. It is known that the sensitivity of the conditioned H-reflex to inhibition depends on the size of the test reflex, and that the onset of a voluntary contraction has been shown to decrease the amount of presynaptic inhibition observed in the H-reflex pathway.

PURPOSE: The purpose of this research was to investigate the effect stimulus intensity (SI) had on both EPI and IPI of the soleus H-reflex, and to examine how a subsequent voluntary contraction influenced each presynaptic mechanism.

METHODS: Ten young healthy subjects were administered two conditioning protocols on the H-reflex and motor response recruitment curves (RC); 1) common peroneal nerve stimulation prior to tibial nerve stimulation (i.e., EPI), and 2) paired tibial nerve stimulation (i.e. IPI). The interstimulus interval was 100 ms for both conditioning protocols. Further, a 10% voluntary isometric plantarflexion was held for two seconds prior to stimulation and the conditioning paradigms were repeated. Three measurements from the RC’s were extracted and standardized to the maximal motor response; H-reflex threshold (Hth), 50% Hmax, and Hmax.

RESULTS: A 3x3x2(protocol x SI x BEMG) repeated measures ANOVA indicated a significant interaction between protocol and SI (F[4,36] = 7.05, p<0.001). Simple effects analyses showed that 50% Hmax [F(2,54) = 31.11, p<0.001] and Hmax [F(2,54) = 27.37, p<0.001] were significantly different across the protocols. Tukey’s post hoc analyses revealed that at 50% Hmax and at Hmax both EPI and IPI were significantly inhibited but not different from each other (23 and 28%, 28 and 35%, respectively). A 10% contraction significantly disinhibited both 50% Hmax and Hmax for EPI and IPI (30 and 14% and 13 and 12%, but also significantly disinhibited Hth for EPI but not for IPI (14% vs 6%).

CONCLUSION: It was shown that the sensitivity of the discrete H-reflex to EPI and IPI cannot be distinguished across SI’s. However, the addition of minimal BEMG revealed that, at very low SI’s, EPI was more sensitive to supraspinal input, which may indicate differences in the pathways/mechanisms between EPI and IPI.
Poster Session #130 9:30 AM - 10:30 AM
Depression and Recovery of Spinal Synaptic Efficiency Following a Balance Task
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The purpose of this study was to explore differences in EPI and IPI. Specifically, we measured the recruitment times of change and temporal trends of both EPI and IPI during and after a balance task. METHOD: Soleus H-reflex amplitudes were measured from 6 healthy adult subjects. Two types of inhibitory conditioning techniques were applied: 1) common peroneal nerve stimulation (EPI) and 2) paired tibial nerve stimulation (IPI). Subjects stood on a custom balance board and performed plantar- and dorsiflexion for 20 min. A 100 ms interval was used between conditioning and test stimulation for both EPI and IPI. The initial amplitude of the soleus H-reflex was set at 50% of H-max. Reflexes were elicited in five blocks, prior to the task (C1) and post-task (immediately after, 5min, 10min, and 20min; C2, C3, C4, and C5). The dependent measure was the peak-to-peak amplitude of the soleus H-reflex (unconditioned) and the conditioned H-reflex (EPI and IPI). RESULTS: The unconditioned H-reflex amplitude was significantly decreased immediately after the termination of the task to 41% of C1 value. By C5, the H-reflex was recovered to 71% of C1 value, however this amplitude was still significantly attenuated (C1 vs C5). EPI was similarly depressed to 44% of the C1 value after the task, and this depression was maintained for the next 20 min (C2 vs C5). IPI demonstrated no significant difference immediately after the task (C1 vs C2) and no significant alteration was found for another 20 min (C2 vs C5). CONCLUSION: EPI contributes to the depression in the unconditioned H-reflex immediately after the termination of the task, whereas IPI does not. However after the task, when the reflex begins to recover, the depression in IPI is maintained. Therefore, recovery in the unconditioned H-reflex is suggested to be independent from the change in presynaptic control of synaptic efficacy, which implies that a postsynaptic mechanism is involved. It is suggested that sensory feedback is gated at the segmental level, but integrated at supraspinal levels to allow more cortical control of motor activity.

#2269-2726–FRIDAY, JUNE 2
The Effects of Inversion Fatigue on Frontal Plane Joint Position Sense in the Ankle
Michelle A. Sandrey, Timothy E. Kent. West Virginia University, Morgantown, WV.
Email: msandrey@mail.wvu.edu

The effect of fatigue in the ankle on joint position sense (JPS) has been reported in the literature with a vast number of studies focusing solely on fatigue of the dorsiflexors and plantar flexors. However, there are very few studies in determining the effects of fatigue to the ankle averters on frontal plane JPS at the ankle.

PURPOSE: To examine the effects of isokinetic concentric-eccentric fatigue of the everters on joint position sense for inversion and eversion of the ankle.

2401 Board #133 8:30 AM - 9:30 AM
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Michelle A. Sandrey, Timothy E. Kent. West Virginia University, Morgantown, WV.
Email: msandrey@mail.wvu.edu

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PURPOSE: To examine the effects of isokinetic concentric-eccentric fatigue of the everters on joint position sense for inversion and eversion of the ankle.

S442 Vol. 38 No. 5 Supplement
METHODS: This study was randomized controlled trial of 12 week course of exercise for the community dwelling elderly aged 65 or over who had experienced at least one fall during the last year. The exercise consisted of lower extremities muscle strengthening of planter flexors, dorsiflexors, inverters, and everters using theraband and proprioceptive exercise using stability ball. The exercise session continued for 90 minutes including flexibility exercises and was performed twice weekly for 12 weeks. For the control group, we did not give any information about fall prevention. We compared the one-leg standing time of each legs and the occurrence rate of falls for 8 months after intervention using Mann-Whitney U test.

RESULTS: The one-leg standing time increased significantly for the exercise group in both sides compared to control group(left: 35.9±3.97 vs. -3.4±10.8 seconds, p<0.001; right: 45.2±9.5 vs. -2.6±14.4 seconds, p<0.001). After the exercise intervention, there were 3 cases(14.3%) of falls out of 21 persons for the exercise group compared to 7 cases(36.8%) out of 19 person for the control group(p=0.212). The frequency of falls tended to be lower for those with high compliance among exercise group.

CONCLUSIONS: Twelve weeks of ankle muscles strengthening and balance exercise program was effective to increase one-leg standing time and tended to decrease the frequency of falls among the elderly.

2404 Board #136
9:30 AM - 10:30 AM
Muscle Fatigue Alters Neuromuscular Performance during Resisted Weight Bearing Exercise
Bryon T. Ballantyne1, Richard K. Shields2, St. Ambrose University, Davenport, IA. 1The Ham/Whitney U Test.

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Neuromuscular control is essential to the maintenance of lower extremity stability during functional activities. Numerous studies suggest that muscle fatigue contributes to deterioration of neuromuscular performance and may increase the risk of injury. However, limited information is currently available regarding muscle synergistic patterns and triggered reflex responses during dynamic weight bearing activities in the presence of muscle fatigue.

PURPOSE: To examine the effect of muscle fatigue on 1) voluntary and reflexive patterns of muscle activation and 2) performance accuracy while tracking a visual target during the weight bearing lateral step down exercise.

METHODS: A specially designed apparatus was used to provide controlled resistance to knee motion during the lateral step down exercise. Motion of the knee was measured as subjects were asked to track a sinusoidal target waveform as accurately as possible during the exercise. Absolute, constant, variable, and endpoint errors were calculated to evaluate tracking performance. Random perturbations were delivered in 20% of the trials by unexpectedly releasing the resistance during the flexion phase of the exercise. Quadriapces and hamstring muscle activity was recorded during both perturbed and unperturbed trials. Tests were conducted in a group of 12 healthy females before and after completing a repetitive submaximal eccentric quadriapces fatigue protocol. A second group of 12 females served as controls.

RESULTS: Muscle fatigue increased the level of quadriapces muscle activity throughout most of the exercise. In the flexion phase, average rectus femoris (RF) and vastus lateralis (VL) EMG increased by 2.5% (p<0.008) and 3.7% (p<0.002) MVIC, respectively. In the extension phase, RF activity increased by 5.5% MVIC (p<0.001), while VL activity increased by 8.5% MVIC (p<0.001). Muscle fatigue also resulted in a reversal in the direction of the constant errors during the extension phase of the exercise, causing subjects to lag behind the target. Unexpected perturbations elicited long latency responses characterized by facilitation of the quadriapces and inhibition of the hamstrings. Muscle fatigue increased the amplitude of this response in VL by 4.3% MVIC (p<0.004). Despite the increased amplitude of the response, errors at the endpoint of the flexion phase increased by 67 cm (p<0.034) after fatigue.

CONCLUSION: These results indicate that muscle fatigue alters patterns of coordinated muscle activity, which may render subjects less able to cope with unexpected perturbations during activities that require a high degree of accuracy.
For %MAXD, there was a significant Time by Gender interaction (F(2,342, p<.04). Among the females, %MAXD was significantly greater at 10:00 (0.824±0.015) compared to 20:00 (0.811±0.016). A significant main effect for Time (F(2,3=2.05, p=0.048) was also present for %MAXD, indicating that 10:00 produced the greatest %MAXD (0.821±0.011) compared to 15:00 (0.814±0.012) and 20:00.

CONCLUSIONS: There seems to be an influence of the time of day on static and dynamic postural control that suggests postural control may be better in the mornings compared to the afternoons. This may influence serial postural control testing as well as between group comparisons of postural control.

Board #140 9:30 AM - 10:30 AM
Muscle Fatigue and Activation Pattern of Upper Back and Shoulder Girdle Muscles in Archers
Huang Yiming, Liao Chien Nan. Institute of Coaching Science, National College of Physical Education & Sport, Taoyuan county, Taiwan Republic of China.
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Control strategy of movement, especially in multiple joint, may alter as one of muscles fatigue. In archery, consistent and repeated movement is performed during whole practice session or in competition game. Therefore, an archer may easily change activation pattern if one of the major contributive muscles is fatigue. It has been widely using median frequency (MF) of EMG signal as a examine way to muscle fatigue.

PURPOSE: To investigate the strategy and fatigue state of upper back and shoulder girdle muscles during a whole practice session in elite and sub-elite archers.

METHODS: Two archers with one won a gold medal of personal archery game in 2012 World University Games were recruited in this study. They performed on practice session with 144 arrows and rules simulated to formal competition with the duration was 2-3 hours approximately. Electromyographic (EMG) signals were recorded from upper trapezius (TRA), infraspinatus (INTRA), posterior teltoid (TEL), Rhomboid (RHOM), Latissimus dorsi (LAT) muscles on pull side of the body. Maximal voluntary isometric contraction (MVIC) before practice session was used to normalize EMG signal. Normalized root mean square (RMS) EMG and median frequency (MF) were calculated within one second by releasing an arrow which defined by accelerometers attached on wrist. The first and the last 3 sets with 18 trials (n=18) individually (6 trials per set) were compared. T-test for repeated measures was used.

RESULTS: Significant decrease in MF in INTRA muscle (79.5±5 Hz vs. 59.6± Hz, p<0.05) was demonstrated on sub-elite archer during the session. In elite one, it revealed slight shift in MF but not significant in INTRA muscle. Besides, TEL, TRA, INTRA, RHOM and LAT muscles activities detected from sub-elite archer were significantly increased (21.0±4.6% vs. 25.8±5.0%; 33.1±4.1% vs. 34.5±5.7%; 26.3±5.5% vs. 36.1±5.5%; 21.6±3.0% vs. 27.7±4.6%; 17.5±2.4% vs. 19.2±3.0% respectively, p<0.05), but only INFRA muscle activity was increased significantly in elite one (17.6±2.2% vs. 19.6±2.7%, p<0.05).

CONCLUSION: Muscle fatigue did occur in sub-elite archer’s INFRA muscle but not in elite one during a practice session. Muscle activation pattern would alter following one of the main muscle fatigue. The scientific information may offer the coach as a reference resource to avoid overtraining due to muscle fatigue.
positive influence on proprioceptive abilities among very young, young, and adult subjects. The conflicting results between the very young group in the two-legged stance test were mainly associated with the degree of difficulty to achieve an adequate two-legged stance due to age-related anatomical conditions.

**PURPOSE:** The purpose of this study was to examine the effectiveness of ballats training compared to more traditional programs of step aerobics and walking on balance in women aged 50 to 75 years.

**METHODS:** Participants were randomly assigned to one of three training groups, ballats aerobics (n = 17), or walking (n = 15), during which they attended one hour, supervised training sessions, three days per week, over a 13-week period. Pre and post-testing included four separate measures of static and dynamic balance (Modified Clinical Test for the Sensory Interaction on Balance - mCTSIB; Unilateral Tandem Walk - TW; Step Quick and Turn - SQT) using the NeuroCom Balance Master.

**RESULTS:** A one-way ANOVA indicated that there were no significant (p<0.05) differences between the three groups for age, height, weight, and body composition. Both variables were measured in the anterior-variable of body sway, and the center of pressure displacement, which is an approximation of the ankle torque. Both variables were measured in the anterior-variable of body sway, and the center of pressure displacement, which is an approximation of the ankle torque.Baseline isotonic strength measurements were taken for the moments of plantar flexion/dorsiflexion and inversion/eversion at a velocity of 120°/s on two separate sessions in random order. Using a 50% decrement of baseline strength as a reference, fatigue was induced in each of these 4 motions individually. Post-fatigue isotonic strength measurements were taken immediately after the fatigue event in a manner similar to that of the baseline test. Simultaneously, electromyographic activity was monitored from the tibialis anterior (TA), peroneals (PER), and gastrocnemius (GAS) muscles. Torque and median frequency (MF) data were calculated. Separate repeated-measures MANOVAs were performed for each of the 4 ankle motions with the conventional alpha level of 0.05.

**RESULTS:** For all 4 motions, torque was greater in males than females, in eccentric vs. concentric muscle actions, and in the pre-fatigue vs. the post-fatigue state (p<0.05). For ankle inversion, the MF decreased in the TA (p<0.000) pre vs. post. For ankle plantar flexion, the MF decreased in the PER muscles pre vs. post (p<0.007) and a time x gender interaction (p=0.03) was noted in the PER muscles. Specifically, the males decreased MF more than females pre vs. post, although males had a higher MF overall than females (p=0.004).

**CONCLUSION:** In general, and as expected, MF decreased in fatigued muscles, although not statistically significant in all cases. The decrease in MF in the PER during plantarflexor fatigue may be of particular importance in ankle stability. The plantarflexors are often fatigued in jumping/landing/cutting activities, which are the same activities associated with ankle sprain risk. Decreased MF seen in the PER muscles correspond with a decreased firing rate. This may be of importance, especially with regard to their role in countering the violent moment seen with inversion ankle sprains.

**CoNCLUsIoNs:** We conclude that the physiological tremor component can be an error source for balance regulation, inducing spontaneous body sway during quiet standing.

**MetHoDs:** To examine neural activity in healthy, uninjured ankles pre and post fatigue.

**Methods:** A total of 9 male (age: 20 ± 1.5 yrs; height: 1.81 ± 0.09 m; mass: 84.4 ± 1.42 kg) and 10 female (age: 20.5 ± 2.0 yrs; height: 1.66 ± 0.05 m; mass: 62.9 ± 3.7 kg) subjects volunteered to participate. Baseline isotonic strength measurements were taken for the moments of plantar flexion/dorsiflexion and inversion/eversion at a velocity of 120°/s on two separate sessions in random order. Using a 50% decrement of baseline strength as a reference, fatigue was induced in each of these 4 motions individually. Post-fatigue isotonic strength measurements were taken immediately after the fatigue event in a manner similar to that of the baseline test. Simultaneously, electromyographic activity was monitored from the tibialis anterior (TA), peroneals (PER), and gastrocnemius (GAS) muscles. Torque and median frequency (MF) data were calculated. Separate repeated-measures MANOVAs were performed for each of the 4 ankle motions with the conventional alpha level of 0.05.

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**Knee Joint**

**Pre-Contact Co-contraction Ratios during Drop Landings onto One or Two Legs Differ at the Ankle but Not at the Knee Joint**

Steven T. McCaw, FACSM; Tibor Horthobagi, FACSM; Paul DeVita, FACSM; Illinois State University, Normal, IL; East Carolina University, Greenville, NC.

**Email:** smccaw@ilstu.edu

Total energy absorption by leg joint powers during a one-leg landing is less than twice the absorption during a two-leg landing, and the relative ankle contribution is higher (1). While leg stiffness is twice as high during one-leg landing, hip and knee stiffnesses double but ankle stiffness increases only 50% (2). We hypothesize that the neuromuscular system differentially activates lower extremity muscles between one and two leg landings.

**Purpose:** To compare knee and ankle joint muscle activity between drop landings on one and two legs.

**Methods:** Eleven injury free college age females were recruited. In one session, 10 trials of one leg and two leg landings were performed from 25% of body height. Surface electrodes over the right leg vastus lateralis (VL), hamstrings (Ha), gastrocnemius (Ga) and tibialis anterior (TA) recorded muscle activity (960 Hz). For each trial, a linear envelope of the individual muscle data rectified and scaled to an isometric reference task was created using a low-pass (9Hz) digital filter. For each trial, the 100ms precontact average value, and the average and peak values between contact and maximum knee flexion were calculated for each muscle. Antagonist muscle co-contraction ratios were calculated at the ankle (TA/Ga) and the knee (Ha/VL). For post contact. The 10 trial mean value of each muscle variable was computed for each participant, and compared between landing conditions using paired t-tests (p<0.05).

**Results:** Average values were higher for VL (~60%) and Ha (~24%) pre-contact in one leg landings, however, pre-contact co-contraction ratios were similar at the knee (~23%) for both landing conditions. Conversely, decreased TA (~19%) and increased Ga (~14%) activity during pre-contact in one leg landings caused a significant decrease.
in the co-contraction ratios at the ankle (Two-leg: 69%; One-leg: 49%). Post contact average and peak VL and HA values were at least 50% greater in one leg landings, but only average GA values increased (32%) at the ankle. Post contact co-contraction ratios were similar between landings at both the ankle and knee joints.

**CONCLUSION:** In preparation for a one leg landing, knee muscle activity is increased similarly in both the VL and HA, so underlying a twofold increase in knee joint stiffness (2). However, increased HA and decreased TA activity during a one leg landing increases ankle stiffness (2) but allows the ankle to serve as the primary energy absorber (1). REFERENCES: (1) McCaw & Hanaki, ACSM 2005; (2) McCaw et al, ASB 2005. ACKNOWLEDGEMENT: Travel Grant from the American Society of Biomechanics and Jump Rope for Heart grant from the Illinois Association for Health, Physical Education, Recreation & Dance.

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**2041 Board #146 9:30 AM - 10:30 AM**

**Kinesthetic Motor Imagery Acutely Increases Spinal Excitability**

Patrick M. Cowley, Brian C. Clark, Lori L. Ploutz-Snyder, FACSM, Syracuse University, Syracuse, NY.

**INTRODUCTION & PURPOSE:** Functional brain imaging studies indicate motor imagery (MI) of a task or movement utilizes similar neural substrates in brain activation, and performance. Data on whether MI results in a descending volley of neural/spinal activity is equivocal. Therefore, the purpose of this study was to determine if imagined planter flexion (PF) muscle contractions alter spinal excitability.

**METHODS:** 17 healthy volunteers (30 ± 8 years) were asked to perform imagined (kinesthetic approach) contractions of the left PF at 25% and 75% of MVC, after performing several practice trials of actual muscle contraction at those intensities. Upon a verbal command and in randomized fashion each subject performed ten imagined contractions at both intensities (~ 15-s duration). Randomly between the 8th and 15th second during a contraction the soleus H-reflex was evoked to assess spinal excitability. Additionally, the H-reflex was assessed 15 seconds before and after each imagined contraction. The H-reflexes were elicited with an intensity equal to 20 ± 2.5% of Mmax and expressed relative to this measure (H20:Mmax). A repeated measures ANOVA was performed to assess the effect of learning (trials 2-4, 5, 7, 8-10), time (at rest, during MI and recovery) and intensity (25% vs. 100% MVC).

**RESULTS:** During MI the H-reflex was facilitated, and immediately returned to baseline values after cessation (see Figure; p<0.01; I=0.40). There was a trend for the MVC intensity level to result in a slightly heightened response than the submaximal MI (see Figure; p=0.06; I=0.19).

**CONCLUSION:** MI acutely results in a heightened H-reflex excitability, which tended to be more exaggerated during higher intensity contractions. This finding suggests MI results in brain activation, and sends a descending volley increasing excitatory input at the level of the spinal cord.

ACKNOWLEDGEMENTS: This work was supported in part by a NASA Training Grant (NGET-505446).

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**2045 Board #147 8:30 AM - 9:30 AM**

**Visual Requirements and Visual Performance Profile in Soccer**

Gernot Jendrusch, Lars Kaczmarek, Peter Lange, Bernd Lingelbach, Petra Platen, FACSM, 1Department of Sports Medicine and Sports Nutrition, Ruhr-University Bochum, Bochum, Germany, 2Department of Sports Science, Ruhr-University Bochum, Bochum, Germany, 3Institute of Optometry; Aalen (IfAA), Aalen, Germany.

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The quality of the eye-foot- and eye-head-coordination, respectively, and the peripheral information input basically influence the success of a soccer player in a match. A basic pre-condition for secure and optimal (related to the individual exercise capacity) sports and movement control is a good eyesight.

**PURPOSE:** The purpose of the study was to generate a multidimensional visual performance profile of professional soccer players and to compare this profile with visual test values of amateur soccer league players.

**METHODS:** In the scope of this study 30 German Soccer League Players (average age: 28.0 ± 4.2 years) were tested in view to their visual performance (visual acuity, motion perception, dynamic visual acuity, contrast sensitivity, refractive errors (e.g. myopia), shape of the cornea, depth perception), 30 leisure time soccer players (average age: 27.2 ± 3.0 years) acted as control group.

**RESULTS:** The professional soccer players achieved a significantly better binocular visual acuity for the distance as compared to the leisure time players (visual acuity: 2.0 ± 0.42 vs. 1.86 ± 0.39; 2p = 0.05). Depth perception angles, however, were similar between both groups (15.5° ± 6.7° vs. 15.3° ± 7.8°; 2p = 0.911). Furthermore, motion perception performance (angular velocities) did not differ between both groups (244.0° ± 46.5% vs. 246.4° ± 38.6%; 2p = 0.832). Related to the field position in a game, the oculomotor performance of the German Soccer League goal keepers was significantly higher than that of the field players (players on midfield or offense) (297.5° ± 60.2% vs. 235.8° ± 39.4%: 2p = 0.011).

**CONCLUSION:** Visual function tests should be included in health diagnostics of soccer players in order to be able to detect and - consequently - correct visual deficiencies at an early stage. Furthermore, visual functions should be controlled regularly.

The fact that professional goal keepers achieve a very good depth perception compared to normal people and also a significantly better motion perception compared field players might be due to strain-induced adaptation manifestations e.g. of the oculomotor system, resulting from the higher demands on visual dynamics in the goal keepers’ situations during matches and training. The possibility to train and positively adapt both of these visual abilities is supported by several studies.

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**2046 Board #148 9:30 AM - 10:30 AM**

**Shape of the Cornea and Visual Acuity of Athletes**

Bernd Lingelbach, Petra Platen, FACSM, Institute of Optometry; Aalen (IfAA), Aalen, Germany, 1Department of Sports Medicine and Sports Nutrition, Ruhr-University Bochum, Bochum, Germany.

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It is well known that on average athletes show higher visual acuity than a representative selection of the whole population. It was proved in former studies that professional athletes (alpine skiing, soccer, table tennis, gliding flight etc.) normally have a visual acuity of more than 2 (~ 40/20), in a few cases even visual acuity values higher than 3 (~ 60/20) were found. Every part of the visual system has to be perfect to obtain perfect vision. The cornea, the lens and all distances for the geometrical projection of the outer world onto the retina should be optimized.

**PURPOSE:** The purpose of the study was to determine the morphological conditions of the cornea which can lead to such a high visual acuity.

**METHODS:** In our experiments we determined the visual acuity of professional athletes, of students studying sports and of normal people. A total of 166 persons participated in these inquiries (63.3% male, 36.7% female). From overall 332 analyzed eyes 321 eyes could be evaluated. Simultaneously we used an Oculus-Videokeratograph to get information about the shape of the cornea of each subject. With a software, especially designed for this experiment, we were able to analyze the shape of the cornea. The best fitting ellipsoid was determined and the deviations from this ellipsoid were fit in terms of Zernike-polynomials. These polynomials were used because each Zernike-polynomial correlates to a special aberration of the geometric optical projection.

**RESULTS:** The higher the visual acuity, the lower the amplitudes of the high-order aberrations. Especially the meridional polynomials like astigmatism or trefoil or four-lobed aberrations are close to zero. The root mean square error (RMS) of the fit - which is an indicator for the amount of the total aberration of an optical system - was significantly lower with high acuity (correlation between RMS and visual acuity; r = -0.20, p < 0.001). On an average the shape of the cornea was close to an ellipsoid with a numerical eccentricity of about 0.7.

**CONCLUSION:** At first we only found very few people with extreme high acuity. All were professional athletes. Their cornea were nearly free of high-order polynomials and the shape was close to an ellipsoid with an eccentricity of about 0.7. A necessary but not sufficient condition for an excellent visual acuity - which plays a major role in numerous sports and field events - are low amplitudes of the high-order Zernike-polynomials in the shape of the cornea.

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**2047 Board #149 8:30 AM - 9:30 AM**

**Agnost-antagonist Coactivation Differences for Young and Old Adults During a Maximal Voluntary Contraction**

Joel A. Enoka, Brach Poston, Evangelos A. Christou, Roger M. Enoka, University of Colorado, Boulder, CO.

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Older adults often exhibit altered agonist-antagonist activity compared with young adults during maximal contractions (MVCs), however, the modulation of agonist-antagonist coactivation has not been determined.

**PURPOSE:** To determine whether the agonist-antagonist EMG coherence differs between young and old adults during MVCs.

**METHODS:** Seventeen young subjects (24±5 yrs) and 16 old subjects (71±7 yrs) performed six abduction MVCs with the first dorsal interosseus muscle of the left (non-dominant) index finger. For the MVC task, subjects were instructed to produce the maximal force in the briefest time possible and to maintain the maximal force for 2 s. The EMG activity of the single agonist (first dorsal interosseus; FDI) and single antagonist (second palmar interosseus; SPI) muscles was recorded with intramuscular
By the center of gravity by time of the trial, was measured in degrees per second. Measured were the velocity (deg/sec) and the directional control.

RESULTS: No significant group differences were found for bilateral or unilateral postural sway. For LOS, no significant group differences were found for movement velocity or end-point excursion. Directional control was significantly (p=0.015) greater for Group G1 and G2 than for Group G3, but for movement to the left only. Near significant (p=0.06) group differences were found between Groups 1 and 2, for directional control. No significant differences among the three groups were found for RWS.

CONCLUSIONS: It is possible that since right-handed golfers consistently utilize left weight shift in the approach, the more proficient and consistent golfers may more accurately demonstrate balance and sway to the left. Accurate and timely balance and weight shift are important factors in the sport of golf and should be considered as contributors, but not independent of other variables in successful play.

Firing Characteristics of Motor Units during the First 90 Seconds of a Fatiguing Low-Level Contraction

**PURPOSE:** This study was designed to determine decomposition-based quantitative electromyographic (DQEMG), which could detect changes in motor unit firing statistics that accompany fatigue in the brachioradialis (BR) and extensor carpi radialis (ECR) muscles over the first 90 seconds of sustained, low-level isometric contractions, to determine if time-dependent changes in surface EMG parameters are correlated with changes in MU firing rates, and to determine if time-dependent changes seen in the MU firing characteristics are repeatable within individuals.

**METHODS:** Changes in mean MU firing rates were investigated in the BR (n=10) and ECR (n=10) muscles in healthy volunteers (mean age = 28.6 yr, SD ± 3.9) during constant- torque isometric contractions held until exhaustion. Three BR contractions were sustained at 25% of the maximum voluntary contraction (MVC) and two ECR contractions were sustained at 20% MVC. Mean MU firing rates were estimated following the decomposition of 30-second EMG data windows. Time dependent changes in firing rates were investigated using an analysis of variance with time (first, second and third 30 second epochs) included as a main effect. Pearson product-moment correlation coefficients were computed to determine if changes in MU firing rates were related to changes in surface EMG amplitude and frequency parameters (n=0.05).

Intra-class correlation coefficients (ICC) were used to determine the within-subject repeatability of the MU firing rate changes and SEMG parameters.

**RESULTS:** Mean MU firing rate decreased within the first 90 seconds in both muscle groups, and was repeatable across trials using the DQEMG method. Significant correlations between changes in mean firing rates and surface EMG amplitude and frequency content were found in the ECR muscle but not the BR muscle. The reliability of firing rate changes within subjects was moderate in both the ECR (ICC = 0.72) and BR muscles (ICC = 0.59). The SEMG mean power frequency significantly decreased over contraction time in the ECR muscle, and was found to be a highly reliable measure in both muscles (ICC = 0.90 and 0.98, respectively).

**CONCLUSIONS:** Changes in MU characteristics were observed as early as 90 seconds into a level low contraction. Differences found between the two muscles may be due to contraction level or fiber type distributions.
RESULTS: Raw data was recorded as follows: maximal effort of IEMG (max) was 0.015 mV, submax = 0.009 mV and maximal thought effort (MTE) = 0.0002 mV compared to rest = 0.0002 mV. Max delta wave = 3.96 µV, submax = 1.66 µV, MTE = 0.87 µV and rest at 1.04 µV. Maximal and submaximal hand dynamometer strength was 68 ft-lb and 34 ft-lb, respectively.

CONCLUSIONS: In comparison to maximal effort, submaximal grip strength elicited proportional decreases in EMG (60% of max) and EEG (42% of max) activity. This is the first investigation to our knowledge exploring the association between force production, EMG and EEG. This case study provides initial confirmation that it may be possible to utilize EMG and EEG to determine the %Maximal Volitional Contraction a person is producing. The ability to determine a genuine maximal force test is of clinical significance. A larger study is planned to confirm these associations.

2422 Board #154
9:30 AM - 10:30 AM
The Effects of Contract-Relax Antagonist-Contract Form of PNF Stretching on Postural Stability
Edwin E. Ryan, Richard Lopez, Mark D. Rossi, Jenna L. Doherty, Patrick L. Jacobs, FACSM, Florida International University, Miami, FL; (Sponsor: Patrick L. Jacobs, FACSM)

The value of pre-activity stretching in the prevention of sport related injuries and subsequent enhancement of performance continues to be a controversial topic in exercise science and sports medicine. Previous studies have reported reduced balance scores following an intervention of static stretching. However, the effects of other stretching modalities and warm-up activities on balance have not been examined.

PURPOSE: To investigate the effects of the Contract-Relax Antagonist-Contract (CRAC) form of PNF stretching, with and without a warm-up intervention, on anterior / posterior (A/P) and medial / lateral (M/L) stability.

METHODS: Thirty healthy physically active individuals (15 males and 15 females, age 25.17 ± 5.4 years, height: 173.76 ± 8.2 cm, and weight: 72.03 ± 14.87 kg) volunteered for the study and were randomly assigned to one of three conditions. The treatment conditions were warm-up and stretch (WS), stretching only (SO), and a control condition (CON) with no treatment. CRAC PNF of the hamstrings, plantar flexors, and hip flexors were performed during WS and SO. A six-minute treadmill warm-up was applied prior to CRAC in the WS condition. Stability measures were taken using a computerized balance platform. Measures of A/P and M/L postural stability were taken before and after treatment conditions.

CONCLUSIONS: A 2 x 3 Analysis of Variance (ANOVA) was used to assess for differences between conditions for each dependent measure. Significance was set at p=0.05.

For the M/L measure, there was a time by condition interaction (F = 4.48, p = 0.015). Follow-up analysis indicated that there was no difference between conditions before treatment. However, after treatment, WS scores were significantly different from the scores of the SO (p = 0.004) and CON (p = 0.013) conditions, while the scores of the SO and CON conditions were not different from each other. Compared to before treatment measures, M/L stability for the WS condition improved 4% while the SO and CON conditions did not improve. Concerning the A/P measure, there was no time by condition interaction and no main effect of condition. However, there was a main effect of time (F = 11.76, p = 0.002). Regardless of condition, A/P stability scores after treatment were significantly better than pre scores.

2423 Board #155
8:30 AM - 9:30 AM
The Effect of Mechanography as a Biofeedback Mechanism During Concentric Isokinetic Muscle Actions
Tammy K. Evetovich, FACSM, Donovan Conley, FACSM, Jay Todd. Wayne State College, Wayne, NE.

Mechanography (MMG) is the recording of muscular vibrations that has been shown to be helpful in providing biofeedback to subjects when attempting to control an external prosthetic (Barry et al., Arch Phys Med Rehabil 67:267-269, 1986). No previous studies however, have determined whether MMG can be utilized to provide information to subjects on their muscle function that will allow for enhanced muscle performance during isokinetic muscle actions.

PURPOSE: The purpose of the present study was to examine the MMG signal as a biofeedback mechanism during concentric isokinetic muscle actions.

METHODS: Twelve adult (mean±SD; age=23.0±4.0 yrs) subjects (weight=88.2±8.4 kg; height=180.3±6.6 cm) performed maximal isokinetic (90 and 270°·s⁻¹) leg extension strength testing while MMG was recorded. Subjects were provided with (by viewing a computer screen graphically displaying the MMG signal) MMG biofeedback (BIO) and then without MMG biofeedback (NOBIO) in a random order separated by 48 hours.

RESULTS: Two-way ANOVA's (biofeedback x velocity) revealed no significant difference in peak torque (p=0.05) for BIO versus NOBIO at 90°·s⁻¹ (M±SEM; BIO=163.5±38.1 Nm; NOBIO=160.0±19.2 Nm) or 270°·s⁻¹ (BIO=101.5±13.1 Nm; NOBIO=100.5±17.0 Nm). In addition, there was no significant difference (p=0.05) in MMG amplitude at 90°·s⁻¹ (BIO=32.1±13.1 mV; NOBIO=35.8±14.9 mV) or 270°·s⁻¹ (BIO=102.2±87.8 mV; NOBIO=96.2±51.0 mV).

CONCLUSION: The results of the present study revealed that using MMG as a biofeedback technique was not useful for enhancing leg extension strength during concentric muscle actions. It is possible that subjects needed to be more extensively trained in viewing the MMG signal while displaying strength in order for it to be useful as a biofeedback method. Future studies are necessary to determine if MMG can be used for other purposes (i.e., pain control, improved athletic performance for other activities, diagnosis of muscular diseases) that may be sensitive to biofeedback.

2424 Board #156
9:30 AM - 10:30 AM
The Role of Foot Position in Postural Stability and Balance
Marjorie A. King¹, Robert Bowers¹, Jean P. Boucher, FACSM; ¹Plymouth State University, Plymouth, NH; University of Quebec, Montreal, Montreal, PQ, Canada.

PURPOSE: The use of assessing the quantity and accuracy of task specific movement patterns to identify deviation in posture, balance and dynamic movement or to note improvement with an intervention is becoming more prominent in the literature. It is unclear if the foot position at the time of assessment would influence the quality of the movement pattern. The purpose of this study is to determine if foot position would effect dynamic postural balance as measured by the translation of the center of pressure using the MatScan® System (Tekscan).

METHODS: A repeated measures design was used testing subjects under two conditions, (1) self-selected foot position (SSFP) and (2) standardized biomechanical foot position (SBFP) (15 deg of ER and 6 inches between the bisection of the calcaneus). Testing occurred in a controlled laboratory setting in a single session. Twenty subjects (10 males and 10 females), mean age 21 ± 1.3 yrs, mean height 168.6 ± 8.3 cm and mean weight of 73.05 ± 14.92 kg participated in this study. The force data was collected at 40 Hz. Using the MatScan® System (Tekscan). Subjects were instructed to squat to 60 degrees of knee flexion in two seconds guided by audio cues from the researcher of “ready, set, down, up” in conjunction with a metronome while standing on the MatScan®. Real time data acquisition tracking the translation of the center of pressure during the squatting movement was then used to calculate the variables of Area, Distance and Variability. Area, thought to reflect postural sway, represents the translation of the COP using X and Y excursions and the formula for an ellipse. Distance represents the total excursion of the COF (calculated using the Pythagorean Theorem) across the selected duration of time and represents overall postural adjustments. Variability is the standard deviation of the moment to moment distances and is thought to reflect fine postural adjustments.

RESULTS: There were statistical significant differences between SSFP and the SBFP for both Area (p < 0.005; t₁ = -3.208) and Distance (p = 0.004; t₁ = -3.289). For Area (representing postural sway), the mean value for SSFP was 12.04 ± 3.83 cm and 8.71 ± 2.67 cm for the SBFP, a 27.6% decrease. For Distance (representing overall postural adjustments), the mean value for SSFP was 19.43 ± 3.82 cm and 17.35 ± 2.48 cm for the SBFP, a 10.71% decrease.

CONCLUSIONS: The results lead to conclude that foot position influences postural balance during a dynamic movement pattern. A predetermined SBFP may limit the external generalization and the clinical application of the balance test results.

2425 Board #157
8:30 AM - 9:30 AM
Exploring for the Skill of the Double Skip in Jump Rope among Elementary School Children
Masaki Ao, FACSM, Kazuo Hashizume, Tomoki Horita, Kiyoshi Toriumi. Toyama University, Toyama, Japan.

PURPOSE: Double skip in jump rope is one of a difficult subject for elementary school children; however, no study is available on analysis of the skill of double skip. The purpose of this study is to explore in the skill of double skip. Methods: Eighteen study subjects were assigned into three study groups (A, B, and C group). A group was with five children who were unable to perform double skip. B group was with three children who were able to perform double skip only one time. C group was with ten children who perform double skip more than two times. All subjects were 4th grade children. After performing two times front jump rope for preparation, all of the subjects were asked to perform double skip. Performances were recorded with a high speed camera and the movement of the jump rope was analyzed using the Frame-DIASII® (DKH, co, Japan).

RESULTS: The average maximum velocity of the rope was 24.18m/s in A group, 26.20m/s in B group, and 27.10m/s in C group respectively. No statistical significance was found among the three groups. The average velocity of A group was 20.92m/s, and it was significantly shorter than B group (23.97m/s), and C group (23.74m/s). The average time for one cycling of the rope of C group was 0.25s that was significantly shorter than A group (0.31s), and B group (0.28s).
CONCLUSIONS: As for A group, increasing the average velocity enabled to perform double skip. As for B group, hastening time for one cycling of the rope enabled to perform double skip for more than two times.

2426 Board #158 9:30 AM - 10:30 AM
The Innervation of the Enthesis Organ of the Rat Achilles Tendon

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PURPOSE: The enthesis (bony insertion of a tendon or ligament) is a common site of overuse injuries in sport. Because enthesopathies can be painful, it is often assumed that the enthesis is highly innervated - but with little evidence to support the assumption. Here we monitored changes in insertional angle between tendon and bone using a force pulse paradigm. The presence of the study was to investigate the innervation of the whole enthesis organ complex.

METHODS: The tendon attachment site was removed from one leg of 3 male Wistar rats at each of the following ages - neonates, 4 weeks, 12 weeks, and 24 months. The tissue was fixed in 4% paraformaldehyde, prepared for routine indirect immunohistochimistry and cryosectioned in the sagittal plane. Serial sections were immunolabelled with polyclonal antibodies to protein gene product 9.5, substance P, calcitonin related peptide and neurotrophin 200. Histology reference sections were stained with toluidine blue.

RESULTS: No nerve fibers were detected at the enthesis itself or in the sesamoid and periosteal fibrocartilagines in rats of any age. However, the fat pad was richly supplied by nerve fibers which immunolabelled with all of the antibodies used. It also contained abundant mast cells. The innervation of the fat pad was confirmed in 10 human Achilles tendons obtained from the Department of Forensic Medicine at the Ludwig-Maximilians-University, in agreement with the ethical regulations of Munich University. The nerve fibers again immunolabelled with all antibodies and formed an intricate network in which the fibers lay between individual fat cells.

CONCLUSION: We suggest that healthy entheses are not innervated because of the high levels of mechanical loading experienced at insertion sites. However, the striking innervation of the enthesis itself proved that it may have an unheralded proprioceptive role monitoring changes in insertional angle between tendon and bone that occur as a result of foot movements.

2427 Board #159 8:30 AM - 9:30 AM
EMG Analysis in Individuals with Chronic Ankle Instability during the Star Excursion Balance Test

Kimberly Becker, Lucinda Boulion, Jacqui Broering, Steve Lyons, Nick Reimer, Dan Wolford. University of Findlay. Findlay, OH. Email: beckerki@findlay.edu

PURPOSE: To compare muscle activity during the Star Excursion Balance Test (SEBT) in subjects with stable ankles (controls) and chronic ankle instability (CAI) under conditions of non-supported (NB) condition and supported (SB) condition.

METHODS: Twenty-four healthy subjects were matched to age and BMI ([Controls: n=12; age=21.5 ± 1.73 yrs; BMI=24.0 ± 2.75 kg/m²][CAI: n=12; age=21.3 ± 1.72 yrs; BMI=24.3 ± 2.83 kg/m²]). Surface electromyography (SEMG) was utilized to record muscle activity of 8 muscles during SEBT after random assignment to either SB or NB. All subjects completed 6 trials on the SEBT in 8 directions (relative to the dominant/stance leg): anterior, anterolateral, lateral, posterolateral, posterior, posteromedial, medial, anteromedial. During the SEBT, SEMG sampled at 1000Hz, was used to simultaneously record 8 muscles on the ipsilateral side of the stance leg: rectus abdominus (RA), external oblique (EO), erector spinae (ES), glutus medius (GM), rectus femoris(RF), peroneus longus (PL), lateral gastrocnemius (LG), and tibialis anterior(TA). Muscle activity was analyzed for 3 seconds, and the SEMG amplitude values (root mean square) were rectified and normalized to each respective maximal isometric contractile peak force of the muscle in question. This value represents the percent maximal voluntary isometric muscle contraction (MVC). The rectified and normalized SEMG amplitude values were then averaged for all subjects across the last 3 of 6 trials in each direction of the SEBT and expressed as %MVC. Maximum reach distance (MAXD) of the non-stance leg was calculated as reach distance/ non-stance leg length x 100 and expressed as %. Summary of Results: Paired student t-tests revealed controls had greater distance when UB for anterior (NB: 100.4 ± 6.49%; B: 96.6 ± 5.47%; p=0.006) and anterior (NB: 90.2 ± 6.70%; B: 85.9 ± 2.92%; p=0.01). CAI had greater distance for lateral (NB: 96.4 ± 11.87%; B: 91.8 ± 11.83%, p=0.007), posterolaterolateral (NB: 103.9 ± 9.11%; B: 100.8 ± 9.96%, p=0.03) and medial (NB: 111.8 ± 5.21%; B: 110.2 ± 3.51%, p=0.04). Paired student t-tests found effects elicited higher %MVC when B in posterolateral for RF (NB: 78.8 ± 4.73%; B: 74.6 ± 3.67%, p=0.04), posteromedial PL (NB: 58.8 ± 24.33%; B: 73.8 ± 23.37%, p=0.04), and anteromed for ES (NB: 25.9 ± 19.93%; B: 32.2 ± 23.96%, p=0.02). CAI had lower %MVC when B for lateral with GM (NB: 57.4 ± 36.67%; B 45.2 ± 33.51%; p=0.005), but higher %MVC when B posterior for TA (NB: 75.3 ± 29.73%; B: 89.2 ± 26.52%, p=0.03).

CONCLUSION: Both groups had greater reach distances when NB in several SEBT directions. The limited excursion while braced may be due to the restriction of inversion and eversion, resulting in less tri-planar motion. In addition, GM %MVC when B was normalized in lateral direction for CAI which may be from increased stability from the brace.
2430 Board #162
9:30 AM - 10:30 AM
Small Lateral Displacement of the Muscle Represents Low-Frequency Force Fluctuations During Voluntary Contractions in Humans
Yasuhiko Yoshitake, Minoru Shinohara, FACSM. 1 Oita University of Nursing and Health Sciences, Oita, Japan. 2 University of Colorado, Boulder, CO. Email: yoshitake@oita-uhs.ac.jp
Small lateral vibration of the muscle surface, termed as muscle sound or mechanomyogram, has been recorded with accelerometers or displacement sensors. The amplitude of this vibration depends on the development of fusion of motor units during electrically stimulated contractions in humans (Yoshitake et al. J. Appl. Physiol. 91:1744-1752, 2001). PURPOSE: To examine if there is a temporal correlation between force fluctuations and small lateral displacement of the muscle surface during voluntary contractions of a muscle in humans.

METHODS: Seven healthy young adults (20-33 yrs) performed steady isometric contractions with the first dorsal interosseus muscle. Target force ranged from 2.5 to 80% of the maximal voluntary contraction force. Small lateral displacement of the muscle surface was measured with a high-resolution laser displacement sensor (LK-G155, Keyence, Japan; 0.4 µm resolution). Abduction force of the index finger and small lateral displacement of the muscle surface were recorded simultaneously. The standard deviations (SD) of force and muscle displacement were calculated after the linear trend was removed. To examine the extent of temporal correlation between force and muscle displacement, cross-correlation function (CCF) between these signals was calculated.

RESULTS: The major frequency range in signals was ~5 Hz for both force and muscle displacement across target forces. The SD of force increased with target force from 47.0 ± 5.7 mN to 606.6 ± 71.1 mN. Similarly, the SD of muscle displacement increased with target force from 2.3 ± 0.21 µm to 57.7 ± 9.3 µm. A significant linear correlation was found between the SD of force and the SD of muscle displacement (r = 0.60, P < 0.0001). There was a significant temporal correlation between the force and muscle displacement as shown by a positive peak in the CCF at all target forces (P < 0.01). The peak value of the CCF and its time lag ranged from 0.49 to 0.59 and from 0.60 to 0.43 ms, respectively. These values were not influenced by target force (P > 0.05).

CONCLUSION: Temporal characteristics of low-frequency force fluctuations in a muscle were represented by small lateral displacement of the muscle surface across a wide range of contraction intensity.

2431 Board #163
8:30 AM - 9:30 AM
Age Does Not Influence the Increase in Force Fluctuations with Contralateral Muscle Activity
Minoru Shinohara, FACSM, Amy L. Stone, Carolyn J. Barry, Roger M. Enoka. University of Colorado, Boulder, CO. Email: shinohara@colorado.edu
Unintended force is produced in the contralateral homologous muscle during unilateral contractions of the first dorsal interosseus muscle and is greater in old adults compared with young adults (Shinohara et al. J Appl Physiol 94:966-974, 2003). PURPOSE: To compare the effect of contralateral homologous muscle activity on force fluctuations during steady contractions of the hand muscle in young and old adults.

METHODS: Twelve young (24.0 ± 4.7 yrs) and 15 old (76.5 ± 6.4 yrs) subjects performed steady, isometric contractions with the first dorsal interosseus muscle of the right hand (test hand). Concurrently, subjects contracted the homologous muscle in the left hand (load hand) to support an inertial load. Subjects were asked to produce a steady force with the test hand while holding the index finger of the loaded hand in a neutral position. The target forces for the test hand were 5, 10, and 20% of the maximal voluntary contraction force (MVC). The inertial load supported by the loaded hand ranged 0.80% of the MVC. Control trials involved the performance of steady contractions with the test hand while the loaded hand was relaxed.

RESULTS: The coefficient of variation (CV) for force in the test hand during control trials tended to be greater in old adults (2.8 ± 1.5%) compared with young adults (2.3 ± 1.0% when collapsed across target forces, P > 0.05). When collapsed across target forces and loads, the CV for force was significantly greater in old adults (3.7 ± 2.6%) compared with young adults (2.7 ± 1.4%, P < 0.05) when collapsed across target forces and loads. The increase in the CV for force was greater for lower target forces in the test hand and with heavier loads in the loaded hand; for example, there was an 85% increase in the CV for force when the target force was 5% MVC and the inertial load was 80% MVC.

CONCLUSIONS: Force fluctuations during steady contractions increased at all target forces for both young and old adults when the contralateral, homologous muscle supported loads. The decline in steadiness was similar between young and old adults. Supported by NIA AG09000.
likely leads to errors in detecting the onset of motor unit activity.

PURPOSE: To quantify the influence of amplitude cancellation on the accuracy of detecting the onset of motor unit activity in the rectified interference EMG.

METHODS: A generic lower-limb muscle with 350 motor units in 20 random locations was simulated using the Fuglevand model (Fuglevand et al J Neurophysiol 70: 2470-2488, 1993). The force profile for the Achilles tendon during the stance phase of walking was used to validate the simulated net muscle force. The surface EMG signal was simulated by summing the motor unit potentials before (cancellation EMG) and after (no-cancellation EMG) they had been rectified. The two EMGs were compared across 20 trials at four levels of excitation: 10, 20, 40, and 100% of maximum. The influence of amplitude cancellation was examined by comparing the mean amplitude of the cancellation and no-cancellation EMGs. The experiment was repeated with median filtering (window sizes of 10, 20, 50, 80, and 100 ms, incremented by 1 ms) and low-pass filtering (cutoff frequency of 13, 20, 40, 60, and 100 Hz) applied to the cancellation EMG signal. Onset time was determined by visual discrimination as well as statistically as the last sample of the current window when the window average exceeded 3 SDs above the baseline mean.

RESULTS: The no-cancellation EMG exhibited a greater rate of increase at the onset of motor unit activity for all four levels of excitation. Onset time differed by up to 12 ms between the cancellation and no-cancellation EMGs and was greatest for window sizes above 50 ms, and for low-pass filter cutoff frequencies below 60 Hz. For example, the comparisons between the cancellation and no-cancellation EMG at 40% excitation indicated that the error in detecting the onset of the contractions from the five-joint cancellation EMG was 8-26 ms, and that from the no-cancellation EMG was 7-17 ms.

CONCLUSION: Amplitude cancellation did not influence the accuracy of visually detecting the onset time of a contraction in the surface EMG. However, errors were introduced when the EMG signal was processed with median and low-pass filtering techniques; the errors were most pronounced for larger window sizes (median filtering) and lower cutoff frequencies (low-pass filtering).

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2436 Board #168 9:30 AM - 10:30 AM
A Comparison of Children and Adults’ Motor Control Strategies During Maximal Cycling
Elaine L. Hunter, Colleen Carroll, Robert D. Horscroft, James C. Martin, FACSM. University of Utah, Salt Lake City, UT.

Previous authors have reported that children and adults use different force trajectories to produce power. The purpose of our study was to determine whether authors have interpreted these differences to suggest that children employ immature control strategies. However, net force arises from muscular, gravitational, and inertial forces, and children’s smaller limb masses must produce smaller inertial and gravitational forces. Interestingly, maximal cycling power has been reported to be highly related to limb mass. Thus, during maximal cycling, muscular, gravitational and inertial forces should all scale with limb mass.

PURPOSE: Our purpose for conducting this study was to examine power delivered to the pedal and power produced at the ankle, knee, and hip by children and adults during maximal cycling. We hypothesized that the scaling effect of limb mass would allow children and adults to employ similar power production strategies.

METHODS: Eleven active children (6 males, 5 females, ages 8-9) and thirteen adult (7 males, 6 females, ages 21.5 ± 1.26 years) performed a maximal, 3 second, cycling trial on an isokinetic ergometer at pedaling rate of 115 rpm. Pedal forces and pedal and crank position were sampled at 240 Hz with an instrumented pedal. Two-dimensional limb kinematics were obtained using a two-camera motion capture system and the joint position and velocity data were used to calculate net joint moments. Net joint moments were used to determine net joint powers on an isokinetic ergometer at pedaling rate of 115 rpm. Pedal forces and pedal and crank position were sampled at 240 Hz with an instrumented pedal. Two-dimensional limb kinematics were obtained using a two-camera motion capture system and the joint position and velocity data were used to calculate net joint moments. Net joint moments were used to determine net joint powers.

RESULTS: Children and adults produced nearly identical scaled pedal power throughout the crank cycle. However, children produced significantly greater scaled knee extension power (82±9% vs. 44±6%) and less scaled hip extension power (47±8% vs. 91±16%) and ankle extension powers (14±5% vs. 25±2%) than adults. Relative joint power produced during ankle extension, knee flexion, and hip flexion transfer extended did not differ in children and adults.

CONCLUSION: Based on these results, we conclude that the inherent scaling of muscular, gravitational, and inertial forces to limb mass in a maximal cycling task allowed children to adopt adult-like pedal power trajectories. We cannot presently allocate children to adopt adult-like pedal power trajectories. We cannot presently allocate children to adopt adult-like pedal power trajectories.
Bosu ball. Subjects also completed the unipedal stand on the floor and foam pad with eyes closed. Each subject was instructed to put his other leg down if he felt that he was going to lose his balance, and not to fail if he was losing his balance. Time was measured in seconds, with a maximal time limit set at two minutes. Subjects randomly completed unipedal balance tests for each leg. Subjects completed tests on both legs before completing another test. Data was analyzed using a multifactor repeated measures ANOVA.

RESULTS: There were no main or interaction effects between right and left leg and gender. Mean time (SD) for unipedal stand with eyes open on the floor, balance pad and Bosu ball were 114.2 (18.9), 87.6 (10.1) and 36.0 (4.0) respectively. Mean time for the unipedal stand with eyes closed on the floor and foam balance pad was 51.6 (35.2) and 6.9 (6.4) sec respectively. All times were significantly different (p<0.0001) from each other. There was no incidence of injury or falls during any of these balance tests.

CONCLUSION: These measures provide a wide range in which to categorize postural balance in a young adult population. Standing on one leg on the floor was completed for the longest time followed by the foam balance pad, floor with eyes closed, the Bosu ball and the foam balance pad with eyes closed. Using these methods to test an individual’s balance will help the determine who may be at risk for short and long term balance related injuries as well as determine individuals with normal and excellent levels of balance. These measures have also been found to be safe, easy to implement and inexpensive in this subject population.

Supported by a University of Chattanooga Foundation grant.

2439 Board #171 8:30 AM - 9:30 AM
The Effects of 4 Different Acute Whole Body Vibration Exposures upon Indicies of Counter Movement Vertical Jump Performance
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The use of whole body low frequency vibration to acutely excite the neuromuscular system is gaining popularity.

PURPOSE: To investigate the affects of four different whole body vibration applications upon indices of vertical jump performance.

METHODS: Twenty-one recreationally trained males aged 24-41 (mean 28.9±7.3) volunteered in a two-phase concurrent study with two different vibration protocols each performed on separate force platforms to record ground reaction forces. Subjects performed a jump-switch mat in a standardized position. The CMJ’s were performed in four series (pre-vibration (T1), two minute post-vibration (T2), five-minutes and 30 seconds post-vibration (T3), 11 minutes post-vibration (T4)) of three trials. Vibration treatments were applied to the subjects’ backs, yielding greater mean power than the continuous bouts of vibration (p < 0.05). Additionally, the pre-vibration trial yielded lower FITRO®dyne mean power values than the trials post-vibration (p < 0.05). Lastly, the intermittent vibration at 50 Hz yielded greater mean power than the continuous bouts of vibration (p < 0.05).

CONCLUSION: The use of an intermittent vibration protocol at a frequency of 50 Hz appears to be more effective than continuous vibration at a lower frequency of 30 Hz at enhancing acute indices of vertical jump performance.

2440 Board #172 9:30 AM - 10:30 AM
Mediolateral Stability During Sit-to-Stand in Individuals After Total Knee Arthroplasty
Catherine A. Stevermer, Shashank Raina, Jason C. Gillette. Iowa State University, Ames, IA. (Sponsor: Rick L. Sharp, FACSM)

PURPOSE: During sit-to-stand tasks, impaired elderly may risk falling due to weight-bearing asymmetry and increased postural sway compared to healthy elderly. Adults after total knee arthroplasty (TKA) may show asymmetry during sit-to-stand due to limited knee motion and/or strength. Center of pressure (COP) oscillation is an indicator of stability of movement during weight-bearing tasks. The goal of this project is to determine therapeutic recommendations for sit-to-stand in an orthopedic population.

METHODS: Six individuals after total knee arthroplasty (age 75.3 ± 5.5 yr) and six individuals (age 70.8 ± 2.0 yr) without any musculoskeletal disorder participated in the project. An eight-camera video system was used to track reflective markers for three-dimensional kinematic analysis. Subjects sat on a bench with their feet at a comfortable width on separate force platforms to record ground reaction forces. Subjects performed sit-to-stand with three levels of upper extremity assistance: no assistance, two hand support from the bench, and one hand support from the bench and one hand support on an assistive device. Two triaxial force sensors measured hand forces applied to the bench or walker. Initial foot placements were varied between symmetrical 90° knee flexion and 100° knee flexion positions and a staggered foot position. Data were analyzed using repeated measures ANOVA.

RESULTS: Across conditions, TKA exhibited a 3.7 ± 0.8 cm reduction in COP excursion and a 0.52 ± 0.1 m/s reduction in COP velocity in the mediolateral plane compared to healthy elderly (p<0.001). TKA also averaged a 3.2 ± 0.4 cm wider base of support across upper extremity and foot positions (p<0.001). There was no statistical difference 114.2 (18.9), 87.6 (10.1) and 36.0 (4.0) sec respectively. Both groups appear more stable in the hands-on-bench condition, traversing the lowest percentage of their base of support (p<0.005). The TKA group utilized more upper extremity support when allowed to do so (p<0.05).

CONCLUSIONS: After TKA, adults appear to exhibit asymmetry due to lower extremity weakness or pain while performing sit-to-stand. They may aim for mediolateral stability by widening their base of support, limiting frontal plane movement and/or using additional upper extremity support.
and prone with a progressive increase of work on the back (heaviest weight up to 90.1 or 102.3 kg). MVV with the heaviest weight was 70% of the seated MVV (122 ± 28 and 156 ± 38 L·min⁻¹, respectively, P < 0.001) and 85% of predicted MVV. In phase 2, oxygen consumption (VO₂) and ventilatory function (VE/MVV) measured in subjects in the PMRP struggled excessively for 60 s were compared with similar measurements in subjects performing a maximal treadmill test. During the restrained struggle, peak VO₂ was lower and only 44% of VO₂peak and VE was 36% of MVV. In our study of healthy subjects, we found that significant weight force in the prone position resulted in decreases in MVV, but remained within the normal range of predicted measurements. Moreover, with maximal struggle in PRMP, VO₂ was lower and VE, when compared with MVV measurements, appear to be adequate to meet ventilatory needs.

2443 Board #175 8:30 AM - 9:30 AM
**Energy Expenditure Requirements to Ascend and Descend a 20 Foot High-Rise Building**

**PURPOSE:** Self-Contained Self-Rescuers (SCSR) provide a non-contaminated air source to wearers during hazardous environmental conditions. These units are designed with a limited air supply that is partially dependent on work rate. SCSR's may be used during emergency escapes from high rise buildings. The purpose of this investigation was to evaluate energy expenditure requirements of participants ascending and descending a 20 foot high-rise facility.

**METHODS:** Fifteen male and female volunteer subjects underwent individual laboratory calibration sessions to relate oxygen consumption and minute volumes to heart rate. They were then brought to a high rise facility located in Rockville, Maryland to perform 4 work-sets: a self-paced stair ascent; a target-paced stair ascent; a self-paced stair descent; and a target-paced stair descent. Heart rate monitors were used to collect and record heart rate responses during ascents and descents. Recorded heart rate data were then converted into oxygen consumptions and respiratory minute volumes. Energy expenditures were calculated using a conversion factor of 1 L O₂ = 4.84 kcal.

**RESULTS:** Participants were able to ascend the high rise in 158 ± 32.15 and 538 ± 159.66 seconds at self- and target-paced work rates, respectively. The average descent times were 103.47 ± 10.66 and 248.73 ± 151.93 seconds at the self- and target-paced work rates. The average heart rate responses were 168.97 ± 16.47 and 132.98 ± 25.31 bpm in the self- and target-paced ascents. The self- and target-paced descents produced heart rate values of 151.15 ± 20.78 and 126.04 ± 25.58 bpm. Oxygen consumption values were 2.15 ± 0.55 and 1.51 ± 0.24 l/min in the self- and target-paced ascents. A self-paced target-paced descents produced oxygen consumption values of 1.53 ± 0.40 and 1.15 ± 0.24 l/min. Energy expenditure requirements were 104.1 ± 2.66 and 73.11 ± 1.16 kcal/min in the ascent and 7.41 ± 1.94 and 5.61 ± 1.16 kcal/min in the descent phase at self- and target-paced work rates, respectively. Predicted minute volumes were 62.35 ± 16.05, 38.71 ± 5.85 l/min and 44.56 ± 10.24 and 31.31 ± 4.32 l/min in the ascent and descent phase, respectively of work rates. Although the rates of energy expenditure and oxygen consumption were lower during target-paced ascent and descent, the longer times required for the target-paced movements resulted in a greater total oxygen consumption requirement (ascent: target- 13.16 ± 5.57 vs. 10.97 ± 2.86 l/min; self-paced, 5.52 ± 1.37 l/min; descent: target- 4.85 ± 3.18 and self-paced, 2.63 ± 0.66 L).

**CONCLUSIONS:** An SCSR designed for emergency escape from a high-rise building needs to have at least a capacity to store 0.46 L of oxygen per floor.

2444 Board #176 9:30 AM - 10:30 AM
**Metabolic Comparison Between a Lifting Task with Identical Weight but Different Coupling Factors**
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The 1991 NIOSH (National Institute for Occupational Safety and Health) revised lifting equation’s objective is to prevent or reduce lifting-related injuries. The coupling component relates to the quality of the hand-to-object interface (grip) and can be rated good (e.g., crate with hand-hold cutouts), fair (e.g., crate with no handles or hand-hold cutouts), and poor (e.g., non-rigid bag that sags in middle). A good coupling is theorized to reduce lifting and grip stress, whereas a poor coupling is theorized to increase lifting and grip stress.

**PURPOSE:** To compare the metabolic cost and perceived exertion between a two-handed lifting task performed with identical weight but different coupling and container factors.

**METHODS:** 21 healthy volunteers participated (14 males, 7 females; 26±6 yr; 177±8±7 cm; 73.9±10.7 kg; grip strength: right - 45.4±12.6 kg, left - 43.1±13.6 kg; all right hand dominant). Subjects transferred either a 12.5 kg milk crate or a 12.5 kg bag of dog food individually back and forth from the floor to a table. During transfer, the dog food bag lay flat on the floor and table respectively and was picked up lengthwise (i.e., hand on top and bottom ends of bag). Distance traveled from floor to table was 152.4 cm horizontally and 74.9 cm vertically. Subjects performed two, 5 minute work bouts with either the milk crate or dog food bag. Order (i.e., milk crate or dog food bag first) was determined randomly. Three minutes of rest was allowed between bouts. Pace was constant at 8 lifts per minute. Lifting technique was self-selected by the subject. Metabolic parameters were monitored throughout the work bouts. Steady state data from minute 2 to 5 was used for analysis with paired T-Test.

**RESULTS:** (mean (sd); mc = milk crate; df = dog food): ml/kg/min: mc = 15.1 (2.7), df = 13.4 (2.2); l/min: mc = 11.0 (2.0), df = 10.0 (2.0); kcal/min: mc = 5.5 (1.1), df = 5.0 (1.1); REE: mc = 0.8 (0.1), df = 0.9 (0.1); HR: mc = 105.3 (12.2), df = 98.9 (11.5); RPE: mc = 9.1 (1.5), df = 8.3 (1.6). Significant difference (p<0.05) occurred on all parameters between the two conditions, except for RER (p>0.05).

**CONCLUSION:** A significantly higher metabolic cost and perceived exertion was observed when subjects performed a paced, 12.5 kg two-handed lifting task with good coupling factors (milk crate), than when using a 12.5 kg dog food bag with poor coupling factors. When lifting stress is measured by metabolic cost and perceived exertion, these results are in contrast to expectations that poor coupling factors would increase stress of a lifting task.
Overhauling (pulling a pike pole) - cadence of 15 pulls/min; (b) Advancing a line - pulling a fire hose at a cadence of 15 pulls/min; and (c) Stair stepping - ascending/descending 3 stairs, 4 up, 4 down (total activity time=12 min). There was a 2 min rest period between Trials 1 and 2. Participants were instructed not to use training apparatus (total gear weight=20.4 kg). Heart rate (HR), core temperature (TC), thermal sensations (TS), and perceived exertion (RPE) were collected before, after each 2 min task (and after each trial), and during 5-min of recovery. PSi and PSi were calculated using formulae developed by Moran et al. (PSi, 1998) and Oikins et al. (PSi, 2002).

**RESULTS:** Significant ($P \leq 0.001$) increases occurred for HR, TC, RPE, and TS across trials. PSi increased significantly across trials ($M=2.9, 4.9, 5.1; P<0.01$), with the second trial being significantly greater than the first ($P<0.036$). This reflected a change from low heat strain to moderate heat strain by the end of Trial 2 and during recovery. PSi also increased significantly across trials ($M=6.6, 7.6, 7.5; P<0.031$), with the second trial again being significantly greater than the first ($P<0.028$). Participants perceived moderately high heat strain following Trial 1, but high heat strain after Trial 2 and during recovery. Within subject correlations between PSi and PSi over time (after each task) revealed r= 0.48±0.95, with an average r=0.74.

**CONCLUSIONS:** Even relatively brief simulated firefighting activities in hot environments results in moderate to high levels of heat strain. It appears from these data that the perceived level of heat strain tends to be higher than the physiological level of strain, albeit reflected a similar pattern over time. This difference is likely due to the slower rise in core temperature in such relatively brief, albeit fairly intense activities.

**Methods:** Twelve professional firefighters, averaging 11.5 years of firefighting experience, participated in two experimental conditions; one in which the firefighter was challenged to make decisions on a computerized fire strategies and tactics drill (FSC) while exercising on a cycle ergometer at 60% of $\text{VO}_{2\text{max}}$ and the other in which the firefighter exercised at the same intensity without the challenge (EAC).

**RESULTS:** There were no differences in the amount of work performed between the two counterbalanced conditions. Furthermore, no differences in self-report measures of anxiety or perceived exertion were revealed, although the FSC did result in greater perceptions of overall workload. Additionally, participants had elevated stress hormone (EPI, NE, CORT) responses during the FSC. Although there were no significant changes in the measures of hemostatic function (IL-6, ET-1, or TXB$_2$), positive correlations were found in the FSC among CORT and IL-6 ($r=0.55$), ET-1 and TXB$_2$ ($r=0.55$), and a negative correlation between IL-6 and TXB$_2$ ($r=-0.54$).

**DISCUSSION:** The exacerbated response of the sympathoadrenal and hypothalamic-pituitary-adrenal axes in response to the combined mental challenge and physical stress along with the significant relationships among these variables may provide evidence in support of a mechanism that explains the elevated incidence of cardiovascular deaths among firefighters.

**Conclusions:** This study is further evidence that even minor adjustments in health and lifestyle programming at fire departments can result in major improvements in overall health that can persist over an extended period of time.

**Health and Fitness Variable**

<table>
<thead>
<tr>
<th>Baseline</th>
<th>2 year post</th>
<th>p-value</th>
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</thead>
<tbody>
<tr>
<td>Resting Double Product ($'$)</td>
<td>125.6 ± 11.6</td>
<td>120.5 ± 12.6</td>
</tr>
<tr>
<td>Body Mass Index (kg/m$^2$)</td>
<td>28.3 ± 4.7</td>
<td>29.4 ± 4.7</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>27.2 ± 6.2</td>
<td>20.5 ± 5.3</td>
</tr>
<tr>
<td>Waist Circumference (in)</td>
<td>39.0 ± 5.4</td>
<td>36.0 ± 4.4</td>
</tr>
<tr>
<td>VO$_2$ (mLkg$^{-1}$‘min$^{-1}$)</td>
<td>38.3 ± 5.0</td>
<td>41.6 ± 5.9</td>
</tr>
<tr>
<td>Sit-ups (# in minute)</td>
<td>33.0 ± 6.4</td>
<td>46.4 ± 18.3</td>
</tr>
<tr>
<td>Sit-and-reach (in)</td>
<td>72.7 ± 3.4</td>
<td>78.0 ± 3.4</td>
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**Conclusion:** We have previously demonstrated a correlation between physical demand level (PDL) achieved upon completion of a rehabilitation program and return-to-work rates in lumbar fusion patients (Kruger et al., Spine J, 2002, 2(5)).

**Methods:** Forty-one compensable patients post-lumbar fusion were monitored during rehabilitation to assess relationships between program performance variables and PDL. Exercise volume was calculated as: Volume = Weight X Sets X Repetitions. RTvol was calculated as the average daily training volume during the first and last week of the program. DLvol was calculated by using the best set during the first and last week of the program (Weight X Repetitions). PDL was measured at program completion. PDL was classified by occupational lifting requirements: LIGHT (20lbs), LIGHT/MEDIUM (55lbs), MEDIUM (55 lbs), MEDIUM/HEAVY (75lbs), HEAVY (100lbs), VERY HEAVY (>100lbs). A one-way ANOVA was used to analyze relationships between PDL and RTvol and DLvol Fisher’s Exact Test was used for post-hoc analysis. Pooled comparisons were analyzed by a Student’s t-test. The level of significance was set at p<0.05. Numerical data are presented as means±SD.

**Results:** PDLs achieved at program completion were LIGHT=1, MEDIUM=6, MEDIUM/HEAVY=16, HEAVY=6, VERY-HEAVY=12. For statistical analysis of the relationship between RTvol and DLvol, and the one LIGHT PDL, patient was eliminated. When grouped by PDL, there were no significant differences in RTvol at the start of the program. All patients significantly increased RTvol during the program (p<0.0001). ANOVA indicated significant differences existed in RTvol and DLvol between groups (p<0.0017 and p<0.0001 respectively). Fisher’s test indicated these differences did not exist between all groups, therefore the MEDIUM/MEDIUM- HEAVY and the HEAVY/VERY-HEAVY groups we pooled (M/MH, n=22; M/H, n=22; H/H, n=18). Student’s t-tests indicated significant differences in RTvol and DLvol between M/MH and H/H groups (32235A=84577b/day vs. 42855A=9424b/day; p<0.002) and 722415±175b/day vs. 1480±491b/day (p<0.0001) respectively.

**Conclusion:** These results suggest that RTvol and DLvol can predict PDL following a rehabilitation program. These results, taken together with our previous findings, suggest that benchmark volume goals may be used during a resistance training program to improve patient outcomes following lumbar fusion.
resULts:

METHODS: An anonymous ergonomic and exercise questionnaire was administered to 393 volunteers in a communication company, 71% female and mean age of 33.6 ± 9.78 yrs. The job required approximately 8 hours of sitting. The questionnaire included body part discomfort, physical activity and fitness club membership assessments. The discomfort scale was 0-5 with 0 = no discomfort to 5 = very uncomfortable. Physical activity categories were established based on the International Physical Activity Questionnaire (IPAQ). The percentage of employees falling into the IPAQ and club membership classifications was determined. The percentage of employees reporting higher levels of discomfort, 3-5 level, were separated and compared to the IPAQ and club membership classifications.

RESULTS: 61% (n=238) of the employees were not club members and 39% (n=151) were club members. Club members reported using club facilities 1.4 ± 1.85 days per week. Utilizing IPAQ fitness classifications, 53% of the employees were “inactive”, 31% were “minimally active”, and 16% engaged in “health enhancing physical activity” (HEPA). Of those reporting low back (n=162) and upper back (n=116) discomfort, 20% were “inactive”, 53% in “minimally active”, and 27% in “HEPA”. The body areas showing the highest relationship with club membership were low and upper back, neck, shoulder, and eye. The outcomes in order of not club member vs. club member were: low back (n=162), neck (n=90), and eye (n=72). Inactive = 53% & 40%; Minimally Active = 36% & 24%; HEPA = 33% & 31%, respectively. The body areas showing the highest relationship with club membership were low and upper back, neck, shoulder, and eye. The outcomes in order of not club member vs. club member were: low back (n=162), neck (n=90), and eye (n=72). Inactive = 53% & 40%; Minimally Active = 36% & 24%; HEPA = 33% & 31%, respectively.

CONCLUSIONS: The ergonomic discomfort profile was an effective tool to demonstrate positive relationships related to physical activity and wellness club membership in this sedentary occupational environment.

2451 Board #183 8:30 AM - 9:30 AM
Comparison of Three Training Programs for Improving Repetitive Lifting Task Performance in Women
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Email: marilyn.sharp@niaamed.army.mil

Soldiers must perform many strength demanding tasks, yet their physical training (PT) is not specifically designed to improve performance of these tasks.

PURPOSE: To evaluate the effectiveness of three PT programs to improve performance of a militarily-relevant repetitive lifting task (RLT).

METHODS: Sixty-three female volunteers (20±2 yrs, 65.6±2.7 kg, 165.6±7 cm) were randomly assigned into one of four groups matched for weight, height and strength: Control (n=9; CT); Resistance (n=16; RES); Aerobic (n=14; AER); Combined, RES and AER (n=15; CB). All group training was performed on three alternating days per week for nine weeks. The RES group used a non-linear, periodized model, performed three sets of seven upper- and lower-body exercises/day. AER training was comprised of 20-30 min. of continuous running (70-85% maximum HR), and progressive interval running (400-1600 m). CB performed both the RES and AER exercise programs on the same day. RLT was the maximum number of times a 20.5 kg box could be lifted from the floor, carried 3 m and placed onto a 155 cm high platform in five minutes. RLT was determined at weeks 0, 4 and after 9 weeks of training.

RESULTS: There were no significant differences (NSD) in week 0 (baseline) measurements between groups. While repeated measures ANOVA revealed NSD's between groups, there was a significant increase of 26.7% (32.9 to 41.7 lifts) from week 0 to week 9, with most of the increase (20.7%) occurring between weeks 0 and 4. Tukey post-hoc analysis of the significant group by time interaction revealed significant increases in all groups (CB: 36.1%, RES: 33.1%, AER: 21.3% and CT: 17.3%). The three trained groups increased significantly from week 0 to week 4, but did not show further increases at week 9. The CT group, which had the smallest increase, did not increase from week 0 to 4, but only from week 0 to week 9. RLT was significantly correlated (p<0.05) at all time points with 2 mile load carriage (-0.32 - -0.42), 50 m casualty drag (-0.29 - -0.51), IRM squat (-0.30 - -0.38) and bench press (0.34 - .49), but not with fat free mass or VO2max.

CONCLUSIONS: It has previously been reported that RLT training is key to improving RLTS. This study demonstrated that RES alone provides a greater training effect than AER alone, but the two combined tended to produce the greatest increase. RLT performance was related to performance of other physically demanding tasks and strength, but was not related to aerobic capacity or body composition. To maximize militarily relevant RLT performance, the Army should consider adding a RES component to its physical training curricula.

2452 Board #184 9:30 AM - 10:30 AM
Low Relationship between Body Part Discomfort Profile and End of Shift Fatigue
David Mills, Robert Boyce, FACSM, Michael O’Connor, Ed Boone, Albert Lee, Brian Cioci, Josh Bolton. UNC Wilmington, Wilmington, NC.

Email: dlm7345@uncw.edu

The relationship between body part discomfort, a typical ergonomic assessment tool, and shift fatigue experienced by workers is critical for recommending exercise and health programs that target increased productivity and lower insurance costs.

PURPOSE: To examine the relationship between a body specific ergonomic discomfort profile and the eventual end of shift fatigue using a principal components analysis.

METHODS: An anonymous ergonomic and exercise questionnaire was administered to 393 volunteers in a communication company, 71% female and mean age of 33.6 ± 9.78 years. The survey included body part discomfort, fatigue, and exercise assessments. The discomfort scale was 0-5 with 0 = no discomfort to 5 = very uncomfortable. Fatigue was measured at the 8th shift hour on a similar scale of 0-5. The International Physical Activity Questionnaire was used to establish the MET-minutes used per week. A principle components analysis combined multiple body part discomfort scores into one discomfort index. A regression analysis established a relationship between the discomfort index and fatigue. Regression and ANCOVA procedures analyzed the effects of age, gender, fitness club membership, shift and total MET-minutes/week on the discomfort index and fatigue relationship.

RESULTS: The discomfort index and fatigue relationship was low, but significant (R2 =0.0866, SEE = +0.04568, p< 0.0001). The non-club member variable was significant, yet low (R2 =0.1675, SEE = 0.05992, p<0.0001). Other variables showed no significant differences.

CONCLUSION: The relationship between the body part discomfort profile and the fatigue experienced at the end of an eight-hour work shift was low in this sedentary work environment. In the practical application of this research, it may be advisable to use both these ergonomic instruments in tandem. Their low relationship suggests each has a unique set of characteristics for which to design and evaluate ergonomic, exercise and nutrition interventions in sedentary occupations. It also suggests that the use of one to predict the outcome of the other may be low in this industry.

2453 Board #185 8:30 AM - 9:30 AM
Profile of Weight Gained after Employment in Sedentary Occupation

Email: bwc0258@uncw.edu

There is a tendency for employees to gain weight after entering sedentary occupations. It is critical for organizations to understand the situations, which promote weight gain.

PURPOSE: To compare demographic and organizational characteristics of those that gained weight and did not gain weight after employment in a telecommunication organization.

METHODS: An anonymous ergonomic and exercise questionnaire was administered to 393 volunteers in a communication company, 71% female and mean age of 33.6 ± 9.78 years. The survey included body part discomfort, fatigue, exercise and ergonomic assessments. The facility was in operation for 8 months before data collection. The discomfort scale was 0-5 with 0 = no discomfort to 5 = very uncomfortable. Fatigue was measured at the 8th shift hour on a similar scale of 0-5. The International Physical Activity Questionnaire was used to establish the MET-minutes used per week. A principal components analysis combined multiple body part discomfort scores into one discomfort index. T- tests, F-tests and ANCOV A procedures were used to compare those that gained weight and did not gain weight as well as for the amount of weight gained for the following variables: Age, gender, body part discomfort index, fatigue after 8 hours, fitness club membership, previous employment type, days it took to become accustomed to the job, and total MET-minutes/week.

RESULTS: 67% (n = 263) stated they gained weight since they were employed. The mean weight gain was 16.7 ± 12.3 pounds. No significant differences were found for any of the variables between those reporting they did or did not gain weight. There was a significant difference in amount of weight gained between those that were not club members and those that were club members (15.2 ± 11.2 vs. 18.6 ± 13.5 lbs, p< 0.05), respectively. No other significant differences were found for any of the other variables in the amount of weight gained.

CONCLUSIONS: Little differences were found between those that reported they gained weight and did not gain weight in this sedentary work environment. Those that joined the fitness club on the average reported the highest weight gain since they were employed.
**CONCLUSION**: Generally it can be concluded that perceptions of fitness are consistent across gender and type of position held in the fire service. The majority of firefighters perceive their fitness to be above average.

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**METHODS**: The purpose of the study was to examine firefighter perceptions of fitness. Perceptions of health-related physical fitness were evaluated using a 5-point Likert scale instrument and a single item question asking "how fit are you?". Participants also completed a survey to determine the stage of behavioral change. Data were analyzed using a multivariate analysis based on the original perception survey validated by Abadie (1988). Significant results were followed by univariate and pairwise comparisons and the significance level set at $p < 0.05$.

**RESULTS**: The results of this study demonstrate that overall perceptions of health-related fitness (PSFA) are consistent across gender and position in the fire service and that the two fitness perception instruments (PSFA & PFI combined) were only moderately correlated ($r = 0.72$). Significant differences were noted between perceptions of health-related fitness and stage of change ($p < 0.01$). Pairwise comparisons revealed those in the maintenance stage of change perceived their muscular condition to be significantly better than those in the contemplation stage ($p < 0.004$) and action stages ($p < 0.006$), while those in the maintenance stage perceived their muscular condition to be significantly better than those in the contemplation stage ($p < 0.014$). Significant differences were noted between subjects interaction effect of gender and stage of change was only significant for physical condition ($p < 0.020$). Forty-six percent of the respondents perceived their fitness level as excellent/good, 28.3% above average, 22.6% were below average/average, and 2.8% failed to respond to this question. Generally, firefighters perceive their overall fitness (PFI combined) to be above average or better (74.5%), while only 22.6% perceived themselves as below average/average.

**CONCLUSION**: It is well known that girls acquire less physical activity (PA) throughout the day compared with boys of the same age. However, there is limited data examining the variations in PA, such as walking to school, in association with gender.

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was detectable in only 7 of the 19 study participants and was not affected by the intervention. Neither the ratio of OPGsRANKL nor concentrations of CTX were significantly influenced by treatment conditions.

CONCLUSION: Aerobic exercise training may protect against reductions in bone mineral density during weight loss by increasing bone formation.

Supported by NIH T32 AR48523, Food for the 21st Century, and the Elizabeth Haggarty Foundation.

2458 Board #190
9:30 AM - 10:30 AM
Actual and Perceived Overweight and Obesity in Older Asian Indians
Grant M. Schofield, Gregory S. Kolt1, Narender K. Chadha2, Melody Oliver1. *Auckland University of Technology, Auckland, New Zealand. 2University of Delhi, Delhi, India.
Email: grant.schofield@aut.ac.nz

Asian Indians have a rapidly increasing prevalence of coronary heart disease and Type 2 diabetes. An important contributing risk factor is weight status (especially central adiposity). Before implementing weight management strategies it is important to understand how actual weight status relates to perceptions of weight status. As well, the strategies most commonly employed to manage weight in a specific population need to be understood.

PURPOSE: The aim of this cross-sectional study was to investigate body fatness, perceptions of weight status, and common strategies used to control weight in two groups of older Asian Indians.

METHODS: Participants were older Asian Indian adults living in middle-class areas of New Delhi (N = 147, mean age = 64.6 ± 2.7 years) and Auckland, New Zealand (N = 112, mean age = 67.5 ± 7.6 years). After recruitment from community groups, physical measures (height, weight, waist circumference, and bioelectrical impedance) were taken and questions pertaining to perceptions of weight status and weight management strategies employed in the last month were administered.

RESULTS: Both groups showed a high prevalence of overweight and obesity using ethnically adjusted BMI cut-points. The New Delhi sample demonstrated less overweight and obesity (40.1% normal weight, 38.8% overweight, and 21.1% obese) than the Auckland sample (29.9% normal weight, 48.7% overweight, and 20.3% obese). Although the majority of both the Auckland and New Delhi samples were overweight or obese (69% and 60% respectively), only a minority perceived that they were overweight (31% and 17% respectively). Some were attempting to lose weight (19.7% Auckland, 8.8% New Delhi). All of those trying to lose weight were overweight or obese. In the previous month both diet and physical activity/exercise had been used to control weight by some in both samples. Diet as a weight management strategy was low (14.5% Auckland, 10.2% New Delhi). Exercise/physical activity was more popular with almost half the Auckland sample (48.7%) and 38.1% of the New Delhi sample having used exercise in the previous month to attempt to control weight.

CONCLUSIONS: Both samples of Asian Indians had a high prevalence of overweight and obesity, yet the majority perceived themselves to be of normal weight. For weight management programs to be effective, people first need to understand their own weight status. We recommend education about weight status measurement as an important component in starting community and self-management programs.

2459 Board #191
8:30 AM - 9:30 AM
Comparison of a Commercial Weight Loss Program to Joining a Fitness Center
Stephen D. Ball, Anne T. Bolhofner. University of Missouri, Columbia, MO.
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PURPOSE: To compare the effectiveness of a popular commercial weight loss program (CW) to joining a fitness center (FC) for weight loss and improving body composition. A secondary purpose was to investigate changes in blood chemistry and blood pressure.

METHODS: Forty-three overweight (BMI ≥ 25) and sedentary women received a 12-week membership to either CW or FC. Subjects in CW were instructed to follow the dietary and exercise recommendations of the program, which generally included weekly weigh-ins, counseling sessions, and a point counting system to monitor calories. Subjects assigned to FC were instructed to follow the American College of Sports Medicine guidelines for weight loss which included both aerobic and anerobic exercise a minimum of three times weekly. Outcomes included body weight (BW), body fat percentage (%BF) measured via skinfolds and the BOD POD, intraabdominal fat (IAF) and subcutaneous abdominal fat (SAF) measured via computed tomography, total cholesterol (TC), HDL cholesterol with subfractions, triglycerides, systolic blood pressure (SBP), and diastolic blood pressure (DBP).

RESULTS: BW decreased significantly for CW (P = 0.001) but not for FC (P = 0.055), while %BF did not change significantly for either group. SAF was significantly decreased only in the CW group. Both groups lost a significant amount of IAF and TC. SBP and DBP decreased significantly in both groups with no between group differences.

CONCLUSIONS: The purpose was to compare the “real-world” differences, especially changes in body composition, between joining a fitness center to joining a popular commercial weight loss program. Exercise performed in a laboratory and controlled setting typically improves body composition. The majority of exercise sessions in this study were purposely performed without supervision to mimic the “real-world.” Thus, the intensity and duration of exercise were ultimately subject controlled. This is a likely reason for the lack of difference in %BF observed with FC. Although CW significantly reduced BW and SAF, %BF was not improved, suggesting a percentage of BW lost was in the form of lean tissue. In the long term this might be detrimental to weight loss and weight loss maintenance. Nevertheless, it appears from this research, in the short term it may be easier to comply with the recommendations of this particular commercial weight loss program and lose BW compared to joining a fitness center.

2460 Board #192
9:30 AM - 10:30 AM
Effect of Exercise Intensity on the Subsequent Hunger-Satiety Profiles
Seiichi Susaki1, Fumimori Katsukawa2, Koichiro Azuma3, Norimitsu Kinoshita4, Yoko Oguma5, Hiroyuki Ishida6, Shohei Onishi7, Akira Shimada8, Hajime Yamazaki9. *Department of Internal Medicine, Keio University School of Medicine, Tokyo, Japan. 1Sports Research Center, Keio University, Yokohama, Japan.
Email: seiichi.susaki@nih.go.jp

PURPOSE: Food intake after exercise affects energy balance and it has been reported that hunger is suppressed shortly after high intensity exercise compared to the longer duration of low intensity exercise of the same energy expenditure (EE). Recently, obesity guidelines recommend a large amount of physical activity to maintain reduced weight or to prevent unhealthy weight gain. Because of time constraint, high intensity exercise may be necessary to achieve this large amount of EE.

PURPOSE: of this study is to evaluate the acute effect of exercise of three different intensities on the various profiles of hunger-satiety in a practical setting, i.e. when the exercise is performed in the same duration.

METHODS: Eight subjects (6M/2F, age: 22±2 yrs, BMI: 19.4±1.0) performed three 60-minute exercise sessions of different intensity, low (LOW), moderate (MOD), and high (HIGH), on three separate days. Subjects were asked to eat the same test meal on the day before exercise session (2501kcal/day, P: F: C = 16: 26: 58) and for breakfast on the day of exercise session (509kcal, P: F: C = 9: 31: 60) at 0900. Various profiles of hunger-satiety, based on Hill (1984) and Flint (2000), were monitored using visual analogue scales of 100mm every hour during 60 minutes of exercise using a cycle ergometer (1000-1100) and three hours of resting period (1100-1400). VO2 and VCO2 were also measured with an indirect calorimeter to evaluate EE and substrate oxidation.

RESULTS: %VO2R and EE in LOW, MOD and HIGH sessions were: 26±5, 52±3, and 67±5%, and 327±73, 564±119, and 675±139 kcal/h, respectively. Both EE and fat oxidation during exercise and 180 minutes of post exercise period showed an increasing trend with an increase in exercise intensity (P for trend <0.01). With an increase in exercise intensity, an increasing trend in hunger and a decreasing trend in ‘desire to eat something fatty’ were observed immediately after exercise sessions (P for trend <0.01 and <0.05, respectively). However, the differences were not observed during the subsequent three hours of resting periods. Other profiles of hunger-satiety did not show any differences by exercise intensity. CONCLUSIONS: Although EE was significantly high with HIGH condition, the profiles of hunger-satiety showed no clear difference, suggesting that high intensity exercise that consumed a large amount of EE in a limited time may favor negative energy balance.

2461 Board #193
8:30 AM - 9:30 AM
Resting Energy Expenditure Response Following Environmental Tobacco Smoke Exposure
Email: natali_sidi@hotmail.com

It has been well-established that active smoking increases the levels of energy metabolism. Specifically, in active smokers resting energy expenditure (REE), exhibits increases equal to 7.2%, when pre- and post-smoking values are compared. Nevertheless, no studies have investigated the effects of passive smoking on energy expenditure.

PURPOSE: The purpose of this study was to investigate the acute effects of passive smoking on REE.

METHODS: The REE of 18 healthy adult non-smokers (9 male; 9 female; age:25.3±3.1 years; height:172.4±10.1 cm; weight: 65.6±13.7 kg) was evaluated four consecutive times, via indirect calorimetry. The first two REE measurements - separated with a one-hour resting period - were reserved for the base-line measurements (REE and , for short). The other two REE assessments were separated by a one-hour resting period while exposed to passive smoke (, and , for short) in carbon monoxide concentrations of 15 ppm. Carbon monoxide (CO) concentrations were determined via a gas mixture in a sample chamber using a Horiba (MEXA 311 GE) CO analyzer. Serum cotinine concentrations were obtained before all REE assessments and analyzed via blood chromatography. Analysis of variance (ANOVA) with Bonferroni adjustment was utilized to detect mean differences among REE measurements and adjust for multiple comparisons.

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#1362-1849–WEDNESDAY, MAY 31 #1850-2268–THURSDAY, JUNE 1 #2269-2726–FRIDAY, JUNE 2 #2727-2915 – SATURDAY, JUNE 3

POSTER SESSIONS
RESULTS: Means±standard deviation for REE and REE, were 1489.2±283.5 kcal/day and 1504.3±286.2 kcal/day, whereas for REE and REE, were 1495.9±291 kcal/day and 1584.9±296.8 kcal/day, respectively. No significant differences were detected between REE, vs. REE, (p<0.05) and REE, vs. REE, (p<0.05), whereas this was not the case for REE, vs. REE, (p<0.01) and REE, vs. REE, (p<0.05). Serum cortinine concentrations before REE and REE were 6.9±3.8 and 6.9±3.6 (p<0.05) respectively whereas for REE and REE, the cortinine concentrations revealed significant differences (7.3±3.6 and 34.9±19.1 respectively, p<0.001).

CONCLUSION: The observed differences between REE vs. REE, suggest that Pasadena smokers significantly increases energy expenditure in healthy adults and in smokers. This may be due to immediate immune and or hormonal responses, as exactly clarified in smokers. Further research is required to establish the mechanisms which underlie the cause of this increase in REE after passive smoking.

This research was supported by the Research Committee of the University of Thessaly.

2462 Board #194 9:30 AM - 10:30 AM Effects Of Submaximal Exercise On Resting Energy Expenditure And Respiratory Quotient In Young Women Lidia G. De Leon, María de Jesus Muñoz, Graciela Rodríguez, Jorge A. Jimenez. University of Chihuahua, Chihuahua, Chih., Mexico. Email: gdbleon@uach.mx

Raising rates of obesity all over the world have been linked to environmental factors that promote inactive lifestyles and excess energy intakes. This aspect account for lower levels of resting and physical activity energy expenditure which may lead to weight gain. Sedentary behavior is associated with lower fat oxidation, which favors fat storage and should cause increases in the respiratory quotient. Although the influence of exercise on energy turnover is well known, the individual response to variations in levels of physical activity remains unclear.

PURPOSE: To compare the effect of a 30-min-treadmill walking at 50% of maximal oxygen uptake on resting energy expenditure and respiratory quotient in physically active and sedentary young women.

METHODS: Sixteen healthy nonobese women 22 to 35 years of age, 8 physically active (PA) and 8 sedentary (S) were measured by weight, height, body mass index (BMI) and maximal oxygen uptake (VO2 max) before to perform a 30-min-treadmill exercise at 50% of VO2 max. Resting energy expenditure (REE) and respiratory quotient (RQ) were measured by indirect calorimetry before and after the submaximal workload and repeated at 6, 12, 24, 30 and 36 hours post exercise. Descriptive statistics, paired t-test and univariate repeated measures analysis at a p<0.05 significance level were used.

RESULTS: Age, weight, height and BMI were similar in both groups. VO2 max was higher in PA than in S women (40.5 ± 6.2 and 27.9 ± 4.6 ml/kg/min, respectively, p<0.05). No differences in REE were seen between PA and S groups before and after exercise (1265 ± 155 vs 1254 ± 313 kcal/day and 1467 ± 258 vs 1478 ± 398 kcal/day, respectively). REE was higher after the submaximal workload in both PA and S women (16% and 17%, respectively, p<0.05), remaining increased during the next hours and returning to the previous levels at 24 hours after the exercise. RQ was lower in PA than in S before the 30-min-treadmill walking (0.77±0.07 vs 0.84±0.07 respectively, p<0.05) and showed a significant decrease during the exercise, lower in PA than in S women (0.70 ± 0.63 vs 0.75 ± 0.63 respectively, p<0.05). RQ remained decreased during the next hours, recovering the previous levels at 24 hours after the submaximal exercise.

CONCLUSIONS: A mild-intensity aerobic exercise increases RQ for several hours in physically active and sedentary young women regardless their different training levels. Physically active women shows a higher fat oxidation than sedentary females, that increased after a submaximal workload.

ACKNOWLEDGEMENTS - This research was supported by CONACyT Government of Mexico, grant 9702009.

2463 Board #195 8:30 AM - 9:30 AM Resting, Exercise and Recovery Energy Expenditure and RQ Differences in Females with Bulimia Nervosa vs. Comparable - Mass Controls Joanna S. Vrabas1, Kiriki Korstanijndor2, Christos S. Riganas3, Gregoris Simos3. 1Ergophysiology - Ergometry Laboratory, Serres, Aristotelian University of Thessaloniki, Serres, Greece. 2Ergophysiology - Ergometry Laboratory, Aristotelian University of Thessaloniki, Thessaloniki, Greece. 3CMHC, Central District/ 2nd Department of Psychiatry, Aristotelian University of Thessaloniki, Thessaloniki, Greece. (Sponsor: Scott K. Powers, FACS) Email: tnvrabas@phel-stauth.gr

Bulimia Nervosa (BN) is an illness that is most commonly found in females of later adolescence and early adulthood. It is characterised by episodes of binge eating. This behaviour may be very severe with enormous quantities of food, most typically carbohydrates being consumed. To prevent the otherwise inevitable consequence of weight gain during periods of food restriction and often vomiting, laxative abuse or excessive exercising. Resting energy expenditure (REE) has been found to be lower in normal weight bulimics than in controls and it has been speculated that metabolic abnormalities might underlie bulimia.

PURPOSE: This study determined if differences exist in energy expenditure (rest, exercise, and recovery from exercise) between females with BN and healthy, body mass matched controls.

METHODS: The Eating Attitudes Test (EAT-26) and the Eating Disorder Inventory (EDI) were the screening instruments as part of a two-stage screening process of 349 female participants (26±3 yrs; 59.7±9.1 kg; 21.6±2.9 kg/m2). Subjects who scored high were referred for a diagnostic interview. An experienced eating disorders psychiatrist conducted the follow-up evaluation and 14 individuals were diagnosed with bulimia nervosa (BN). An equal number of healthy comparable - mass subjects were selected as controls (C) (BN=21.5±1.12; C=21.2±1.9 kg/m2). Both groups underwent an incremental cycle ergometer test (50rpm) that started at 50W (4min) and increased stepwise 25W every minute until exhaustion. Oxygen consumption and carbon dioxide production were measured at rest, during exercise, and during recovery (20min) by open circuit spirometer (Jaeger Eos Spiro).

RESULTS: REE was significantly lower in BN compared to C (0.86±0.08 vs 0.96±0.09 kcal/min, p<0.05). No differences were observed in exercise and recovery energy expenditure between groups. RQ was lower in BN compared to C during rest (0.96±0.07 vs. 0.89±0.08, p<0.05), at submaximal exercise (50W 1.01±0.09 vs. 0.93±0.07, p<0.005; 75W 1.02±0.08 vs 0.94±0.08, p<0.05; 100W 1.08±0.01 vs. 0.97±0.07, p<0.01) and during recovery (15th min 0.98±0.16 vs. 0.86±0.09, p<0.05; 20th min 0.91±0.13 vs. 0.78±0.07, p<0.01).

CONCLUSION: We conclude that BN is accompanied by a disturbance in energy expenditure during both rest and exercise.
RESULTS: On days the participants walked their child to or from school they obtained 26.6 ± 13.3 minutes of MVPA compared to 17.6 ± 13.3 minutes of MVPA on days they did not walk their child to or from school (p<0.05).

CONCLUSION: Although not significant, participants had 35% more minutes of MVPA on days they walked their child to or from school compared to days their child was not walked. This may be assumed if these sedentary women walked their children to and from school each day, they may be able to meet the recommended level of daily physical activity (30 minutes). Future studies are needed to examine the long-term health benefits of escorting children to and from school using active forms of transportation.

2466 Board #198 9:30 AM - 10:30 AM
Comparison of Bariatric Surgery and Weight Management with Very Low Caloric Diet
Darielle Anderson, Steven J. Koecky, FACSM, Amy Roble, Kimberly Gottesman, Jill Ruben, Jonathan K. Ehrman, FACSM, Henry Ford, Detroit, MI. Email: jehrman1@hfhs.org
Bariatric surgery is rapidly becoming standard treatment for the morbidly obese (BMI > 40). However, treatment alternatives exist, including high-protein supplementation or very low caloric intakes < 800 per day. These are commonly known as very low calorie diets (VLCD). PURPOSE: To compare the rate of weight loss in morbidly obese individuals undergoing bariatric surgery versus VLCD.

METHODS: Consecutive patients from the hospital’s bariatric surgery (BS, n=43) and Weight Management (VLCD, n=11) programs were evaluated using prior clinic notes and a protective database. Inclusion criteria included females and a BMI between 40 and 50. Body mass was determined at baseline, and at 1, 3, and 6-month follow-up appointments. Each program includes several follow-up visits, including exercise counseling performed by an exercise physiologist. Only those VLCD patients attending one or more follow-up visits were included for analysis. Mean values were compared using an independent t-test with Bonferroni adjustment for multiple comparisons (alpha = 0.016).

RESULTS: No differences were noted between the BS and VLCD groups, respectively, for baseline body mass (119 ± 13 vs. 124 ± 31 kg, p=0.36), BMI (45 ± 4 vs 44 ± 3 kg/m^2, p=0.09) and age (44 ± 10 vs. 47 ± 10 yr, p=0.11). The table presents decline in body mass (absolute and relative) from baseline.

<table>
<thead>
<tr>
<th>Group</th>
<th>6-month % Weight lost</th>
<th>6-month % Weight lost</th>
<th>12-month % Weight lost</th>
<th>18-month % Weight lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>5.0 ± 6.3</td>
<td>7.4 ± 6.7</td>
<td>9.5 ± 7.9</td>
<td>11.5 ± 8.8</td>
</tr>
<tr>
<td>VLCD</td>
<td>5.0 ± 6.3</td>
<td>7.4 ± 6.7</td>
<td>9.5 ± 7.9</td>
<td>11.5 ± 8.8</td>
</tr>
</tbody>
</table>

CONCLUSIONS: Both treatments were effective at weight reduction at each time point. However, BS resulted in greater absolute and % weight loss at each time point. Assuming typical surgery costs of $25,000 versus $2,000 (counseling, dietary supplements, and exercise) for 6-months of weight management with VLCD, the average cost per pound is almost 9 times greater for BS. The combination of a 19% weight reduction and low cost make the VLCD an attractive alternative for some patients with a BMI > 40.
Numerous studies evaluating the efficacy of a carbohydrate restricted (CR) nutritional strategy, as compared to calorie and fat restricted (CFR) diets, have demonstrated an advantage of the CR approach up to 6 months with regard to body weight loss, fat loss, and abdominal fat loss. Several studies have found a greater weight loss on a CR diet despite a greater calorie intake than a CFR diet, suggesting a possible metabolic advantage with the CR approach. Two studies have found that a possible mechanism is a smaller reduction in resting metabolic rate (RMR) than on a CFR diet.

**PURPOSE**: to determine the effect of a carbohydrate restricted diet on RMR in overweight/obese women.

**METHODS**: Thirty (age=48.8 ± 7.6 yrs, wt= 93.4 ± 14.8 kg), 19.3± 2.8 cm, and BMI=33.6 ± 4.1 kg/m²) of 20 healthy women completed the study. At baseline (BL), subjects had been on an ad lib high carbohydrate (CHO) diet, followed by 8 wk on an ad lib CR diet with at least the initial 2 wk with ≤25g/m/d CHO. Metabolic measurements were taken at BL, 4, and 8 wk.

**RESULTS**: Caloric intake decreased from 2135 kcal/d (37% fat, 47% CHO, 16% protein) at BL to 1129 kcal/d (54% fat, 11% CHO, 34% protein) at week four and 1148 kcal/d (54% fat, 14% CHO, 32% protein) at week eight (p<0.05). Grams of CHO intake were ~27 during wk 1, ~30 during wks 4-5, and ~40 during wk 7-8. Body weight decreased from 93.4± 14.8 kg to 89.8± 14.8 kg (p<0.00001), 3.9% body weight, at week 4, and 89.3± 14.3 kg (p<0.05), or 5.2% body weight, at week 8. RMR was 1354± 390 kcal/d at baseline, 1326± 145 kcal/d at week four, and 1366± 187 kcal/d at week eight. RER decreased from 0.832 (±0.017) at baseline to 0.751 (±0.037) at week four and 0.744 (±0.043) at week eight (p<0.05), with corresponding fat utilization calculated from the non-protein RQ as 50% at BL to 83% at wk 4 and 8 (p<0.0001).

**CONCLUSIONS**: Mean RMR did not decrease on the CR diet, but data shows a wide range of individual responses. Data confirms a large increase in fat utilization on CR diet, possibly explaining greater total and abdominal fat loss compared to CFR diets seen in previous studies.

Grant from Mary E. Griff Foundation
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RESULTS: Stage progression for diet was statistically significant from month 1 to 6 (p < .0005) in the treatment group as participants moved from pre-action stages to action and maintenance stages. However, stage of change was also significant (p = .004) for diet during the 6-month period after the intervention as participants relapsed. There were no significant changes in stage distribution for exercise during the study. Analysis of covariance revealed no significant improvement in behavioral and physiological measurements of the treatment group as compared to the control group. Participants in the action stage spent the most amount of time on the website (mean = 25 min/month) while precontemplators spent the least amount of time (6 min/month). As a group, participants spent the least amount of time on the fitness information. Eighty-five percent of participants would recommend this type of program to others in the military.

CONCLUSIONS: The study findings are not sufficiently conclusive to suggest that an educational intervention based on the Stages of Change Model would be effective in improving eating and exercise behaviors of senior military officers, although participants progressed through the stages of change for consumption of fruits and vegetables. These findings suggest that the Internet is a promising and viable medium for delivering education to military personnel stationed and/or deployed around the world. Future research should focus on program content, factors that initiate and sustain behavior change, and possible use of email and other technology to deliver education to a military population.

2474 Board #206 9:30 AM - 10:30 AM
Effects of Exercise and a Low Carbohydrate Diet on Serum PYY Concentrations
Gregory A. Brown, Allison Swendener. University of Nebraska at Kearney, Kearney, NE. (Sponsor: Douglas S. King, FACSM)

E-mail: brownga@unk.edu

Peptide tyrosine tyroisine (PYY) is a hormone produced by the gut, which, similar to leptin, is released into the circulation after food intake and contributes to sensations of satiety perhaps resulting in decreased caloric consumption. Advocates of low carbohydrate diets purport that by restricting carbohydrate intake, sensations of satiety are increased while appetite is decreased thus facilitating reductions in body mass. However, the effects of a low carbohydrate diet on serum PYY concentrations have not been evaluated. Exercise is also advised for the reduction of body mass, but the effects of exercise on serum PYY concentrations have not been well defined.

PURPOSE: The purpose of this project was to examine the effects of a moderate intensity exercise program and low carbohydrate diet that facilitates weight loss on serum PYY concentrations in healthy adults.

METHODS: Nineteen healthy adults who desired to lose weight engaged in brisk walking (~50% VO2peak) for 30 minutes, 3 times per week for 7 weeks and were randomized to either a low carbohydrate diet (Atkins diet; LoCho; n=9) or to maintain their current diet (Con; n=10). Aerobic fitness, body composition, dietary composition, and fasting serum PYY concentrations were measured at baseline and again at week 7.

RESULTS: Aerobic fitness did not change in either group. Body mass (82 ± 8 vs. 82 ± 8 kg), fat mass (25 ± 4 vs. 25 ± 4 kg), and percent body fat (30 ± 3) did not change in Con from week 0 to week 7 (respectively). Body mass (96 ± 8 vs. 90 ± 9 kg), fat mass (30 ± 4 vs. 26 ± 4 kg), and percent body fat (32 ± 4 vs. 29 ± 3) were significantly (P<.05) reduced from baseline to week 7 (respectively) in LoCho. Total dietary energy intake (11,831 ± 2,036 vs. 10,923 ± 1,484 KJ/d), protein intake (1,761 ± 368 vs. 1,680 ± 208 KJ/d), carbohydrate intake (4,759 ± 368 vs. 4,709 ± 760 KJ/d), and fat intake (4,610 ± 1,458 vs. 3,989 ± 356 KJ/d) did not change in Con, from week 0 to week 7 (respectively). Dietary energy intake (11,831 ± 2,036 vs. 10,923 ± 1,484 KJ/d), protein intake (1,761 ± 368 vs. 1,680 ± 208 KJ/d), carbohydrate intake (4,759 ± 368 vs. 4,709 ± 760 KJ/d), and fat intake (4,610 ± 1,458 vs. 3,989 ± 356 KJ/d) did not change in Con, from week 0 to week 7 (respectively). Dietary energy intake (11,831 ± 2,036 vs. 10,923 ± 1,484 KJ/d), protein intake (1,761 ± 368 vs. 1,680 ± 208 KJ/d), carbohydrate intake (4,759 ± 368 vs. 4,709 ± 760 KJ/d), and fat intake (4,610 ± 1,458 vs. 3,989 ± 356 KJ/d) did not change in Con, from week 0 to week 7 (respectively).

CONCLUSIONS: These data indicate that participating in a low carbohydrate diet for 7 weeks does not reduce VO2peak in exercising people and does facilitate reductions in body mass. Moreover, a low carbohydrate diet may amass feelings of hunger during reductions in body mass by maintaining serum PYY concentrations.

2475 Board #207 8:30 AM - 9:30 AM
Effects of Exercise Combined with a Low Carbohydrate Diet on Health
Allison M. Swendener, Gregory A. Brown. University of Nebraska at Kearney, Kearney, NE. (Sponsor: Douglas S. King, FACSM)

As a result of the obesity epidemic in the United States, numerous dietary strategies have been advocated as effective methods for reducing body mass. One such dietary strategy, which has previously experienced large-scale popularity, is a carbohydrate restricted diet, most notably the Atkins diet. Although several investigations have documented significant reductions in body mass with a carbohydrate restricted diet, the effects of a carbohydrate restricted diet on aerobic fitness and body composition in physically active persons are less well known.

PURPOSE: This study examined the effects of a carbohydrate restricted diet on body mass, body composition, blood cholesterol levels, and VO2peak in persons engaged in a walking exercise program.

METHODS: Nineteen healthy adults who desired to lose weight engaged in brisk walking for 30 minutes, 3 times per week for 7 weeks and were randomly assigned to either the Atkins diet (LoCho; n=9) or a diet which followed the current USDA guidelines (Con; n=10) and were provided written material describing the respective dietary strategies.

RESULTS: Body mass (82 ± 8 vs. 82 ± 8 kg; for wk 0 vs. wk 7, respectively), fat mass (25 ± 4 vs. 25 ± 4 kg), and percent body fat (30 ± 3) did not change in Con while body mass (96 ± 8 vs. 90 ± 9 kg), fat mass (30 ± 4 vs. 26 ± 4 kg), and percent body fat (32 ± 4 vs. 29 ± 3) were significantly (P<.05) reduced from baseline to week 7 in LoCho. Blood LDL (127 ± 16 vs. 112 ± 10 mg/dl) and triglyceride (97 ± 30 vs. 107 ± 33 mg/dl) concentrations did not change in Con, but there were significant (P<.05) reductions in HDL concentrations (54 ± 5 vs. 48 ± 5 mg/dl) from baseline to week 7. Blood LDL (122 ± 18 vs. 113 ± 12 mg/dl) and HDL (41 ± 6 vs. 39 ± 6 mg/dl) concentrations did not change in LoCho but there was a significant (P<.05) reduction in triglyceride concentrations (174 ± 40 vs. 109 ± 22 mg/dl) from baseline to week 7. There were no changes in VO2peak for either Con (39 ± 2 ml/kg/min vs. 37 ± 2 ml/kg/min) or LoCho (38 ± 4 ml/kg/min vs. 41 ± 6 ml/kg/min). There were no changes in dietary composition in Con while LoCho did not alter protein or fat consumption but decreased caloric consumption due to decreased (P<.05) carbohydrate intake (1,150 ± 222 vs. 525 ± 214 kcal/day; baseline vs. week 7) intake.

CONCLUSIONS: Neither dietary strategy alters aerobic fitness when followed for 7 weeks. A carbohydrate restricted diet may be beneficial to health over a short period of time by lowering serum triglyceride concentration, body mass, and body fat. The USDA guidelines do not seem to alter body mass, body composition, or fitness when followed for a short period of time, perhaps due to insufficient emphasis on caloric restriction.

2476 Board #208 9:30 AM - 10:30 AM
Preservation of Fat-Free Mass with a Comprehensive Weight-Loss Program
Linda Zakulek, Joshua Lownes, Von Nguyen, Renee Melton, Theodore J. Angelopoulos, FACSM, James M. Rippe, FACSM. Ripple Lifestyle Institute, Celebration, FL.

Introduction: Obesity increases the risk for coronary heart disease, diabetes, and a myriad of other health conditions. Dietary methods to produce weight loss are often accompanied by undesirable loss of fat-free mass. Exercise preserves or builds fat-free mass, but its ability to produce weight loss is limited. The purpose of this study was to compare the effects of a comprehensive weight loss program vs exercise alone on measures of weight loss and body composition.

METHODS: Thirty-three overweight and obese individuals (mean age 41.1 ± 5.8 years) were randomized into either a comprehensive weight loss program (WW) or Exercise Only (EO). The EO group received an exercise prescription from an exercise physiologist in line with the Surgeon General’s recommendations for physical activity. The WW group received a comprehensive weight-loss program that included both structured diet and exercise components as well as weekly meetings. Adiposity and body composition were assessed using air displacement plethysmography (two compartment model). Independent t-tests were used to evaluate differences in changes in variables over 12 and 24-weeks. There were no differences at baseline between the groups. In body mass (183.04 ± 19.87 vs 170.82 ± 20.90 lbs) or body fat percentage (46.08 ± 6.81 vs 45.03 ± 6.42).

RESULTS: Changes over the course of 24-weeks are seen in table 1. Discussion: These data show that the WW group was successful at creating a significant weight loss while preserving fat-free mass. Conversely, the EO group preserved fat-free mass but did not achieve significant weight loss. The exclusive loss of fat and complete preservation of lean tissue during weight loss is important to maintenance of that loss, having been shown to yield multiple health benefits, including a preservation of metabolic rate.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>WW</th>
<th>EO</th>
</tr>
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<tbody>
<tr>
<td>Body weight change (lbs)</td>
<td>8.07 ± 5.39***</td>
<td>1.19 ± 3.88</td>
</tr>
<tr>
<td>BMI change</td>
<td>-10.07 ± 8.73***</td>
<td>-1.73 ± 6.06</td>
</tr>
<tr>
<td>Body Fat Percentage</td>
<td>-1.36 ± 9.40***</td>
<td>-0.19 ± 6.64</td>
</tr>
<tr>
<td>Fat Mass change(lbs)</td>
<td>-3.59 ± 1.92***</td>
<td>-0.78 ± 2.04</td>
</tr>
<tr>
<td>Fat-Free Mass change (lbs)</td>
<td>-4.25 ± 3.07***</td>
<td>-0.92 ± 1.78</td>
</tr>
</tbody>
</table>

** between group difference p<0.01 *** between group difference p<0.001

Supported by a grant from Weight Watchers International
Differential Impact of High-Carbohydrate vs. Low-Carbohydrate Diets on Endothelial Function in Adults with the Metabolic Syndrome

David Brock, Christopher Davis, Brian Irving, Jessica Rodriguez, Eugene Barrett, Arthur Weltman, FACS, Glenn Gaesser, FACS, University of Virginia, Charlottesville, VA.

BACKGROUND: Endothelial dysfunction has been linked to the pathogenesis of atherosclerotic vascular disease and predicts future cardiovascular events in patients with or without CVD. We evaluated the impact of two distinctly different diets on brachial artery reactivity in subjects with elevated risk for CVD and T2D.

METHODS: Ten subjects (3 males and 7 females, age 44.7 ± 7.8 years, BMI 34.4 ± 5.4 kg/m², mean ± SD) who meet the NCEP ATP III criteria for the metabolic syndrome participated. In a single-blinded, crossover design, each participant received 150% of their caloric needs on both diets and were instructed to eat only until no longer full. The low-carbohydrate (LC) diet contained 15-20% carbohydrate (10g/day of fiber), 55-60% fat, and 25-30% protein, and the high-carbohydrate (HC) diet contained 55-60% carbohydrate (45g/day of fiber), 20-25% fat, and 15-20% protein. Diet order was randomized, followed by a 4-week washout period. Brachial artery flow-mediated dilation (FMD) and response to sublingual glyceryl trinitrate (GTN) were assessed using high-resolution ultrasound and edge-detection software. Subjects were imaged in a fasted state at baseline and after 4 weeks of each diet.

RESULTS: Changes in vascular reactivity are reported as the mean % change over baseline. A Student’s t-test revealed a non-significant decrease in FMD as a result of the LC diet (8.57 ± 2.74 %; 6.26 ± 3.43 %, P = 0.15), whereas a significant increase was observed after the HC diet (8.90 ± 4.56 %; 11.70 ± 5.83 %, P = 0.02). A significant difference between diets was also observed [LC] - 2.00 ± 4.02 % vs. [HC] + 2.55 ± 3.12 %; P = 0.01]. Resting brachial artery diameter (mm; FMD % change, and GTN % change did not differ at baseline between the two meal challenges (3.22 ± 0.59 mm vs. 3.17 ± 0.64 mm, P = 0.4; FMD: 8.57 ± 2.74 % vs. 8.90 ± 4.56 %, P = 0.69; GTN 20.89 ± 7.06 % vs. 22.68 ± 5.24 %, P = 0.41)

CONCLUSION: Endothelium-dependent vasodilation of the brachial artery was markedly improved following the HC diet in adults with the metabolic syndrome. In as much as both endothelial dysfunction and the metabolic syndrome are markers for increased cardiovascular disease risk, the high-carbohydrate diet may improve clinical outcomes in metabolic syndrome subjects.

This work was supported by research grants from the NIH (grant number RR08847) and the Wheat Foods Council.

Differential Impact of High-Carbohydrate vs. Low-Carbohydrate Diets on Endothelial Function in Adults with the Metabolic Syndrome

David Brock, Christopher Davis, Brian Irving, Jessica Rodriguez, Eugene Barrett, Arthur Weltman, FACS, Glenn Gaesser, FACS, University of Virginia, Charlottesville, VA.

BACKGROUND: Endothelial dysfunction has been linked to the pathogenesis of atherosclerotic vascular disease and predicts future cardiovascular events in patients with or without CVD. We evaluated the impact of two distinctly different diets on brachial artery reactivity in subjects with elevated risk for CVD and T2D.

METHODS: Ten subjects (3 males and 7 females, age 44.7 ± 7.8 years, BMI 34.4 ± 5.4 kg/m², mean ± SD) who meet the NCEP ATP III criteria for the metabolic syndrome participated. In a single-blinded, crossover design, each participant received 150% of their caloric needs on both diets and were instructed to eat only until no longer full. The low-carbohydrate (LC) diet contained 15-20% carbohydrate (10g/day of fiber), 55-60% fat, and 25-30% protein, and the high-carbohydrate (HC) diet contained 55-60% carbohydrate (45g/day of fiber), 20-25% fat, and 15-20% protein. Diet order was randomized, followed by a 4-week washout period. Brachial artery flow-mediated dilation (FMD) and response to sublingual glyceryl trinitrate (GTN) were assessed using high-resolution ultrasound and edge-detection software. Subjects were imaged in a fasted state at baseline and after 4 weeks of each diet.

RESULTS: Changes in vascular reactivity are reported as the mean % change over baseline. A Student’s t-test revealed a non-significant decrease in FMD as a result of the LC diet (8.57 ± 2.74 %; 6.26 ± 3.43 %, P = 0.15), whereas a significant increase was observed after the HC diet (8.90 ± 4.56 %; 11.70 ± 5.83 %, P = 0.02). A significant difference between diets was also observed [LC] - 2.00 ± 4.02 % vs. [HC] + 2.55 ± 3.12 %; P = 0.01]. Resting brachial artery diameter (mm; FMD % change, and GTN % change did not differ at baseline between the two meal challenges (3.22 ± 0.59 mm vs. 3.17 ± 0.64 mm, P = 0.4; FMD: 8.57 ± 2.74 % vs. 8.90 ± 4.56 %, P = 0.69; GTN 20.89 ± 7.06 % vs. 22.68 ± 5.24 %, P = 0.41)

CONCLUSION: Endothelium-dependent vasodilation of the brachial artery was markedly improved following the HC diet in adults with the metabolic syndrome. In as much as both endothelial dysfunction and the metabolic syndrome are markers for increased cardiovascular disease risk, the high-carbohydrate diet may improve clinical outcomes in metabolic syndrome subjects.

This work was supported by research grants from the NIH (grant number RR08847) and the Wheat Foods Council.
CoNCLUsIoN:
These results suggest that frequent walking to and from school may provide enough stimulus to increase total daily PA and in turn attenuate excessive weight gain among grade school children. Future studies should be conducted to determine the long-term impact of walk- to- school programs on physical activity and weight gain.

2483 Board #215 8:30 AM - 9:30 AM Increased Body Fat Diminishes Insulin Sensitivity in Young, Non-Obese, Healthy, Women
Costas A. Anastasiou, Stavros A. Kavouras, Gianna Rapti, Vassiliki Pratiki, Mary Yannakoulia, Lios S. Salomidou. Department of Dietetics & Nutrition, Harokopio University, Athens, Greece. (Sponsor: Panteleimon Ekkekakis, FACSMM)
Email: acostas@hua.gr

Obesity is commonly assessed by using body mass index (BMI); however scientific evidence suggests that it is the accumulation of body fat and not excess body weight that adversely affects health.

PURPOSE: To study the influence of increased body fat on insulin sensitivity in young, non-obese (BMI: 18.5±25.0 kg/m2), healthy women.

METHODS: 32 women (age 19-33 yr) were classified into two groups according to their body composition: normal and high body fat groups (NBF and HBF, % body fat <30 and ≥30, respectively). The two groups did not differ in total energy intake, physical activity levels or maximal oxygen consumption and body fat distribution. Body composition was assessed by DXA and insulin sensitivity by the homeostatic model assessment (HOMA).

RESULTS: The HBF group had significantly lower insulin sensitivity, compared to the NBF group (0.1±0.01 vs. 0.2±0.02, p<0.05). No significant differences were found in fasting plasma triglycerides, free fatty acids, cholesterol and HDL-cholesterol. Linear regression analysis revealed that among the insulin sensitivity parameters assessed; only triglycerides were significantly associated with insulin sensitivity.

CONCLUSIONS: Data suggest that excess body fat, even in young, healthy women with normal BMI, can diminish insulin sensitivity. Furthermore, our data provide evidence that BMI values may not be appropriate for the assessment of obesity in clinical practice.
Effect of Rapid Weight-Loss Caused by Dehydration on Whole-body Glucose Uptake and Basal Metabolic Conditions

- Meiz-Chen Chen
- Wing-Chiang Wu
- Wei-Hsiang Chang
- Ming-Sheng Chan
- Wen-Chih Lee
- Chia-Hua Kao

Taipei Physical Education College, Taipei City, Taiwan Republic of China. *Shih Hsin University, Taipei City, Taiwan Republic of China.

Purpose: To compare the effects of a low carbohydrate diet and a grain-based diet on exercise performance and psychological variables during exercise in normal and sedentary men.

Methods: Twelve men (normal, n=6, VO2 peak=43±8 L/min; sedentary, n=5, VO2 peak=3±4 L/min) completed two dietary interventions. The low-carbohydrate diet (LCD) trial limited bioavailable carbohydrate intake to less than 50 g/day. The grain-based diet (GBD) trial saturated fat intake and emphasized fiber-rich whole grain foods. For both diet trials, the subjects completed a seven day diet diary, were weighed, and underwent body composition analysis and physical fitness testing.

Results: The LCD diet resulted in significant weight loss (p<0.05) and improvements in VO2 peak compared to the GBD diet. The LCD diet also resulted in decreased perceived exertion (RPE) and improved psychological variables including mood, motivation, and drive.

Conclusions: Low carbohydrate diets elicit significant weight loss, which has been questioned by whether lifestyle hinders exercise performance. Thus, the purpose of the study was to compare the effects of a low carbohydrate diet and a grain-based diet on exercise performance in normal and sedentary men.

Supported by the University of Oklahoma Health Sciences Center General Clinical Research Center grant M01-RR14467, National Center for Research Resources, National Institutes of Health.
PURPOSE: To examine the pattern of eating periodicity in overweight and obese adults engaging in weight loss efforts, and to examine the relationship between eating periodicity and subsequent changes in body weight.

METHODS: Seventy-five sedentary overweight adults participated in a behavioral weight loss program. Participants were prescribed a reduced energy (1,200 to 1,500 kcal/d) and dietary fat (20 to 30%) diet. Participants were instructed to complete daily food logs that included the frequency of eating episodes (meals and snacks) over a 20-week period. The data obtained from these diaries was used to assess meal patterns and was used in the analyses to determine the effect of meal periodicity on weight loss. Body weight was measured at baseline, 12 and 20-weeks.

RESULTS: Data were available on 63 (84%) and 55 (73%) of participants and 12 and 20-weeks, respectively. Analysis revealed significant weight loss of -6.3 ± 4.3 kg (6.6 ± 4.2 %) from baseline to week 12 (N=63; p<0.01), with weight loss of 8.9 ± 5.8 kg (9.2 ± 5.8 %) observed from baseline to week 20 (N = 55; p = 0.01). Correlation coefficients revealed a significant inverse correlation between total meals and snacks consumed and absolute body weight change at 12- and 20-weeks (0.39 and 0.40, respectively, p<0.05), indicating that an increase in meal periodicity was associated with a lower body weight. However, eating periodicity was not significantly associated with absolute or relative magnitude of weight loss.

CONCLUSION: These results suggest that individuals of lower body weight report eating more meals and snacks per day than individuals of higher body weight. While this study did not show an impact of eating periodicity on weight loss, the impact of eating periodicity on weight loss maintenance or the prevention of initial weight gain may warrant investigation.

F-23 Free Communication/Poster – Body Core Temperature

FRIDAY, JUNE 2, 2006 2:00 PM - 5:00 PM
ROOM: Hall B

Board #1 2:00 PM - 3:00 PM
Core Temperature Comparison Based on Time of Pill Ingestion Prior to Exercise
Joseph W. Domitrovich, Erika Lieberg, Nicole Plante, Ian Marshall, John Cuddy, Brent C. Ruby, FACSM, University of Montana, Missoula, MT.
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PURPOSE: The purpose of this study was to determine the effects of sensor ingestion on core temperature measurements during cool weather exercise.

METHODS: Seven subjects (m=3; f=4) ran on a 400 meter outdoor dirt track for 45 minutes at a predetermined pace (70% V02 max) during four exercise trials. Thirty to forty-five minutes prior to each exercise trial subjects ingested one core temperature pill (P1). Over the four trials for each subject there were 15 sessions where subjects retained their pill from the previous trial (P2). Core temperature was recorded every minute with a capsule recorder (MiniMitter, Bend, Oregon) in conjunction with a Vital Sense monitor (MiniMitter, Bend, Oregon). Temperatures were averaged at five minute intervals. Significance was set at the 0.05 level.

RESULTS: There was a statistical difference between P1 and P2 pills during the start temperature (37.86 ± 0.04 P1 and 37.98 ± 0.04 P2) and the first five minutes of exercise (37.96 ± 0.12 P1 and 38.07 ± 0.04 P2, p<0.05). During the remainder of the exercise trial (40 minutes) there was no statistical difference between P1 and P2 pills on core temperature readings (p>0.05).
CONCLUSION: The majority of the exercise there was no difference in core temperature values based on the time that the core sensor was ingested. However, early difference suggest that ingestion of the sensor should be standardized, especially for shorter periods of work.

Funded by: Saucony-Ride.

2494 Board #2 3:00 PM - 4:00 PM
The Effects of Passively Elevated Core Temperature on Maximal Oxygen Consumption and Time to Exhaustion
Abigail Lydia Rink, Declan AJ Connolly, FACSM. University of Vermont, Burlington, VT.
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PURPOSE: To examine the effects of elevated core body temperature to the individual’s critically attained level during maximal exercise and the effect on maximal oxygen consumption (VO2max) and time to exhaustion during cycle ergometry.

METHODS: Fourteen healthy subjects, 11 male and 3 female (age = 22.7 ± 4.7 years, height = 174 ± 8.88 cm, weight = 71.56 ± 10.07 kg, percent body fat = 34.4 ± 7.69 %, lean body mass (LBM) = 61.09 ± 8.97 kg) with no apparent cardiovascular medical history were recruited for this study. Each subject performed a progressive bout of exercise to exhaustion on a stationary bicycle for the measurement of maximal oxygen consumption (VO2max). With a minimum of 48 hours rest between tests, the subjects were asked to return for a second visit to perform a time to exhaustion test, conducted at a work-rate of 85% of the ending resistance during the previous VO2max test. Core body temperature (Tc) at the point of fatigue was recorded for both trials. The third and fourth visits involved a repetition of the two tests, respectively, with time in a hot tub bath prior to each bout of exercise until critically attained level Tc was reached, previously determined during the initial two trials.

RESULTS: With an alpha level set at P < 0.05, a paired Students’ T-Test compared means between the control and the tests performed at an elevated core body temperature and indicated a significant decrease in time to fatigue (T of 3.690, P = 0.003). Conversely, paired T-Tests demonstrated a lack of significance between VO2max control results and VO2max under hyperthermic conditions (T = 0.626, P = 0.542). Maximum heart rate (HRmax) during the control and elevated core body temperature tests for VO2max did not indicate a significant change (T = 0.070, P = 0.945), and although HRmax during the time to exhaustion trials did show elevated trends during the hyperthermic tests, the results were not significant (P = 1.408).

CONCLUSION: Elevating body temperature to one’s critically attained level significantly decrease time to exhaustion during submaximal exercise.

2495 Board #3 4:00 PM - 5:00 PM
Telemetry Pill and Oesophageal Assessment of Core Temperature during Moderate Duration, High Intensity Exercise
Warren A. Gregson, Noureddin A. Altaraki, Nigel T. Cable, Greg Atkinson, Barry Drust. Liverpool John Moores University, Liverpool, United Kingdom. (Sponsor: Keith George, FACSM)
Email: W.Gregson@ljmu.ac.uk

Telemetric monitoring systems using an ingestible pill provide a practical means of assessing core temperature compared with more invasive measurement sites such as the oesophagus. Telemetric pills provide valid measurements of core temperature during prolonged steady-state exercise or in clinical situations requiring ambulatory monitoring. A comparison of such core temperature measurements during self-paced, moderate duration, high intensity exercise has yet to be reported.

PURPOSE: To compare telemetry pill and oesophageal temperature responses to a simulated 4-km cycling time trial performed at different environmental temperatures.

METHODS: Nine competitive cyclists (mean ± SD age = 34 ± 4.5 years, maximal oxygen uptake = 61.7 ± 8.6 ml kg⁻¹ min⁻¹) completed a 4-km cycling time trial in laboratory dry bulb temperatures of 35°C and 13°C (relative humidity = 60%, air velocity 5.6 m s⁻¹). A temperature pill was ingested 4 hrs prior to exercise, during which time participants remained in a fasted state. An oesophageal probe was inserted through the nasal passage at a distance equal to one-quarter of the participants standing height. Oesophageal (Tje) and telemetry pill (Ttp) responses were analysed using a three-factor (condition x site x time) general linear model with repeated measures.

RESULTS: Pooled mean Tje (37.41 ± 0.93 °C) and Ttp (37.40 ± 0.82 °C) during the 4 km time trials were not significantly different (p=0.957). Nevertheless, there was a significant interaction between body temperature methods and time trial distance (p=0.01), with the largest difference occurring at the end of the time trial in the hotter environment (Tje = 38.19 ± 1.31 °C; Ttp = 37.62 ± 0.45 °C). The rate of increase in Tje during the time trial was significantly higher than that in Ttp irrespective of environmental temperature (0.17 °C min⁻¹ vs. 0.06 °C min⁻¹; p=0.0065).

CONCLUSION: These data indicate that an ingestible pill is less sensitive to exercise-induced increases in body temperature compared to oesophageal temperature. This blunted response may lead to underestimations of core body temperature during the latter stages of moderate duration high intensity exercise. Such differences may be scientifically and clinically important.

2496 Board #4 2:00 PM - 3:00 PM
UtiliDig the Nike Ice Vest in Distance Running Training
Andrew R. Tegeder1, Ian Hunter1, Emily Martin2. 1Bryant Young University, Provo, UT. 2Nike Corp, Beaverton, OR. (Sponsor: Gary Mack, FACSM)
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When running in a hot environment, running performance may suffer due to increased body temperature (Tc). Previous studies have shown that decreasing Tc prior to exercise can increase performance. However, no studies have reported how wearing an ice vest prior to long-distance interval training affects Tc.

PURPOSE: This study determined the effectiveness of using a Nike ice vest on Tc during long-distance interval training in warm (24-30°C) conditions.

METHODS: Subjects ingested a radiotelemetry temperature sensor three hours before reporting. Each subject’s Tc was taken prior to putting on the cooling vest and warming-up. Each subject warmed-up and exercised under two conditions: 1) an experimental condition in which subjects wore a cooling vest during warm-up and 2) a control condition in which subjects wore no shirt during warm-up. Subjects put on the cooling vest 30 minutes prior to their warm-up, then performed their typical warm-up of 15-20 minutes of jogging, followed by stretching and four 100 m strides at workout pace. Subjects then removed the cooling vest and ran eight 1000 m intervals separated by one Tc of rest. Heart rate and Tc were measured during the 30-minute rest, prior to warm-up, and after each interval. Repeated measures ANOVA was used to measure the impact of the ice vest on Tc at all measurement times.

RESULTS: After warm-up, Tc was elevated by 0.50 ± 0.08°C in the no vest group compared to 0.11 ± 0.13°C for the vest group (p=0.03). Differences in Tc persisted between groups until the end of the second interval.

CONCLUSIONS: Wearing a Nike ice vest prior to long-distance interval training in warm conditions slows the rise in Tc. However, the temperature benefit only lasts about 10 minutes once the vest is removed.

F-24 Free Communication/Poster – Children: Obesity and Weight Control
FRIDAY, JUNE 2, 2006 2:00 PM - 5:00 PM
ROOM: Hall B

The prevalence of obesity increases with age, and there is a greater chance that obesity beginning in early childhood will persist through the lifespan. Obesity is associated with cardiovascular disease (CVD) risk factors such as pediatric hypertension, diabetes mellitus, coronary heart disease, and dyslipidemia.

PURPOSE: The clustering of CVD risk factors and dietary habits among a sample of clinically obese children are described in the Canadian children and controls evaluated.

METHODS: A sample of 1556 children (644 males; 912 females) aged 14.12 years (range: 13 - 17 years) was assessed for anthropometry, blood pressure, body fat %, total cholesterol, and cardiorespiratory fitness. General dietary habits were assessed using an 11-item questionnaire.

RESULTS: Overall, males were found to have significantly higher systolic blood pressure and cardiorespiratory fitness than females. Concomitantly, females revealed significantly higher body mass index (BMI), diastolic blood pressure, body fat %, and total cholesterol. Both clinically obese males and females revealed significantly higher BMI, systolic/diastolic mean arterial pressure, body fat %, total cholesterol, and significantly lower cardiorespiratory fitness when compared to controls. An exploratory factor analysis identified three stable factors in dietary habits among obese participants (n = 778) including meal consistency, frequency of fast food eating, and the consumption of food cooked at home.

CONCLUSION: These findings suggest that clustering of the CVD risk factors is especially evident among clinically obese children, independently of gender. As expected, clinically obese children demonstrated alaramingly high values of blood pressure, total cholesterol, BMI, body fat %, as well as very low cardiorespiratory fitness. A clustering of CVD risk factors may, therefore, begin during early adolescence among the clinically obese. In this regard, meal consistency, frequency of fast food eating, as well as the consumption of food cooked at home are key dietary factors that should be mediated.
Adiponectin is an adipose-derived hormone that plays a protective role against insulin resistance and atherosclerosis. Body weight reduction increases plasma adiponectin levels in severely obese patients. However, little is known regarding the effects of exercise on plasma adiponectin of moderately obese.

PURPOSE: To determine the effects of a weight-reduction program and following a self-management program on plasma adiponectin, blood lipid profile, visceral adipose tissue area and physical fitness age in obese women.

METHODS: The experimental subjects were 23 moderately obese women (% body fat 32.6±2.3 %, age 51.4±7.2 yrs, body mass index 27.1±2.3 kg/m²). The weight-reduction program consisted of aquatic and resistance exercise, nutritional education and behavioral modification for 12 weeks, twice per week. Aquatic aerobic exercise was conducted 45 ~ 60 min at 60 ~ 70% of maximum heart rate. Resistance exercise consisted of three sets of four exercises using Nautilus weight-training equipment. The self-management program met for weight management for a 12 week period, once every four weeks. Baseline measures were performed before starting (W0), at the end of weight-reduction program (W12), and the end of self-management program (W24).

RESULTS: Significant reductions were demonstrated in body weight (4.6±kg), body fat percent (2.46%), visceral adipose tissue area (17.0 cm²), triglycerides (54.9 mg/dL), LDL concentrations (18.9 mg/dL) at W12, and these significant changes continued until W24. Whereas, adiponectin and HDL levels had not changed at W12, however, they increased significantly at W24 than at W12 (2.67±mg/mL, 5.54 mg/dL, respectively). Physical fitness age decreased significantly at W12 (6.5 yrs), and continued at that age until W24. CONCLUSION: These results suggest that exercise and weight loss induced beneficial changes in plasma adiponectin, blood lipid profile and visceral fat area in overweight women, but the change patterns were different. Future studies should focus on the relation between exercise induced weight reduction, the changes of plasma adiponectin and the risk for atherosclerosis.

CONCLUSIONS: The prevalence of childhood obesity has increased worldwide. It is a major public health concern in Japan as well. There are, however, few studies on the trends of childhood obesity in Japan.

PURPOSE: To examine the trends of overweight and obesity in Japanese youth using international BMI cutoffs.

METHODS: In Japan, a large-scale nationwide, cross-sectional survey has been carried out every year under the direction of the Ministry of Education, Culture, Sports, Science and Technology. Standing height and body mass in the survey, and the survey matrices on height (every 1 cm) and mass (every 1 kg), but not the raw data, have been published. For the present study, we used the matrix data for the years 1978, 1983, 1998, 2003. The body mass index (BMI) in each cell of the matrix was calculated from the body mass (kg) of the cell divided by the square of the height (m) of the cell. Then the BMI of each cell was compared with sex- and age-specific international BMI cutoffs presented by Cole et al (2000). When the BMI of a cell exceeded the international cutoffs for overweight or obesity, we identified the subjects included in that cell as overweight or obese, respectively. The prevalence of overweight and obesity were obtained from the sum of frequencies included in the cells where the BMI exceeded the international cutoffs.

RESULTS: The percentage (%) of overweight and obesity increased over the 25 years, as shown in the Table. The highest percentages were seen at age 11 for overweight and at age 8 for obesity in 2003, for both males and females. Mean values for standing height, body mass, and BMI gradually increased over time. However, the modes of BMI were almost constant during the 25 years, suggesting that the increasing percentage of youth having high BMI above a cutoff is not attributed to secular increase in body size or secular trends towards earlier maturation. CONCLUSIONS: A substantial increase over time in overweight and obesity was observed in Japanese youth, particularly for younger children aged 8 and 11 years.
weight status was a significant predictor of change in PA for both males (p < .01) and females (p < .05). Analysis of covariance indicated that females who perceived their weight status to be OW or VOW significantly increased their PA by 0.2 and 1.7 hrs/wk respectively while females who perceived their weight status to be UW or NW decreased their PA by 1.2 and -1.4 hrs/wk respectively. Among males, those who perceived their weight status to be VOW significantly increased their PA by 2.6 hrs/wk while males who perceived their weight status as UW, NW or OW decreased their PA by -4.7, -2.5 and -1.1 hrs/wk respectively.

CONCLUSIONS: These data indicate that perception of weight status may be a predictor of change in physical activity. Over a 2 year period, PA decreased in those who perceived they were under or normal weight while PA increased among those who were overweight.

F-25 Free Communication/Poster – Children: Physical Activity and Health

FRIDAY, JUNE 2, 2006 2:00 PM - 5:00 PM
ROOM: Hall B

Childhood physical inactivity is a serious problem. In 2001, 60% of Canadian children aged 9-12 years were not active enough for normal growth and development. Canadian health care costs associated with treating inactivity-related diseases is estimated at $5.3 billion annually. Despite this, a significant number of schools in Canadian public education have been devoting less than 10% of school time to physical education. School administrators and parents might assume that dedicating instructional time to physical activity (PA) has a negative impact on a child’s academic performance (AP). Whether PA detracts, or enhances AP in practice remains unclear. Some studies have found a positive relationship between PA and AP whereas others reported no influence of PA on AP.

PURPOSE: The purpose of this study was: 1) to evaluate the effectiveness of a school-based PA intervention, Action Schools! BC (AS!BC) on AP in a multi-ethnic group of elementary school children and 2) to determine whether boys and girls’ AP changed similarly following participation in AS! BC.

METHODS: This was a 16-month cluster randomized controlled trial. Ten schools were randomized to Intervention (INT) or Usual Practice (UP). AS!BC is a socioecological model whereby children undertake PA across 6 action zones. The overall goal was to provide 150 min/wk of moderate to vigorous PA. UP schools continued with their regular program of PA. Children (143 boys 144 girls) in grades 4 and 5 were recruited to participate. We used the Canadian Achievement Test to evaluate AP and weekly teacher activity logs to determine minutes of PA delivered by teachers to students. Children’s PA was determined with the Physical Activity Questionnaire for Children. We used a linear mixed model to evaluate differences in total standardization academic performance score between groups at follow-up and an independent t-test to compare total standardized change score between boys and girls.

RESULTS: PA delivered by teachers to children in INT schools increased by approximately 50 minutes per week (139 ± 62 vs. 92 ± 45, p < 0.001). Participants attending UP schools had significantly higher baseline TotScores than those attending INT schools. Despite this, there was no significant difference in TotScore between groups at follow-up. There was no sex difference in TotScore at baseline or for TotChg.

CONCLUSION: The AS!BC model is an attractive and feasible intervention that provides increased PA opportunities for students within school. Classroom time devoted to physical activity did not detract from students’ academic achievements.

British Columbia Ministry of Health Services.

F-25 Board #12 4:00 PM - 5:00 PM


1 Purpose: The purpose of this study was: 1) to evaluate the effectiveness of a school-based PA intervention, Action Schools! BC (AS!BC) on AP in a multi-ethnic group of elementary school children and 2) to determine whether boys and girls’ AP changed similarly following participation in AS! BC.

2 Methods: This was a 16-month cluster randomized controlled trial. Ten schools were randomized to Intervention (INT) or Usual Practice (UP). AS!BC is a socioecological model whereby children undertake PA across 6 action zones. The overall goal was to provide 150 min/wk of moderate to vigorous PA. UP schools continued with their regular program of PA. Children (143 boys 144 girls) in grades 4 and 5 were recruited to participate. We used the Canadian Achievement Test to evaluate AP and weekly teacher activity logs to determine minutes of PA delivered by teachers to students. Children’s PA was determined with the Physical Activity Questionnaire for Children. We used a linear mixed model to evaluate differences in total standardization academic performance score between groups at follow-up and an independent t-test to compare total standardized change score between boys and girls.

3 Results: PA delivered by teachers to children in INT schools increased by approximately 50 minutes per week (139 ± 62 vs. 92 ± 45, p < 0.001). Participants attending UP schools had significantly higher baseline TotScores than those attending INT schools. Despite this, there was no significant difference in TotScore between groups at follow-up. There was no sex difference in TotScore at baseline or for TotChg.

4 Conclusion: The AS!BC model is an attractive and feasible intervention that provides increased PA opportunities for students within school. Classroom time devoted to physical activity did not detract from students’ academic achievements.

British Columbia Ministry of Health Services.
PurPose: CPS has a district-wide waiver of the mandate for grades 11 and 12. No written PE elementary schools (10% of the total schools) representing each of the cluster areas find out what needs exist related to improving PE instruction.

Public Schools (CPS). The intent was to find out exactly how PE is delivered and to Physical education (PE) is a key tool in promoting health and fitness in students. Funded by U01HL66845, U01HL66852, U01HL66853, U01HL66855, U01HL66856, physical activity, especially schools that serve low-income students.

CONCLUSIONS: Results indicate that schools have some policies and practices that Free/reduced lunch program participation (p=0.04), perceived priority of physical activity, especially schools that serve low-income students.

Major obstacles to quality physical education were lack of funding and lack of indoor facilities. An overall score created to assess school environmental support for physical activity indicated that, on average, schools met 6.7 items of 10 items (range 3-9). Free/reduced lunch program participation (p=0.04), perceived priority of physical education instruction over coaching (p=0.02), and safety for walking/bicycling to school (p=0.02) predicted environmental support scores. CONCLUSIONS: Results indicate that schools have some policies and practices that support physical activity, although unfavorable practices also exist. Schools must work with community partners and officials to provide environments that optimally support physical activity, especially schools that serve low-income students.

Funded by U01HL66845, U01HL66852, U01HL66853, U01HL66855, U01HL66856, U01HL66857, U01HL66858.

2506 Board #14 3:00 PM - 4:00 PM Policies and Opportunities for Physical Activity in Middle School Environments Deborah R. Youg, FACSM, Gwen M. Felton1, Mira Griesser1, John P. Eldor, Carolyn Johnson1, Jung-San Lee1, Martha Y. Kubac1, 1University of Maryland, College Park, MD. 2University of South Carolina, South Carolina, SC. 3San Diego State University, San Diego, CA. 4Tu lane University, New Orleans, LA. 5University of North Carolina, Chapel Hill, NC. 6University of Minnesota, Minneapolis, MN.

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PURPOSE: Government agencies assert that schools are ideal venues for increasing opportunities for physical activity, and have published documents identifying approaches that schools can implement. However, information on school-level implementation and barriers has not been fully documented. This study examined physical activity opportunities and barriers at 36 geographically diverse middle schools (6 field sites) participating in the Trial of Adolescent Girls (TAAG).

METHODS: School principals, physical education and health education department heads, and program leaders from each school were interviewed to assess policies and instructional practices that support physical activity. All survey instruments were field tested. Data collectors were centrally trained and certified on data collection procedures.

RESULTS: Schools provided an average of approximately 110 hours per year (range 39-180) in physical education instruction. Approximately 20% of students walked or bicycled to school. Eighty-three percent of schools offered interscholastic sports and 69% offered intramural sports. Most sports (range 27-33, depending on grade level) offered programs for girls, but on average, only 24 girls (4%) in the schools attended any programs. Less than half of schools collaborated with external community groups to provide programs. Only 25% of schools allowed after school free play. Major obstacles to quality physical education were lack of funding and lack of indoor facilities. An overall score created to assess school environmental support for physical activity indicated that, on average, schools met 6.7 items of 10 items (range 3-9). Free/reduced lunch program participation (p=0.04), perceived priority of physical education instruction over coaching (p=0.02), and safety for walking/bicycling to school (p=0.02) predicted environmental support scores. CONCLUSIONS: Results indicate that schools have some policies and practices that support physical activity, although unfavorable practices also exist. Schools must work with community partners and officials to provide environments that optimally support physical activity, especially schools that serve low-income students.

Funded by U01HL66845, U01HL66852, U01HL66853, U01HL66855, U01HL66856, U01HL66857, U01HL66858.

2507 Board #15 4:00 PM - 5:00 PM Physical Education Instructional Profile and Needs Assessment in the Chicago Public Schools David Q. Thomas, FACSM1, Pat Faire1, Sara Verbel2, Tracy Gallavich3, 1Illinois State University, Normal, IL. 2University of Minnesota, Minneapolis, MN. 3University of North Carolina, Chapel Hill, NC. 4University of Maryland, College Park, MD. 5University of South Carolina, South Carolina, SC. 6University of North Carolina, Chapel Hill, NC. 7University of Minnesota, Minneapolis, MN.

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Policies and Opportunities for Physical Activity in Middle School Environments Deborah R. Youg, FACSM, Gwen M. Felton1, Mira Griesser1, John P. Eldor, Carolyn Johnson1, Jung-San Lee1, Martha Y. Kubac1, 1University of Maryland, College Park, MD. 2University of South Carolina, South Carolina, SC. 3San Diego State University, San Diego, CA. 4Tu lane University, New Orleans, LA. 5University of North Carolina, Chapel Hill, NC. 6University of Minnesota, Minneapolis, MN.

E-mail: dryoung@umd.edu

PURPOSE: The purpose of the Youth Sport Camps project is to understand behaviors and motivations for children’s health activities and to develop an effective program that leads to healthier childhood behaviors. Phase two of this project includes two main goals: developing a health-specific camp and examining camper and parental behaviors and responses. Specifically, we examined children’s behaviors relative to activity and nutritional behaviors and parents’ knowledge relative to children’s exercise and eating habits.

METHODS: Data were collected from campers in the FunLIFE Camps (LIFE = Learning to Improve Fitness and Eating). These camps were designed to help children understand the value of healthy lifestyles and learn behaviors to achieve their lifestyle goals. Each camper wore a pedometer for a one-week period (both during and out-of-camp), and children were given knowledge tests about physical activity and nutrition. Parents were asked about their perceptions of their child’s exercise and eating patterns and their own behaviors designed to help the child maintain healthy behaviors.

RESULTS: 97 families completed the project (mean age 8.7 yrs; range 5-14). The campers were adequately active (daily mean of 14,560 steps; national mean = 8,400). However, we found disturbing results in parent data: most parents believed that their children engaged in physical activity more than the children’s peers. Only 3% believed that their children were “less active than an average child.” In reality, nearly 25% of the campers scored below the national average. This suggests that parents have unreasonable perceptions of their children’s activity levels. Finally, parents reported minimal activity in helping their children to be more active.

CONCLUSION: Data suggest that the campers participating in the FunLIFE Camps may be appropriately active; however, this cannot be attributed to their parents perceptions of their activity level or promotion of their child’s physical activity.

2509 Board #17 3:00 PM - 4:00 PM A Qualitative Analysis of a Comprehensive After School Program: the After-School All-Stars Walter R. Thompson, FACSM, Lyndsey Greene, Jennifer K. Markburn, Randi L. Roberts, Georgia State University, Atlanta, GA. After school programs take on many different characteristics including, but not limited to tutoring, mentoring, sports, and special interest clubs. After school programs are typically offered from one day to five days a week.

PURPOSE: the purpose of this study was to use a qualitative methodology to determine classroom effectiveness for after school student programs operating five days a week in the inner city and includes all the fundamental programming mentioned previously with the addition of frequent Friday afternoon field trips with educational, cultural, and structured physical activity components.

METHODS: The After-School All-Stars, a comprehensive after school program for middle school students (grades 6-8, ages 11-14 years) of the inner city that their program studied. Because of the scope of this program and the fact that it is replicated in other schools within the inner city district, only one school was evaluated (student population in the after school program was 200). The Quality Assurance System (QAS) created by Foundations, Inc. (a non-profit organization with a mission to assist...
in the evaluation of after school services and programs was used as the assessment instrument. The QAS assesses program implementation, develops building blocks for continuous improvement, qualitatively analyzes the program as a whole, and develops an improvement program based on the analysis. There are 11 evaluation areas including program planning, determining and improving effectiveness, leadership, facility and program space, health and safety, family and community connections, social climate, academics, recreation, youth development, and the degree to which the program is comprehensive.

RESULTS: The QAS rates the program on a scale of 1 to 4 (unsatisfactory, needs improvement, satisfactory, outstanding). Scores ranged from a low of 1.8 (leadership and staffing) to a high of 3.1 (for overall comprehensive program). Recreation and youth development scored 2.0 and 2.5, respectively. The average score across all domains was 2.32.

CONCLUSIONS: The QAS provides an independent qualitative analysis of an after school program. It is replicable and easy to use. Specific and targeted program improvement plans, and utilization of essential building blocks for each evaluated domain helps to continuously provide improvement.

2510 Board #18 4:00 PM - 5:00 PM The Impact of Lifestyle Behaviors on Physical Activity in High School Students
Jeremy L. Knous, Joshua J. Ode, Patricia W. Bauer, James M. Pivarnik, FACSM. Michigan State University, East Lansing, MI.
Previous reports have linked youth lifestyle behaviors to physical activity levels, but few have quantified these effects.

PURPOSE: To assess the relationship of television viewing/computer use and soda consumption on minutes of physical activity performed in high school students.

METHODS: Participants were 1157 (51% female; grade 9-12) students from two high schools who completed a survey as part of the Michigan Healthy School Action Tool. Physical activity (PA) was reported as the total minutes (min) of moderate and/or vigorous activity performed on the previous day. Television viewing/computer use (TV/CU) during free time was dichotomized using a cut point of less than two hours on a usual day (CDC recommendation). A cut point of less than one drink per day was used to dichotomize soda consumption (SC). The individual and combined effects of TV/CU and SC on PA were examined by analysis of variance (ANOVA).

RESULTS: Total moderate and vigorous PA averaged 73±43 min in boys and 54±42 min in girls (P<0.001). Overall, 70% of survey respondents met CDC recommendations for less than two hours of television/computer use per day and 59% reported consuming less than one soda per day. Students who met CDC recommendations for TV/CU performed 13% more minutes of PA (P<0.001). Those who drank less than one soda per day performed 9 more minutes of PA (P<0.001). Students with both low TV/CU and SC performed the greatest amount of PA the previous day (P<0.001). Specifically, PA values were 75±43 min (low TV/CU and low SC; n=499), 67±42 min (low TV/CU and high SC; n=292), 63±42 min (high TV/CU and low SC; n=158), and 55±42 min (high TV/CU and high SC; n=178). Although girls performed less PA than boys, gender did not modify the effect of TV/CU and SC on activity levels.

CONCLUSION: It appears that lifestyle behaviors considered unhealthy (high television/computer use, high soda consumption) play a significant and combined role in daily minutes of physical activity performed by high school students.

Supported by the United Dairy Industry of Michigan and the USDA.

2511 Board #19 2:00 PM - 3:00 PM Determinants of Active Travel to School: What We Learned from Parents
Dianne S. Ward, FACSM, Amber Vaughn1, Brian Neelon2, Laura Linman1, Janet Fulton1, Sarah Martin1. 1UNC Chapel Hill, School of Public Health, Chapel Hill, NC. 2UNC Chapel Hill, Center for Health Promotion and Disease Prevention, Chapel Hill, NC.
Email: dsward@email.unc.edu

BACKGROUND: The proportion of students walking and bicycling to/from school has declined substantially over the past 30 years. Distance and parents’ fear of crime and traffic danger are often cited as barriers. Counter measures to reduce these barriers has declined substantially over the past 30 years. Distance and parents’ fear of crime and traffic danger are often cited as barriers. Counter measures to reduce these barriers are needed. In order to create effective interventions targeting AT, a better understanding of the determinants of AT are needed.

PURPOSE: To compare the characteristics of students who use AT and their parents to those who do not (NAT).

METHODS: Schools (13) representing 5 geographic regions of the US were randomly chosen from a convenience sample of parents to a Walk to School (WTS) survey. WTS coordinators provided school level information and parents of 4th and 5th grade students completed a brief survey. School level data (size, % free or reduced lunch, walkability assessments, WTS Day participation, etc.) and parent level data (child gender and age, distance between home and school, perceived barriers of AT, perceived norms, etc.) were compared based on parent-reported AT status. After assessing differences between AT & NAT, we used a Generalized Estimating Equation (GEE) procedure to identify significant predictors of AT. To build the model, we used a split-sample validation approach.

RESULTS: Five significant covariates for AT were included in the final model: gender, distance, perceived barriers around personal safety, and two norm-related variables - the perceived use of walking or bicycling for school travel by other children in the neighborhood and the reported frequency with which neighbors walked or bicycled with kids to school. Boys were twice as likely to use AT compared to girls (OR = 2.1, CI: 1.29, 3.42). The odds of AT increased by a factor of 2.73 (CI: 1.95, 3.86) for every 0.5% closer the child lived to school. Those who identified fewer personal safety barriers were significantly more likely to use AT (OR = 1.18, CI: 1.05, 1.32). The odds of using AT increased three-fold when parents noted the presence of other children walking or bicycling in the neighborhood (OR = 2.88, CI: 2.12, 3.91). Finally, those who reported higher frequency of neighbors walking or bicycling with children to school had higher odds of AT (OR = 1.34, CI: 1.14, 1.58).

CONCLUSIONS: In addition to the association of gender and the previously described barriers of distance and safety, perceived norms about walking/bicycling to school are important predictors of AT. These findings suggest that efforts to increase AT may need to address personal as well as community factors.

Funded by the Centers for Disease Control and Prevention, SIP 9

2512 Board #20 3:00 PM - 4:00 PM The Effects of Parental Encouragement on Physical Activity Levels of Preadolescent African American Females
Jennifer Q. Lancot1, Michelle B. Stockton1, Barbara S. McClanahan2, Lisa M. Klesges3, Robert C. Klesges3. 1University of Memphis, Memphis, TN. 2Mayo Clinic, Rochester, MN.
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African American girls are at high risk of developing obesity at menarche and have moderate to low levels of vigorous levels of physical activity. Determining the focus of future prevention efforts related to increasing physical activity levels, especially among African American girls is needed. African American families show a high degree of interdependence among members which may have a significant influence in children’s health behaviors. While the influence of parents/caregivers as a significant predictor of children’s physical activity choices has been reported, the specific relationships among African-American families has not been well studied.

PURPOSE: The purpose of this research was to propose a model of family influence, specifically parental encouragement for physical activity.

METHODS: This study used a path analysis model to determine the influence parental encouragement from both the child’s and the parent’s perspectives on moderate to vigorous physical activity of 259 8- to 10-year-old African American girls.

RESULTS: The results indicated significant effects of parental encouragement in the two path models but were significantly differential between parent and child perspective. When considering the parents’ perspective model, parental encouragement was associated with a significant inverse association with children’s physical activity (β = .151, p = .009) but a significant positive effect on children’s positive outcome expectancies (β = .142, p = .010), with no significant indirect effects. In marked contrast to the child’s perspective model, parental encouragement was significantly positively related to girl’s sports competence (β = .289, p = .000) and self-efficacy for physical activity (β = .127, p = .000), neither of which related to physical activity in either a direct or indirect pathway.

CONCLUSION: The low levels of explained variance (~6% in either model), suggest that when parental encouragement is viewed from the parent’s perspective there was a significant negative relationship while from the child’s perspective no significant relationship was found. This indicates a need for further research regarding parental influences in promoting girls’ physical activity levels in African American families. Supported by NIH grant U01-HL62662.

2513 Board #21 4:00 PM - 5:00 PM Contribution of Youth Sport to Daily Physical Activity
Eric E. Wickel, Josy C. Eisenmann, Gregory J. Welk. Iowa State University, Ames, IA. (Sponsor: Rick Sharp, FACSM)
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Participation in youth sport provides an outlet for increasing daily physical activity among children. However, the contribution of youth sport to overall daily physical activity is largely unknown.

PURPOSE: To determine the contribution of youth sport (flag-football, soccer, and basketball) to daily physical activity among 6-12 yr olds.

METHODS: An MTI accelerometer was programmed to record daily physical activity in 30-second intervals between 7AM and 9PM in 78 boys and 21 girls during a day in which they participated in an organized youth sport. A sub-sample wore the accelerometer on a non-sport day to examine day-to-day differences in physical activity. Total daily physical activity and physical activity during youth sport, recess, and physical education were estimated using a physical activity cut-point of ~1500 counts/30 sec. The contribution of youth sport, recess, and physical education was determined by dividing the amount of physical activity from each activity by the total daily amount of physical activity.

RESULTS: During a weekday involving youth sport, boys and girls accumulated 63±23 and 60±17 minutes of physical activity (~1500 counts). Specifically, youth sport contributed 26 and 28% of the daily minutes of activity for boys and girls, respectively. Recess accounted for 18 and 23% of the daily minutes of activity while physical activity contributed 16 and 15%.
education accounted for less than 5% for boys and girls. During a day without youth sport, boys and girls accumulated 51±25 and 41±14 minutes of physical activity (>1500 counts), respectively. Recess accounted for 26 and 19% of the daily minutes of activity while physical education accounted for 8-9% for boys and girls. During a youth sport day during the weekend boys and girls accumulated 56±13 and 64±28 minutes of physical activity (>1500 counts), respectively. Youth sport contributed 41 and 28% of the daily minutes of activity for boys and girls, respectively. During a weekend day without youth sport, boys and girls accumulated nearly 38 minutes of physical activity.

CONCLUSION: Youth sport contributes a significant amount to the daily levels of physical activity. Youth sport, however, was not as important as the other components of a day, which included physical education and recess.

Methods: The participants were 731 students from 7 to 18 years old, enrolled in two public schools from São José dos Pinhais, Brazil, in 2004. Previous data revealed that 68.8%, 3.6% and 6.3% of these students were overweight, obese and underweight, respectively. Girls were at greater risk of overweight and obesity (13.5%) and boys more likely to be underweight (7%). Due to these findings, a school based health promotion programme was focused on hygienic and healthy eating habits was implemented. The intervention employed strategies linked with play and cultural and economic realities. Instruments used to evaluate the improvement in knowledge were classroom survey and observation during mealtimes.

RESULTS: Among the creative educational strategies, theatre play was the most effective for improving knowledge for every age group after 3 months. On the other hand, students showed no interest in participating in classroom intervention activities, like games or printed activities. It was possible to identify improvements in knowledge concerning the pyramid food groups, avoidable types of food (high fat and energy process foods) and personal hygiene habits. However, no changes in food habits or nutritional status were observed in the first year of the study.

Conclusions: Despite the poor environment, overweight and obesity were found to be as important as malnutrition among the students in this study. Nutritional status among these children should be affected negatively by the urbanization process. It is important to note that complex issues of food deficiencies, domestic violence, psychosocial and economic problems made program implementation very difficult. More research is needed in order to understand the dynamics of life among these children and adolescents so that it will be possible to employ more effective strategies to promote better health and quality of life for them.

Board #22 2:00 PM - 3:00 PM Health Promotion and Nutritional Education for Children and Adolescents Enrolled in Two Public Schools in Southern Brazil

Isabela C. Ribeiro1, Gisele Vencini1, Thiás Maistrovic2, Michael Pratt3, FACSM4, UNIFESP, Sao Paulo, SP, Brazil. 1PUCPR, Curitiba PR, Brazil. 2PUCPR, Curitiba, Brazil. 3CDC, Atlanta, GA.

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Once thought of as a problem of affluent counties only, obesity is now becoming an epidemic in developing countries. Worldwide findings show that obesity is linked to poverty. However, in many disadvantaged communities underweight and overweight coexist despite nutritional differences from very different environmental, behavioral and individual risk factors. The association between obesity in childhood and adulthood is already well established. Therefore, it is clearly necessary to focus on nutrition and physical activity education for children and adolescents in order to prevent the adverse consequences of obesity.

PURPOSE: To evaluate a school based health promotion programme for children and adolescents.

METHODS: The participants were 731 students from 7 to 18 years old, enrolled in two public schools from São José dos Pinhais, Brazil, in 2004. Previous data revealed that 68.8%, 3.6% and 6.3% of these students were overweight, obese and underweight, respectively. Girls were at greater risk of overweight and obesity (13.5%) and boys more likely to be underweight (7%). Due to these findings, a school based health promotion programme, focused on hygienic and healthy eating habits was implemented. The intervention employed strategies linked with play and cultural and economic realities. Instruments used to evaluate the improvement in knowledge were classroom survey and observation during mealtimes.

RESULTS: Among the creative educational strategies, theatre play was the most effective for improving knowledge for every age group after 3 months. On the other hand, students showed no interest in participating in classroom intervention activities, like games or printed activities. It was possible to identify improvements in knowledge concerning the pyramid food groups, avoidable types of food (high fat and energy process foods) and personal hygiene habits. However, no changes in food habits or nutritional status were observed in the first year of the study.

Conclusions: Despite the poor environment, overweight and obesity were found to be as important as malnutrition among the students in this study. Nutritional status among these children and adolescents so that it will be possible to employ more effective strategies to promote better health and quality of life for them.

Board #23 3:00 PM - 4:00 PM Food Intake and Exercise Frequency Survey of Inner-City Youth Involved in a Structured After-School Program.

Dan Benardot, FACSM, Walter R. Thompson, FACSM, Georgia State University, Atlanta, GA.

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PURPOSE: Eleven black females between the ages of 11 and 14 years (x=12.57; SD=5.23) were assessed for height, mass, body fat percentage, nutrient and energy intakes, and exercise frequency to determine the potential of using a structured after-school program to improve food intake, exercise frequency and obesity risk in a population of inner city youth.

METHODS: All subjects were involved in the “After-School All-Stars” program. Participation was voluntary, and all protocols for this study were approved by the Institutional Review Board of Georgia State University. Height (cm) was obtained using an anthropometer without socks or shoes and measured to the nearest ½ cm; mass (kg) and body fat percentage were obtained using a Tanita digital scale/biocelleraud impedance analyzer (model BF-350); food intake was obtained using an interviewer guided 24-hour recall technique and food photographs to assist in serving size; and exercise habits were obtained from the ‘Youth Media Campaign Longitudinal Survey’ (YMCLS) developed by the CDC. Food intake was analyzed for nutrient and energy composition with the ESHA nutrient database (The Food Processor SQL, Version 9.2.0). SSPS version 12.0 was used for statistical analysis; correlations were derived from nonparametric Spearman’s rho.

RESULTS: Mass (r=.56.49kg; SD=22.46) and height (r=154.85cm; SD=8.53) resulted in a mean BMI of 23.04 (SD=6.91). Body fat percent (r=.26.42; SD=11.99) was significantly correlated with BMI (r=.764; p<.006), although was more suggestive of overweight than BMI, which was in the normal range. The exercise patterns were generally light, with subjects having an average of fewer than 15 minutes daily in structured exercise. This can be compared to an average of 108 minutes of daily TV watching. Mean energy intake was calculated to be 1,836 kcal (SD=840), which was most strongly correlated with fat (r=.695; SD=43.13) and sugar (r=.192; SD=61.95) consumption (r=.936; p<.001) and (r=.607; p<.048) respectively. Beta-carotene intake (r=.239;SD=415.96), a marker of fresh fruit and vegetable intake, was negatively correlated with average hours spent watching TV (r=.862; p<.001).

Conclusions: Low daily hours of structured physical activity and excessive intakes of fat (>33% of total kcal) and sugar (>22% of total kcal) may all contribute to obesity risk. In addition, these preliminary data suggest that BMI (in the normal range), although correlated with body fat percent (suggestive of obesity), may not be a sufficiently sensitive means of predicting obesity prevalence in this population of inner-city young minority females.
interpret the patterns of human variability in physical growth, maturation and development, and to understand the major genetic and environmental influences in those traits.

METHODS: Sample was composed by 131 Mozambican school aged subjects (61 boys, and 70 girls; age 8 to 16) from a rural area with no electric power, water system, roads and concrete houses. Variables assessed included height, weight, skinfolds, fitness (sit and reach, hangrip, curl up, flex arm hang. 10x5 meters run, and 1600 meters run) and physical activity (by questionnaire). Data was analyzed in relation to international reference norms (IRN) and to norms published for Mozambican urban school aged population (MUN).

RESULTS: Percentage of subjects below 50th percentile are: height by age = 92% for IRN and 86.4% for MUN; BMI = 85.6% for IRN and 64.8% for MUN; sum of skinfolds = 65.8% for MUN. Subjects classified as stunting and wasted were 24.8% and 10.4% respectively. Relative to MUN and norms published for North Americans, Mozambican rural subjects performed better in all fitness tasks, except for hangrip, but for handgrip subjects were body size was a major determinant. In physical activity, and compared to urban, rural area subjects scored significantly higher for domestic tasks and lower for recreational activities such as sports and games.

CONCLUSIONS: The presence of substantial differences in all variables relative to those variables measured in the same subject indicated that the presence of substantial differences in growth, fitness and activity, justifying a more in depth study of human variability in this population taking into account a broader approach that would include nutrition, genetics, parasitology, and biochemistry.

2518 Board #26 3:00 PM - 4:00 PM
Hour-by-Hour Analysis of Amount and Pattern of Physical Activity in 9-Year-Old Children

Detailed information about variations in pattern of physical activity with regard to day-to-day (e.g. weekday vs. weekends) and gender differences may provide valuable information for promotion of physical activity and for intervention strategies.

PURPOSE: To examine gender differences between weekdays and weekends in amount and patterns of physical activity.

METHODS: The study population comprised 1306 children (653 boys, 653 girls; 9.6 ± 0.4 yrs) who participated in the European Youth Heart Study (EYHS), a multi-center study including data from Denmark, Estonia, Portugal and Norway. Physical activity (PA) was measured during four consecutive days, two weekdays and two weekend days, using the MTI accelerometer. Mean counts per registered hour (cnts·hour⁻¹) was calculated for every hour between 7 a.m. and 9 p.m. Total PA was expressed as counts over registered time (cnts·min⁻¹). Children were divided in quartiles of total PA based on their average cnts·min⁻¹, stratified by gender.

RESULTS: Significant differences in PA pattern between weekdays and weekends were observed in both genders for hours 7 a.m., 12 p.m. and 9 p.m. (P < 0.05), indicating higher activity levels during weekdays at these time points. However, no significant difference for total PA (cnts·min⁻¹) was observed between weekday and weekend days (697 ± 245 vs. 684 ± 292) in gender combined analysis. In contrast, in stratified analysis, boys were significantly more active during weekdays (P < 0.05) compared to weekend days. As expected, boys were significantly more active on boys (760 ± 258 vs. 629 ± 195 cnts·min⁻¹; P < 0.001). Gender differences in total PA were largely explained by very high activity levels in boys in the upper quartile of total amount of activity (cnts·min⁻¹). Girls in the highest PA quartile were significantly more active (p < 0.01) during most hours of the day compared to boys in the three lower quartiles.

CONCLUSIONS: The pattern of PA differs between weekdays and weekends. However, in gender combined analysis, the total amount of PA does not differ between weekdays and weekend days, whereas activity levels are higher during weekdays in boys. Gender differences in total amount of PA are, at least partly explained by a very high activity level among the highest quartile of boys.

2519 Board #27 4:00 PM - 5:00 PM
Activity Selection and Heart Rates of High School Physical Education Students
Kelly Laurson, Dale Brown, FACSM, Robert Cullen, Karen Dennis, Kristen Lagally, David Q. Thomas, FACSM. Illinois State University, Normal, IL.

Physical education is one medium with which health promotion and obesity prevention has a widespread opportunity to make an impact in youth. However, before adequate benefits can be amassed, increased physical activity and health education for all students must be accomplished. It is known that age, sex, and the type of activity all play a role in the students’ energy expenditure during physical education class participation. However, it is unknown how these factors interrelate.

PURPOSE: The purpose of this research is to explore how age, sex, and activity selection influence the heart rates of adolescents participating in high school physical education.

METHODS: 796 high school students (mean age = 16.4 years) from a high school within a state practicing mandated physical education were equipped with heart rate monitors during physical education classes. Student sex, grade level (sophomore, junior, senior), and activity type (team, individual, fitness) were utilized as independent variables in a 2 X 3 X 3 Factorial ANOVA to determine differences in the heart rates and time spent in a target heart rate zone for all students.

RESULTS: The results indicated fitness (142.39 ± 24.1 bpm) activities elicited higher average heart rates than did team (117.72 ± 24.1 bpm) or individual (114.32 ± 17.6 bpm) activities. The same was also true for the percentage of class time spent within a target heart rate zone (Fitness 81.7 ± 15.9%, Individual 68.43 ± 30.5%, Team 60.69 ± 30.5%). Interestingly, an interaction occurred between the type of activity selected and sex of the student with regards to mean heart rate (ANOVA, p = 0.001). Males attained higher mean heart rates within the team activities than did females, however heart rates of female students were higher in individual activities. There was no difference between the mean heart rate values of male and female students within the fitness activities.

CONCLUSIONS: These findings indicate that male and female adolescents may respond differently to separate types of activities in physical education classes. Considering the inverse rate elicits in the team and individual classes of both male and female students, it may be beneficial to focus more on fitness activities in high school physical education. This approach may better serve the needs of students as they progress towards life as an adult. Funded by IL Office of Attorney General, Vitamin Anti-Tuss-Settlement and IAPHERD Jump Rope for Heart Program.
MetHoDs: Children with intellectual disabilities (ID) have higher obesity rates compared to children without ID. Both adults and children with Down syndrome (DS) have even higher rates of obesity than those with ID without DS. Few studies to date have assessed the influence of physical activity level on weight management in children with ID or DS. Children with ID and DS often have cognitive, physical and social delays limiting participation in play thereby potentially reducing activity level and contributing to increased obesity risk. Thus, the purpose of this study was to assess the physical activity level of children with ID and DS compared to age-matched healthy control children (C). A secondary aim was to determine what percentage of children within each group met physical activity objectives recommended by Healthy People 2010 (HP2010).

METHODS: 46 children (DS n=18; C n=15; ID n=12) (mean age 7.6 ±2.2 years) were an accelerometer on the right hip for 7 days. Activity counts were collected at one-minute intervals during waking hours. Average counts per day and time spent at various activity intensities as defined by previously established cut-offs were calculated. An ANOVA was performed to determine differences in activity measures between the groups. The percentage of children in each group meeting HP2010 Activity Guidelines (AG) 22.6 and 22.7 was determined.

RESULTS: There was no significant difference between groups in average counts per day, or minutes spent at moderate, vigorous, or very vigorous activity intensities. All of the children with ID met HP2010 AG 22.6 recommending accumulation of 30 minutes or more of moderate intensity physical activity. 94.5% of children with DS and 81.3% of children with ID met HP2010 AG 22.7. No children meet HP2010 AG 22.7 recommending children participate in 20 minutes or more of vigorous activity continuously 3 or more days per week.

CONCLUSION: School-aged children with and without disability demonstrate similar activity levels. Children with disability are accruing the recommended amount of moderate intensity activity sporadically throughout a typical day. Neither children with ID and DS or healthy control children are performing continuous higher-intensity activity as is recommended by HP2010. This may be due to the sporadic nature of play in children.

This study was funded by a grant from Special Olympics.


Board #29
3:00 PM - 4:00 PM
Physical Activity in School-Aged Children with Intellectual Disabilities
Dawn E. Roberts, Patty S. Freedion, FACSM. University of Massachusetts, Amherst, MA.
Email: droberts@ecscc.umass.edu

Purpose: Children with intellectual disabilities (ID) have higher obesity rates compared to children without ID. Both adults and children with Down syndrome (DS) have even higher rates of obesity than those with ID without DS. Few studies to date have assessed the influence of physical activity level on weight management in children with ID or DS. Children with ID and DS often have cognitive, physical and social delays limiting participation in play thereby potentially reducing activity level and contributing to increased obesity risk. Thus, the purpose of this study was to assess the physical activity level of children with ID and DS compared to age-matched healthy control children (C). A secondary aim was to determine what percentage of children within each group met physical activity objectives recommended by Healthy People 2010 (HP2010).

Methods: 46 children (DS n=18; C n=15; ID n=12) (mean age 7.6 ±2.2 years) were an accelerometer on the right hip for 7 days. Activity counts were collected at one-minute intervals during waking hours. Average counts per day and time spent at various activity intensities as defined by previously established cut-offs were calculated. An ANOVA was performed to determine differences in activity measures between the groups. The percentage of children in each group meeting HP2010 Activity Guidelines (AG) 22.6 and 22.7 was determined.

Results: There was no significant difference between groups in average counts per day, or minutes spent at moderate, vigorous, or very vigorous activity intensities. All of the children with ID met HP2010 AG 22.6 recommending accumulation of 30 minutes or more of moderate intensity physical activity. 94.5% of children with DS and 81.3% of children with ID met HP2010 AG 22.7. No children meet HP2010 AG 22.7 recommending children participate in 20 minutes or more of vigorous activity continuously 3 or more days per week.

Conclusion: School-aged children with and without disability demonstrate similar activity levels. Children with disability are accruing the recommended amount of moderate intensity activity sporadically throughout a typical day. Neither children with ID and DS or healthy control children are performing continuous higher-intensity activity as is recommended by HP2010. This may be due to the sporadic nature of play in children.

This study was funded by a grant from Special Olympics.


Board #31
2:00 PM - 3:00 PM
Pedometer-Determined Habitual Physical Activity Levels of New Zealand High School Students
Maea Hohepa, Grant M. Schifflord, Gregory S. Kolt. Auckland University of Technology, Auckland, New Zealand.
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Despite the recent and growing advocacy to measure physical activity with objective methods, activity levels of youth in New Zealand have, to date, only been measured via self-report methods. This study is the first in New Zealand to measure physical activity levels of high school students from Year 9 through to Year 13 inclusively.

Purpose: To assess, using pedometry, the physical activity levels of high school students (Years 9-13) living in South Auckland, New Zealand. Method: High school students were requested to wear a sealed seven-day memory pedometer for 5 consecutive days to measure physical activity during 3 school days and the weekend. Preliminary analysis of the first 177 participants who wore the pedometer for a minimum of two school days and/or one weekend day were included in the analysis.

Results: For the total sample, the mean daily step count for school days was 13,139±3,287, a significantly higher step count compared to weekend activity (8,834±4,450; p<0.00). Males were significantly more active than females on school days only (14,266±5,458 vs. 12,403±3,945; p=0.013), with both males and females obtaining fewer steps in the weekend (7,915±5,101 and 8,309±3,879 respectively; p<0.00). Age-related patterns indicated junior (school years (aged 13-14 years old) were more active than their senior counterparts aged 17-18 years old only during the school week (14,701±4,242 vs. 11,261±3,390) and that all students, irrespective of age, significantly decreased their activity during the weekend period. When the data were analysed using Cohen effect size calculations, a moderate effect (es=0.64) was found for differences in school day activity levels between junior (13-14 years old) and senior (17-18 years old) high school students. A small effect size was noted for the mean in daily step count between school days and the weekend (es=0.47).

Gender differences in daily activity on school days (es=0.20) and weekends (es=0.16) also resulted in small effect sizes.

Conclusion: The findings indicate that youth are less active during the weekend than on school days. Irrespective of gender, during the weekend youth fall short of achieving step-based guidelines articulated for either the adult or child population groups. Health promotion strategies targeting weekend activity especially are warranted. Future strategies need to take a community-based approach beyond the school environment to provide opportunities for youth to be active during the weekend period.

Supported by Health Research Council of New Zealand Maori PhD Scholarship.
After School Behaviors of Middle and High School Students in Canada were examined using uniaxial accelerometers (CSA 7164). Volunteers wore accelerometers for one week and data recorded for at least four days with 10 hours per day were used for the analysis. BMI (body mass index) and % body fat using BIA (bio impedance analysis) were assessed and fasting lipids, glucose and insulin were measured. The relationship between 4 co-morbidity factors (triglyceride, glucose and insulin and low level of high density lipoprotein cholesterol) and physical activity variables (count per minute, time spent on each of light, moderate and vigorous activities) were investigated by Pearson correlation and also by partial correlation controlled for age. To compare the physical activity pattern of obese children with and without co-morbidities, subjects were divided into 3 groups according to the number of co-morbidity factors: group 1 (n=26) with no co-morbidity factor, group 2 (n=19) with 1 co-morbidity factor, group 3 (n=8) with 2 or more co-morbidity factors. Physical activity level (count/min) and time spent on various intensity activities were compared among groups by one-way ANCOVA with % body fat as a covariate because there was significant difference in % body fat among groups.

RESULTS: Fasting insulin correlated positively with time spent on light activity (r=.301, p=.028) and negatively with time spent on moderate activity (r=-.301, p=.028). But after the influence of age was removed, these were no longer significant. The group comparison of physical activity also revealed no significant difference of any physical activity variables.

CONCLUSION: Physical activity patterns of obese children with and without co-morbidities do not differ. Studies with a larger sample size may be needed to further verify this result.

2526 Board #34 2:00 PM - 3:00 PM Physical Activity Pattern of Obese Children with and without Co-Morbidities Jae-Hyun Lee1, Boguslawa Wilk, FACSM, Katherine Morrison1, Oded Bar-Or, FACSM1. 1Sport Science Research Center of Korea, Seoul, Republic of Korea. 2Children’s Exercise and Nutrition Centre, Hamilton, ON, Canada. 3Lipid Clinic, Hamilton, ON, Canada. 4Children’s Exercise and Nutrition Centre, Hamilton, ON, Canada. Email: inossang@yahoo.co.kr

PURPOSE: The aim of the present study was to compare objectively measured physical activity pattern of obese children with and without co-morbidities.

METHODS: Physical activity pattern of 53 6~17 year old obese children (boys : 23, girls : 30) who were on the waiting list at the Children’s Exercise and Nutrition Centre in Canada were examined using uniaxial accelerometers (CSA 7164). Volunteers were randomly assigned to one of three groups: without co-morbidities, without co-morbidities and with 1 co-morbidity (39% of the sample), and with 2 or more co-morbidities (31% of the sample). The results were analyzed to determine the time spent watching television, using a computer, doing homework, commuting, and exercising after school.

RESULTS: The results indicated that in the junior highs 13% of males were overweight, which is 7.3% below the national average while only 11.6% of females were overweight or 7.5% below the national norms according to the children’s body mass index 95th percentile of the CDC 2000 growth charts. For senior high students, 6.7% males and 8.2% females were overweight, which were 13.6% and 10.9% below national norms respectively. More importantly, % body fat measurements by BIA in the senior high students indicated that 100% and 83.6% of the males and females met or exceeded the Fitnessgram norms respectively for body composition. For all Fitnessgram variables tested (mile run, pacer, curl-ups, push-ups, sit & reach), on average 82.4% of males and 77.0% of females met or exceeded the Fitness gram norms respectively for body composition. For all Fitnessgram variables tested (mile run, pacer, curl-ups, push-ups, sit & reach), on average 82.4% of males and 77.0% of females met or exceeded the Fitnessgram norms respectively for body composition. For all Fitnessgram variables tested (mile run, pacer, curl-ups, push-ups, sit & reach), on average 82.4% of males and 77.0% of females met or exceeded the Fitnessgram norms respectively for body composition.
skills were scored in accordance to criteria, on a 0 to 3 scale, representing the consistency of proper technique. An inter-rater reliability of .74 was achieved.

RESULTS: Pearson correlations indicated a significant relationship between motor skill competency and physical fitness (r = .40; p < .01). Despite the low aerobic demand of the testing protocols, aerobic (r = .67; p < .01) and muscle fitness (r = .55; p < .01) had a strong association with motor competency. BMI (r = .13; p > .01) was neither a contributor nor barrier to motor competency. All fitness components were significantly correlated to basketball (r = .46; p < .01) and gymnastics (r = .40; p < .01), but not significantly correlated to throwing (r = .15; p > .01). There were gender differences in the gymnastics sequence tasks.

CONCLUSION: These findings indicate that aerobic capacity and muscle fitness influenced motor competency, while BMI made little contribution to motor performance. Therefore, those who attain aerobic and muscle fitness, regardless of body composition, are more likely to be proficient at complex motor tasks.

2529 Board #37
2:00 PM - 3:00 PM
Body Composition, Neuronmuscular Function, and Physical Activity among Adolescent African-African Females
Richard H. Williams1, Gary A. Dudley, FACSFM, Kevin K. McCully, FACSFM; 1Langston University, Langston, OK; University of Georgia, Athens, GA
Email: rhwilliams@lanet.edu

PURPOSE: American adults are facing two major lifestyle-related problems that have surfaced during the previous two-to-three decades: an epidemic of increasing adiposity and a deteriorating pursuit of physical activity. To what extent prior to adolescent growth and development, are culturally linked. The literature suggests that this “weight plague” and “inactivity lifestyle” is ethnically prevalent and gender specific. In particular, the African-American race and the female gender are associated with this condition. Therefore, what consequences, if any, do these trends have on the neuromuscular characteristics of adolescent African-American females?

METHODS: Thirty-two subjects were randomly selected to participate in a seven week protocol that encompassed analysis of body composition, indices of skeletal muscular strength, and questionnaires which quantified time spent in leisure, occupational, and/or structured physical activity endeavors. In order to illustrate comparisons, subjects were grouped as “low-risk” or “high-risk,” depending upon their body mass index (BMI) < 22.5 = “low-risk” and BMI > 22.5 = “high-risk,” respectively.

RESULTS: There was no sound evidence that suggests lessening of neuromuscular function among subjects. Although possessing significantly greater total body fat-free-mass (p < .029), leg fat-free mass (p < .041), arm fat-free mass (p < .025), and thigh extensor absolute strength (p < .013), the “high-risk” individuals demonstrated less attributable variance in their muscle strength and size indices. Surprisingly, the “high-risk” subjects were more active (kcal/d, p < .042 and 5 day pedometry readings, p < .0001) than their “low-risk” counterparts according to self-report measures of physical activity. However, the pursuit of hard-to-vigorous physical activities was almost non-existent between both groups (1.88 and 2.56 hrs/wk for “low-risk” and “high-risk” respectively).

CONCLUSIONS: Although groups differed in body composition, muscular strength, and activity durations, altered neuromuscular function among subjects were not present. Given the minimal pursuit of hard-to-vigorous activities, more time engaging in these activities may be the critical element in offsetting premature neuromuscular disorders, although not observed. Moreover, more research is needed that focuses on adolescent skeletal muscular characteristics and their relation to physical activity durations. Additionally, developing ways to enhance hard-to-vigorous activities is strongly encouraged.

2530 Board #38
3:00 PM - 4:00 PM
Promoting Motor Skills and Motor Fitness of School-Age Youth Through a Schoolyard Environment
Kari Aa. Gunderson1, Jon B. Fjeld1, Nina Skjøstel2, Rita Galteland2; 1Agder University College/Faculty of Health and Sport, Kristiansand, Norway; 2Guidance Counselor; Kristiansand S 4604, Norway; 1Obstetricians for Children, Kristiansand, Norway. Email: kari.a.gundersen@hia.no

It is recommended that school-age youth should participate in physical activity every day in 60 minutes or more of moderate to vigorous physical activity that is enjoyable and developmentally appropriate (Strong et al. 2005). The schoolyard promotes physical activity during recess and before and after school programs. How can we make children become more active during school day? What characterizes schoolyards that motivates the pupils to healthy physical activity? PURPOSE: The purpose of the study is to find out how the schoolyard landscape influences the children type and intensity of physical activity.

METHODS: 13 schools (1 primary school 1.- 4. grade, 7: 1.-7. grade, 2: 1.-10. grade and 3: 8.-10. grade) in Kristiansand community participated in the study. Each school principal drew a map showing the spaces and places in the schoolyard where the children physically active. The map showed green spaces, playground spaces, sports grounds and equipment. We asked the pupils twice to tell us where and what they have been doing in the long recess, one day when the weather was nice and one day when the weather was bad.

RESULTS: We found that the following factors were determinantes for the amount and intensity of physical activity: Age, sex and certain qualities of the schoolyard: The young children were more active than the older ones. The boys were more active than the girls. The schoolyard facility stimulated boy’s activities prior to significantly lower with girls. The schools with green spaces and playground spaces and loose equipments afforded a variety of activity to the children. These playscapes where were dominant in the lower grade schools. The youth in the junior high school with similar schoolyards were more active than youth in schools with fewer facilities.

CONCLUSIONS: Children and youth, boys and girls are to a varying degree active in the recess. The conclusive factors for the amount of self-regulating physical activity is the quality of the schoolyard and the recess time.

2531 Board #39
4:00 PM - 5:00 PM
Four Years of Universal Prevention in Primary Schools - Effects on BMI and Motor Abilities in Childhood
Gisa Falkowski,1 Benjamin Koch,1 Birna Bjarnason-Wehrens,1 Hildegar德 Christ,2 Walter Tokarski,3 Sigrid Dordel1, Hans-Georg Predel1, Christine Graß1; 1German Sport University, Cologne, Germany; 2University, Cologne, Germany. Email: falkowski@dsbs-koeln.de

Objectives: Obesity in childhood is increasing worldwide. To combat overweight and obesity in childhood, the school-based CHILIT project combines health education and physical activity. This paper examines the effect of intervention on the body mass index (BMI) and motor abilities after nearly 4 years in 12 randomly selected primary schools compared with 5 randomly selected control schools.

METHODS: The anthropometric data was assessed. BMI was calculated. Gross motor development was determined by a body coordination test (KTK) and endurance performance by a 6-minute run.

RESULTS: No difference in the prevalence of overweight and obesity was found between the intervention (IS) and control schools (CS) either at baseline or final data (each p>0.05). There was no difference between the result of the endurance performance and the complete KTK, but the performance in lateral jumping and balancing backwards was better in the IS than in the CS (p=0.005; p=0.007), adjusted for age and test result of the entrance examination, gender and BMI-classification at final examination. Overweight and obese children produced significantly lower scores in more tasks than their counterparts (each p<0.05).

Conclusions: Preventive intervention in primary schools offers an effective means to improve coordinative skills in children, but overweight and obese children always produce significantly lower results. To improve motor skills in overweight and obese children and to prevent overweight and obesity, selective family- and school-based measures are necessary and parents should be included.

2532 Board #40
2:00 PM - 3:00 PM
Hypertension Is an Early Complication of Childhood Obesity and Is Associated with Physical Activity and Aerobic Fitness
Nathalie J. Farpourt-Lambert1, Laetitia MI Keller-Marchand2, Xavier E. Martin1, Emmanuelle Golay1, Valerie Schwizgbece2, Yacine Aggoun1, Maurice Beghetti1; 1Pediatric Cardiology, Dept of Pediatrics, University Hospital, Geneva, Switzerland. 2Pediatric Endocrinology and Diabetes, Dept of Pediatrics, University Hospital, Geneva, Switzerland. Email: nathalie.farpourlambert@hcuge.ch

Hypertension is a major complication of obesity and may develop during childhood. Physical activity has beneficial effects on arterial function however little is known in obese children.

PURPOSE: To measure ambulatory 24-hour BP in obese children and to evaluate its relationships with physical activity and cardiorespiratory capacity.

METHODS: This cross-sectional study included 42 obese children and 35 healthy controls (mean age 9.3 +/- 1.5 yr). We measured 24-hour systolic and diastolic BP and heart rate using a DynaSys Integra monitor with adapted cuffs. Standard deviation scores (SDS) were calculated using reference values of the German Working Group on Pediatric Hypertension (n=949). Other measures included anthropometrics, maximal aerobic capacity (peak VO2) by treadmill test; past year physical activity by questionnaire; 7-day physical activity by accelerometer (Actigraph GT3X); and BP, heart rate and 6-minute run.

RESULTS: Groups were matched for age, height and puberal stage. Compared to controls, obese children had significantly higher body weight, body mass index (BMI), and body fatness. Physical activity count (317 ± 57 vs. 376 ± 119.0 cpm) and peak VO2 (35.7 ± 6.6 cc/min vs. 46.1 ± 7.5 ml/kg/min) were significantly lower in obese children than controls however, the peak VO2 difference disappeared when adjusted for lean tissue mass. Obese children had significantly higher systolic and diastolic BP than controls (table 1) and 16 % of them had hypertension during the night (BP > 2 SDS). All BP measures were positively correlated (P<0.05) with BMI and body fatness, and negatively with physical activity and peak VO2.
**CONCLUSION:** Our study show that obese children develop high blood pressure early in life and it is associated with body fatness and low physical activity level. They should be encouraged to participate in adapted sports, to improve body composition and prevent premature vascular complications.

**Funded by the Swiss National Science Foundation and the University of Geneva.**

<table>
<thead>
<tr>
<th>Table 1. Ambulatory Systolic and Diastolic Blood Pressure</th>
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<td><strong>Groups</strong></td>
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<tr>
<td>Children n=43</td>
</tr>
<tr>
<td>Controls n=35</td>
</tr>
</tbody>
</table>

**F-26 Free Communication/Poster – Clinical Exercise Testing II**

**FRIDAY, JUNE 2, 2006 2:00 PM - 5:00 PM**

**ROOM: Hall B**

**2533 Board #41**

**3:00 PM - 4:00 PM**

**Should Pediatric Patients Exercise Tested for Induced Exercise Bronchospasm be Monitored by an Electrocardiographic Recorder?**

Wayne A. Mays, Yvette M. Gerdes, Randy P. Claytor, Timothy K. Knulands; Cincinnati Children’s Hospital Medical Center, Cincinnati, OH.

**Email:** wayne.mays@cchmc.org

**ABSTRACT:** We compared the electrocardiographic (ECG) and heart rate data from a multi lead electrocardiographic recorder to the pulse rate data obtained from an oxygen saturation (O2 Sat) monitor in 77 pediatric patients undergoing exercise testing for the evaluation of exercise induced bronchospasm (EIB).

**PURPOSE:** To assess the accuracy of pulse rate data during exercise in pediatric patients tested for EIB and the ability to document significant diagnostic findings using a multi lead electrocardiographic recorder.

**METHODS:** Seventy-seven pediatric patients were evaluated for EIB utilizing a treadmill protocol designed to exhaust the patient within 6 to 8 minutes and elicit an 85% or greater maximal heart rate response for the last 4 minutes of the protocol. The patients were continuously monitored with a GE Medical Case 8000 ECG recorder and a Nellcor N-595 O2 Sat monitor utilizing a temple oximeter. The heart rate (HR) and pulse rate (PR) data were indexed against the measured maximal heart rate as a measure of maximal exercise intensity.

**RESULTS:** The average age was 13.6±2.4 years old with 36 males and 71 Caucasian, 5 African Americans and 1 Asian. Weight was 54±16Kilograms; Body Mass Index (BMI) was 21.6±4. The referral pattern for the patients was 57% from Pediatric Pulmonologists, 26% from community based Pediatricians, 14% from Pediatric Cardiologists and 3% from Pediatric Thoracic Surgeons.

The O2 Sat monitor pulse rate function failed in 4/77 patients (5.2%) and one due to a hypertensive systolic blood pressure response (>250mmHg). These findings identify compliance trends for the initial and follow up exercise tests associated with a weight management program for obese pediatric patients. All groups required aggressive scheduling practices with the initial scheduling encounters greater than 1. Additionally, there was significant attrition from the initial to the follow up test with the greatest fall out occurring in the AA group. These finding highlight areas for increased efforts to improve test and program compliance.

**F-2534 Board #42**

**4:00 PM - 5:00 PM**

**Free Communication/Poster – Clinical Exercise Testing II**

**F-2535 Board #43**

**2:00 PM - 3:00 PM**

**2535 Board #43**

**2:00 PM - 3:00 PM**

**Rapid Resolution of Ischemic ST-Segment Depression in the Immediate Post-Exercise Recovery Period: Clinical Significance**

Emily E. Balagna, Angela J. Fern, Judith Boura, Adam T. deJong, Barry A. Franklin, FACSM. William Beaumont Hospital, Royal Oak, MI.

Symptomatic or silent coronary artery disease (CAD) may be identified by ischemic ST-segment depression (ST↓) during graded exercise testing. However, the significance of rapid resolution of these abnormalities electrocardiographic changes is unclear.

**PURPOSE:** To clarify the significance of rapidly resolving ST↓ (i.e., within one minute) in the immediate post-exercise recovery period.

**METHODS:** Six hundred and eighty five diagnostic exercise tests utilizing modified, stage half or conventional Bruce treadmill protocol were reviewed. All patients simultaneously underwent myocardial perfusion imaging (MPI) with Technetium 99m sestamibi or tetrofosmin (93% specificity, 90% sensitivity).

**RESULTS:** Eighteen patients (mean SD age = 54.5±9.3 years) demonstrated significant ST↓ (≥1mm) which resolved within the first minute of walking recovery without residual ST↓ wave abnormalities. By cardiovascular history, 2 of the 18 patients (both men) had known CAD whereas 16 (6 women, 10 men) did not. Sixteen tests were terminated secondary to volitional fatigue, one due to increasing ST↓ (≥2mm) and one due to a hypertensive systolic blood pressure response (>250mmHg).

Selected results in these 18 patients (mean SD at test termination were:

<table>
<thead>
<tr>
<th>Variable</th>
<th>mean ± SD</th>
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<tbody>
<tr>
<td>Heart Rate (beats/min)</td>
<td>157.5 ± 4.8</td>
</tr>
<tr>
<td>Double Product (mmHg x beats/min x 10^-3)</td>
<td>288.0 ± 45.0</td>
</tr>
<tr>
<td>Fitness (METs*)</td>
<td>13.0 ± 1.2</td>
</tr>
<tr>
<td>Perceived Exertion (6-20 scale)</td>
<td>15.8 ± 3.1</td>
</tr>
<tr>
<td>% of Predicted Maximal Heart Rate</td>
<td>84.7 ± 6.1</td>
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</table>

None of the 18 patients demonstrated significant ventricular ectopy and only one subject experienced anginal symptoms (mild) during exercise. Of the 18 patients, only one had an abnormal heart rate recovery response in the first minute of recovery (i.e., ≤12 beat/min drop). Neither of the 2 patients with known CAD had reversible defects (RD) by MPI. Moreover, only one of the 18 patients (6%) had a RD. In contrast, 8 of the 54 patients (14.8%) with significant ST↓ (≥1mm) that persisted in the immediate post-exercise recovery period had reversible perfusion defects.

**CONCLUSION:** Rapid resolution of diagnostic ST↓ in the immediate post exercise recovery period may represent a false positive response in relatively fit persons with and without known CAD, in that it is unlikely to be associated with a RD by MPI.
RESULTS: Age, BMI, resting HR and BP were not different between overweight subjects with OSA vs. without OSA (P = 0.05). Peak systolic and diastolic BP were significantly higher in the OSA group (P = 0.04) and remained higher (P < 0.05) up to 3-min post-exercise (low load recovery). Exercise HR for the OSA group was lower during both maximal (P = 0.03) and peak exercise (P = 0.01), compared to the overweight controls. Despite no differences in Vo2peak (P = 0.05), peak Vp was significantly higher for the OSA group (P = 0.04). This hypertensive response may result from augmented peripheral and central chemosensitivity to CO2 resulting from repeated episodes of intermittent hypoxia during sleep.

CONCLUSION: Blunted HR and altered ventilatory response characteristics in standard exercise tests and/or protracted BP recovery following exercise testing should be investigated further as potential markers to better identify patients who might benefit from diagnostic overnight polysomnography testing. Supported by a grant from ResMed Sleep Disordered Breathing Foundation, Poway, CA.

2537 Board #45 4:00 PM - 5:00 PM
The Effect of Gender on Maximum Heart Rate in Men 65 Years and Older
David N. Ercog, Alberto F. Vallejo, Karen Hwang, Fred R. Sattler, E. Todd Schroeder, University of Southern California, California Department of Biokinetics & Physical Therapy, Clinical Exercise Research Center, Los Angeles, CA. (Sponsor: Steve Hawkins, FACSM)

Clinical graded exercise stress tests (GXT) are typically terminated when patients reach 85% of age predicted maximum heart rate (APMHR). However, if older adults are tested to levels greater than 85% of APMHR, it is unknown whether underlying cardiac disease may be revealed.

PURPOSE: To examine the diagnostic benefit of performing GXT’s to maximal physical capacity in community dwelling, at risk, older men.

METHODS: As part of an intervention study, 40 older men: 30 Caucasian, six Hispanic, two Asian, one Black, one unspecified (age: 65-85 years, height: 1.44-1.86m, weight: 55.3-114.5kg, BMI: 20.8-38.6) performed a GXT on a cycle-ergometer following a ramping protocol to physical exhaustion or until contra-indications. Subjects were divided based on the presence of ST-segment changes, 2) No serious arrhythmia or ectopy, 3) Reaching 85% of APMHR.

RESULTS: Thirty-four of the 40 participants met the passing criteria for the GXT. Reasons for failing the GXT included: 1) The inability of the subjects to complete 85% of APMHR (range 72-82%) due to leg pain or fatigue and 2) One subject demonstrating ST-segment changes, 2) No serious arrhythmia or ectopy, 3) Reaching 85% of APMHR following a ramping protocol to physical exhaustion or until contra-indications. Subjects were divided based on the presence of ST-segment changes, 2) No serious arrhythmia or ectopy, 3) Reaching 85% of APMHR.

CONCLUSION: These data indicate that GXT’s performed to age predicted maximum heart rate on a cycle-ergometer in an older, at risk population are safe to perform; however, there appears to be limited diagnostic benefit compared to tests terminated at 85% of APMHR.

2538 Board #46 2:00 PM - 3:00 PM
Maximal Lactate Steady State in Patients with Coronary Heart Disease in Contrast to Healthy Subjects
Rochus Pukan, FACSM1, Alfred Primus2, Peter Hoffmann3, Serge Vondavallard, FACSM4, Manfred Wonsch5, Gerhard Smeikal6, Norbert Bachl1, Peter Schmid1, E. Todd Schroeder. 1Faculty of Physical Activity and Sport Sciences, 2Center for Cardiac Exercise Research, 3University of Southern California, California Department of Biokinetics & Physical Therapy, Clinical Exercise Research Center, Los Angeles, CA. (Sponsor: Steve Hawkins, FACSM)

Email: ercog@usc.edu

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CONCLUSION: These data indicate that GXT’s performed to age predicted maximum heart rate on a cycle-ergometer in an older, at risk population are safe to perform; however, there appears to be limited diagnostic benefit compared to tests terminated at 85% of APMHR.

2539 Board #47 3:00 PM - 4:00 PM
Heart Rate Recovery in Elderly Patients with Diastolic vs Systolic Heart Failure and Healthy Normal Subjects
Sara Maldonado-Martín1, Peter H. Brutbaker, FACSM2, Brian Moore2, Dalane W. Kitzman3, 1Faculty of Physical Activity and Sport Sciences, 2Wake Forest University Health Sciences, Winston-Salem, NC.

Email: smaldonado@wanadoo.es

PURPOSE: The rate of decline in heart rate following maximal exercise (HRR) has been shown to be a strong independent predictor of mortality in patients with classic systolic heart failure (SHF). However, little is known regarding HRR among patients with diastolic heart failure (DHF).

METHODS: One-hundred thirty subjects were classified into one of three groups: 50 patients with isolated DHF (clinical symptoms of heart failure, EF<50%, and no coronary, valvular, or pulmonary disease), 57 patients with SHF (EF<50%, and 23 age matched, healthy normal subjects. Both groups of heart failure patients were stable and well compensated outpatients with NYHA II-III symptoms. All subjects underwent a maximal cardiopulmonary exercise test. Heart rate recovery was calculated as the difference between maximal heart rate and heart rate one minute of recovery.

RESULTS: Compared to healthy normals, HRR was significantly reduced in DHF (24 ± 1.78 bpm vs. 35 ± 2.87 bpm; p<0.001) and in SHF (22 ± 2.61 bpm vs. 35 ± 2.87 bpm; p<0.001). No differences were observed in HRR between DHF and SHF (p=0.62). When reduced HRR was defined according to the standard decrease of less than 18 bpm during the first minute of recovery, 38% of DHF, 46% of SHF and 13% of normal subjects had a reduced HRR.

CONCLUSIONS: Heart rate recovery in elderly patients with diastolic heart failure is severely reduced compared to age-matched normals, and is similar to patients with heart failure due to systolic dysfunction. This finding may have important prognostic and therapeutic implications.

2540 Board #48 4:00 PM - 5:00 PM
Bioenergetics and Heart Rate Variability during Locomotion in Patients with Parkinson’s Disease
Arsenio Veicsteins, FACSM1, Martina Maggiore2, Emiliano Ce3, Sara Rapuzz2, Rafielli Nemmi4, Gianpietro Merati5, 1Istituto di Esercizio Fisico, Salute e Attività Sportive, Milan, Italy; 2Centro di Medicina dello Sport, Don C. Gnocchi Foundation, Milan, Italy; 3Dipartimento di Biologia della Vita e Scienze della Salute, Università degli Studi di Milano, Milan, Italy; 4Sezione di Neurologia, Don C. Gnocchi Foundation, Milan, Italy.

Autoimmune (AF) is a clinically relevant consequence in Parkinson’s Disease (PD), but its impact on daily living activities, such as locomotion, has been little evaluated. Heart rate variability (HRV), explored in the frequency domain, is a well established tool to assess the autonomic impairment in different pathologies, including PD.

PURPOSE: To assess bioenergetics and HRV at rest and during steady state locomotion at self-selected speed in long established, pharmacologically treated PD patients.

METHODS: Oxygen consumption (breath-by-breath) and heart rate (beat-to-beat) were measured in 9 PD patients (P: 72±8 yr; 62±12 kg; 5 males) and in 5 age and sex-matched healthy controls (HC). The study was approved by the Ethics Committee of the Medical School of the University of Milan, Italy.

RESULTS: VO2peak and HRpeak were significantly lower in PD vs HC (p<0.001). HRpeak, HRrest, HRV, HRV low frequency, HRV medium frequency, HRV high frequency, HRV total power were significantly lower in PD vs HC (p<0.001).

CONCLUSIONS: Oxidative stress and inflammation are severe in PD, affecting different tissues, and may contribute to the development of secondary chronic diseases. These findings may have important implications for the development of new therapies.
matched control subjects (C: 63±17 yrs; 74±12 kg; 2 males) in different conditions: 1) sitting at rest (5 min); 2) walking at the self-selected speed (5 min). Short term HRV in the frequency domain (Low Frequency: 0.04-0.15 Hz; High Frequency: 0.15-0.40 Hz, and LF/HF ratio) was evaluated during each period.

RESULTS: Self-selected speeds did not differ between P and C groups (2.8±1.0 vs 2.4±0.5 km/h). Resting (3.5±0.5 to 3±1.0 3.6 kg/min) and in resting and walking oxygen consumption compared to the subjects without AF (LF: 2.4±0.0±1.7 Hz) and to C subjects. However, a negative linear regression (r²=0.55, p=0.05) between self-selected speed and resting LF/HF and a positive linear regression (r²=0.05; p=0.03) between oxygen cost of locomotion and resting LF/HF were observed in PD patients.

CONCLUSIONS: In PD patients the AF seems not to affect the overall energy consumption both at rest and during walking at self-selected speed. However, in these subjects resting LF/HF may predict the subsequent cardiovascular performance during locomotion, suggesting that an increased sympathetic tone can negatively affect the energy cost of locomotion.

Supported by a grant from the Italian Ministry of Health.

2541 Board #49 2:00 PM - 3:00 PM

Dose-Response of Exercise and Heart Rate Recovery in Postmenopausal Women: The DREW Study

Conrad P. Earnest, FACSIM, Timothy S. Church, Gina M. Morss, FACSIM, Elisa L. Priest, Steven N. Blair, FACSIM. The Cooper Institute, Dallas, TX

PURPOSE: An increasing body of clinical evidence suggests that slow heart rate recovery (HRR) following maximal exercise testing is associated with a greater risk of CVD mortality. The purpose of our study was to examine the dose-response effects of 6 months of moderate intensity cardiorespiratory exercise training on 3-month posttest HRR after maximal exercise testing in postmenopausal women.

METHODS: We examined 361 initially sedentary women (Mean±SD: age 57±4 years; body mass 84±1.12 kg). We selected participants from the DREW study (Dose-Response to Exercise in postmenopausal Women) randomized to control or one of three aerobic exercise groups (low, 4 kcal/kg/wk; KKW; moderate 8 KKW, high 12 KKW) performing at a moderate intensity (HR: 50% VO2peak). The intervention period was 6 months. We expressed our data as mean HRR (b•min⁻¹) recovery (max HR - 3 min recovery HR), as well as the percentage of low responders failing to meet a clinically recovery criteria at follow-up.

RESULTS: We observed no significant difference between treatment groups at baseline or the percentage failing to meet a minimal HRR criterion. Following intervention, those in the High exercise group showed a significant improvement in HRR (b•min⁻¹; P<0.05). Though not statistically significant, the percentage of individuals in the High exercise group who failed to meet our minimal cardiovascular clinical recovery criteria at follow-up was lower than in the control group (P=0.08). We did not observe a significant statistical effect for trend.

CONCLUSION: Accumulating 12

KKW of moderate intensity physical activity may provide a sufficient stimulus to improve impaired HRR in previously sedentary postmenopausal women.

Supported by NIH grant HL66262 and equipment grants from Life Fitness

2542 Board #50 3:00 PM - 4:00 PM

Effects of Increased BMI on Cardiovascular Exercise Responses and Insulin Levels in Pediatric Patients

Yvette M. Gerdes, Wayne A. Mays, Sandy K. Knecht, Timothy K. Knulands, Randy P. Clayton. Cincinnati Children’s Hospital, Cincinnati, OH

Email: Yvette.Gerdes@cchmc.org

ABSTRACT: We evaluated 67 obese patients with elevated insulin levels and 67 age matched obese patients with normal insulin levels using a modified Balke protocol. Aerobic capacity and cardiovascular responses were compared between the groups.

PURPOSE: To assess aerobic capacity and cardiovascular responses of obese pediatric patients with elevated insulin levels.

METHODS: Sixty-seven obese patients with normal insulin levels (<15 µu) (N) were age matched (17AAfrican American (AA), 50Caucasian (C); 26 Male(M), 41 Female(F)) with 67 obese patients with elevated insulin levels (>15 µu) (H) (17AA, 50C, 24M, 43F). All patients underwent a maximal treadmill test using a modified Balke protocol before entering a 20 week weight management program.

RESULTS: The age was 10.7±2.6 years old for both groups. Weight was 76±21 vs. 78±23 kg; Body Mass Index (BMI) was 30±6 vs. 35±7; and Insulin levels were 11.7±2 vs. 29±6. (p<0.001, **p<0.001).

<table>
<thead>
<tr>
<th>Max HR (bpm)</th>
<th>Max SBR (mmHg)</th>
<th>VO2 max (ml/kg/min)</th>
<th>VO2 max (cc/kg/min)</th>
<th>Exercise Duration (min)</th>
<th>Max HR (bpm)</th>
<th>Max SBR (mmHg)</th>
<th>VO2 max (ml/kg/min)</th>
<th>VO2 max (cc/kg/min)</th>
<th>Max HR (bpm)</th>
<th>Max SBR (mmHg)</th>
<th>VO2 max (ml/kg/min)</th>
<th>VO2 max (cc/kg/min)</th>
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<tr>
<td>176±14</td>
<td>204±21</td>
<td>75±7</td>
<td>23±6</td>
<td>11.1±6</td>
<td>176±14</td>
<td>204±21</td>
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<td>201±16</td>
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<td>216±25</td>
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<td>11.1±6</td>
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<td>23±6</td>
<td>11.1±6</td>
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</table>

SUMMARY: The two groups were age matched with no significant differences in respect to gender and race. However, the H group was significantly heavier with a greater BMI compared to the N group. Although both groups achieved the same exercise intensity as demonstrated by comparable maximal heart rates, the H group had a significant lower working tolerance and aerobic capacity. The H group also exhibited a delay in return to baseline in their cardiovascular response to exercise as demonstrated by a significantly higher heart rate and blood pressure levels post exercise.

CONCLUSION: With in the obese pediatric population there is relationship between high body mass index, elevated insulin levels and poor exercise response. Future research should focus on the causal relationship between these findings.

2543 Board #51 4:00 PM - 5:00 PM

Metabolic Syndrome Impairs Function, Health-Related Quality of Life, and Peripheral Circulation in Patients with Intermittent Claudication

Polly S. Montgomery, Andrew W. Gardner. CMRI Metabolic Research Center, University of Oklahoma Health Science Center, Oklahoma City, OK.

Patients limited by intermittent claudication have multiple co-morbid conditions and are sedentary, thereby increasing their risk of having metabolic syndrome. Metabolic syndrome’s possible negative effects on ambulation and peripheral circulation in these patients are of particular importance.

PURPOSE: To examine the effect of metabolic syndrome on intermittent claudication and peripheral circulation in patients with peripheral arterial disease (PAD), and to determine whether peripheral vascular function was predictive of the severity of intermittent claudication in patients with metabolic syndrome.

METHODS: Patients limited by intermittent claudication who had metabolic syndrome (n = 155) were compared to those without metabolic syndrome (n = 428). Patients were assessed on metabolic syndrome characteristics, ambulatory function, and peripheral circulation.

RESULTS: Initial claudication distance (ICD) was 300 shorter (p < 0.007) in patients with metabolic syndrome than in the controls (132±19 vs. 189±165 m; mean±SD), and absolute claudication distance (ACD) was 21% shorter (p = 0.028) (327±194 vs. 413±248 m). Furthermore, patients with metabolic syndrome had greater calf ischemia (p = 0.016) following a vascular occlusion test. Calf ischemia was correlated with ICD (r = 0.28, p < 0.031), and ICD (r = 0.39, p = 0.003) in the group with metabolic syndrome.

CONCLUSION: Metabolic syndrome worsens intermittent claudication and peripheral circulation in patients with PAD. Thus, the additive burden of metabolic syndrome places patients limited by intermittent claudication at even greater risk for living a functionally dependent lifestyle.

Supported by NIH (R01-AG16685, K01-00657).

2544 Board #52 2:00 PM - 3:00 PM

Sweat Test and Electrolyte Losses in 56 Professional Soccer Referees, during a Regular Training Session

Francisco E. Arroyo,1 Lourdes Mayor,1 Amara Montalvo,2 Guillermo Olivera,2 Sport Med, Guadalajara, Jalisco, Mexico. 1Bermuame, Mexico DF, Mexico. 2Sport Med, Guadalajara, Jalisco, Mexico.

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PURPOSE: To quantify the volume and composition of sweat loss in 56 professional soccer referees from (Mexico) three of them were women, during a regular training session. Having available fluids to drink during the session.

METHODS: The 56 professional soccer referees, were weighed nude before and after the session training and also a urine sample were collected before to see the hydration status when arriving for training. The weather conditions were measured every 30 minutes during the session. All referees had free access to sport drink and water so they drank ad libitum. We labelled every bottle of water and sport drink with the referees names so can drink only from their own bottles. Patches to collect sweat were positioned on eleven referees before training on the right forearm and retired at 45 min. after the session started.

RESULTS: The weather conditions were DT 23.21±6.7°C, HR 39.08±6.09%

The
average heat stress index was 31.9. The urine sample density before the training session was 1.018 (1.003-1.029); The Initial weight was 73.58 (58.20-91.92); The total weight lost:1.100 (0.350-3.900) kgs; The percentage of dehydration:1.5% (0.4-6.1%); The sweat Rate was: 1.320 (0.75-3.0 Liters/hour); The fluid Intake:0.800 (0.869 - 1.69) Ls/h; The water intake:0.683(0.204-1.236)Liters/hour...and related to electrolytes (11 Referees) the results were: Sodium Loss: 49.7Mmols.(19-9.79-79)and the Potassium Loss :5.05 Mmols(3.8-6.3).

CONCLUSIONS. We can see that with the heat stress index that we had during the training session there was one referee with 6.1% dehydration showing no symptoms of heat stroke or heat illness. The question is how can a referee rule on a soccer game with 6.1% dehydration?, The physical aspect can have a great influence on referee performance because even being dehydrated a referee can jog, jump, etc., but taking the mental right arbitral decision...simply is not possible. We have to give also enough fluids to the referees not only to the players to avoid dehydration so they can carry out their job without any physical or mental detriment. Acknowledge. Thanks to Gatorade Sports Science Institute for supporting this study.

2545 Board #53 3:00 PM - 4:00 PM
“Boosting”
Sandeep Singh1, Guy W. Fried2. Thomas Jefferson University Hospital, Philadelphia, PA; Magee Rehabilitation Hospital, Philadelphia, PA.

Many athletes with spinal cord injury voluntarily induce autonomic dysreflexia (AD) to enhance performance. This is better known as “boosting.” This technique is usually employed before or during a competition and is applied primarily to overcome the physiologic and metabolic limitations that the spinal cord injured athlete may encounter. Although the performance is enhanced, there can be potential life-threatening consequences. These consequences include hemorrhagic stroke, cardiac arrhythmia, myocaridal infarction and death.

PURPOSE: To illustrate how boosting significantly improves or enhances performance outcome.

METHODS: In this study, a spinal cord injured athlete was observed performing boosting. Measures of performance time and cardiovascular response were recorded with and without boosting. His baseline performance status was compared to the performance status while boosting. The athlete was observing performing wheelchair sprinting for a distance of 0.13 miles. The variables recorded before and after the activity included blood pressure, heart rate, pulse oximetry, respiration rate, and performance time.

RESULTS: The results collected illustrated a 30 mm Hg increase in systolic and diastolic blood pressure during the period of AD when compared to baseline values. Elevation of heart rate by 15 beats per minute was also noted. The respiratory rate increased by 4 breaths per minute, along with a 1% decrease in oxygen saturation. Comparison of the “boosted” task to the “unboosted” task reveals disparity. The diastolic blood pressure was elevated by 35 mm Hg, and there was a 20 mm Hg increase in systolic blood pressure for the “boosted” task. Heart rate, respiratory rate, and oxygen saturation were relatively unchanged. Performance time showed a decrease of about 5.3 seconds (39.21 with AD, and 44.53 without AD).

Table: Vital signs recorded at different intervals of performances
BP (mm Hg) HR (bpm) RR (breaths/min) PO2 (%) Pt (sec)
Voluntary induction of AD provides a performance advantage. Given the data, an improvement in performance time by 5.32 seconds over a distance of 0.13 miles (200 meters) existed. Performance enhancement was compared to the performance status while boosting. The athlete was observed performing wheelchair sprinting for a distance of 0.13 miles. The variables recorded before and after the activity included blood pressure, heart rate, pulse oximetry, respiration rate, and performance time.

CONCLUSION: It is apparent that a significant performance improvement exists in the athlete who applies the boosting technique. Although boosting can create a performance advantage, it can cause a significant risk of mortality and morbidity for the SCI athlete. This practice should be discouraged by all physicians and health care providers.

2546 Board #54 4:00 PM - 5:00 PM
Effects of Different Intensities of Active Recovery on the Blood Lactate Concentration Post-Exercise
Sidnie Noda1, Waldecir Paula Lima1. ‘FEFISA - Faculdades Integradas de Santo André, Santo André, Brazil, ‘FEFISA - Faculdades Integradas de Santo André / Instituto de Ciências Biomédicas da Universidade de São Paulo, Santo André / São Paulo, Brazil. Email: snoda@uol.com.br

PURPOSE: The present study was supported by the Ethics Committee on Research of FEFISA and has as an objective to analyze the blood lactate concentration ([La]) concerning different active recovery (AR) intensities after high intensity exercise.

METHODS: The volunteers of this study were 8 male with age 25±3±1.35. The participants attended to the experiments on 4 different occasions with a pause of at least 3 days. On the first occasion, they were submitted to a physical evaluation and on the 3 posterior occasions they were submitted to tests of different ways of recovery after lactic acidosis induction (2 shots of 30 seconds pedaling at the maximum speed on a cycle ergometer, with a 1 min break between the shots). The recovery tests were: on the 1st day, a passive recovery (PR), on the 2nd day an AR, running on an intensity corresponding to 75% of the ventilatory threshold 2 (VT2) and on the 3rd day an AR running on an intensity corresponding to 90% of the VT2. The different forms of recovery had a 15 min duration and were named as control (C), AR1 and AR2, respectively. During the recovery tests, blood samples of the 1st, 3rd, 5th, 10th and 15th min were collected and stored to be later dosed by the lactate analyzer Yellow Springs 1500. It was used, as statistical procedure, the factor variance analysis - ANOVA, with the Tukey post-test (p<0.05).

RESULTS: There was a significant difference between the [La] of AR1 when compared with C on the 10th min (p<0.05) and on the 15th min (p<0.01). On the comparison between AR2 and C there was a significant difference on the 10th min (p<0.05) and on the 15th min (p<0.05). There was no significant difference between AR1 and AR2 in all the moments. When the [La] was compared among the different moments of C, there was a significant difference on the 3rd min (p<0.01), 5th min (p<0.001) and on the 10th min (p<0.001) in relation to the 1st min. In the comparison between the different moments of AR1, there was a significant difference on the 1st min (p<0.05), 3rd min (p<0.001) and the 5th min (p<0.001) in relation to the 15th min. When the same comparison was made between the different moments of AR2, there was a significant difference on the 3rd min (p<0.05) and the 5th min (p<0.01) in relation to the 15th min.

CONCLUSIONS: That way, the conclusion is that AR is more efficient when compared to the PR, however, the different used AR intensities doesn’t seem to present an influence on the post-exercise [La].

2547 Board #55 2:00 PM - 3:00 PM
Exercise Capacity in McArdle’s Patients After Sucrose Intake
José L. Maté-Muñoz1, Carolina Chamorro-Vilá1, Alejandro F. San Juan1, Claudia Cardona-González1, Susana Morál1, Margarita Pérez2, Carl Foster, FACSM1, Alejandro Lucía1. 1Universidad Europea de Madrid, Madrid, Spain. 2Department of Exercise and Sport Science, University of Wisconsin-La Crosse, La Crosse, WI. Email: alejandro.lucia@uems.eu

PURPOSE: Human muscle glycogen phosphorylase (MPL) deficiency (McArdle’s disease) is a metabolic disorder characterized by exercise intolerance, myalgia and cramps during exertion. Visiting and Haller recently reported that sucrose ingested pre-exercise alleviates the exercise intolerance, particularly during the early stages of exercise (N Engl J Med 2002;4;793-801). We aimed to compare the exercise capacity of patients of McArdle’s disease after sucrose ingestion to normal individuals.

METHODS: We compared peak oxygen uptake (VO2 peak) and ventilatory threshold (VT) during ramping exercise (10W·min-1) of 10 McArdle’s patients (McA) (11 f, 14m); all with a history of exercise intolerance, muscle spams and urinary exertion of myoglobin; to a control group (C) (8f,12m). In patients, exercise tests were preceded by the ingestion of a 660 ml solution containing 8 g of sucrose per 100 ml.

RESULTS: McA[glucose] increased from 91.8±6.6 (before sucrose ingestion) to 134±4.5 mg/dl immediately before the tests and mean blood lactate levels increased from 0.8±0.1 mmM at rest (before sucrose ingestion) to 1.9±0.8 mmM after exhaustion and end-exercise. BER reached a value of 0.95±0.03, reflecting the occurrence of glucose-based energy production. Subjectively McA reported improved exercise tolerance following sucrose compared to their normal experience. Although considerable individual variability existed in patients’ exercise capacity, the results showed a significantly lower (P<0.01) VO2 peak and VT values in McA vs C (Table 1). The VO2 peak levels of McA women were barely above the limits necessary for independent living, despite the subjectively favorable response to pre-exercise sucrose ingestion.

CONCLUSIONS: The exercise capacity of patients of McA remains severely impaired, even when high levels of blood glucose are available to working muscles, consistent with the effects of deconditioning. The results suggest the potential value of systematic exercise training in this population.

Table 1: Mean (± standard) characteristics of subjects
Variable McArdle’s histopathologic patients (N = 10) Control patients (N = 10) McArdle’s & control patients (N = 15) Male controls (N = 15)
Age (years) 37.2 47.0 47.0 47.0
Height (cm) 163.1 (19) 166.2 (26) 167.2 (21) 165.8 (25)
Mass (kg) 71.4 (16) 62.2 (22) 65.2 (19) 72.6 (26)
Peak power output (W) 41.1 (13) 84.1 (16) 61.1 (19) 46.1 (21)
Peak power output at VT 33.0 (17) 66.2 (24) 52.2 (17) 73.7 (20)

2548 Board #56 3:00 PM - 4:00 PM
Impact of a Beta-Blocking Agent on Exercise Tolerance in Type 2 Diabetic Patients
Nadine Bonneville, Patrice Brassard, Annie Ferland, Lison Fournier, Sara Croteau, Jean Jobin, FACSM, Paul Potier. Centre de Recherche de l’Hôpital Laval, Institut Universitaire de Cardiologie et de Pneumologie, Université Laval, Québec, PQ, Canada.

Patients with type 2 diabetes without cardiovascular complications present exercise intolerance compared to non diabetic subjects. It has been shown that beta-blocking agents reduce exercise tolerance in the latter. However, it is not known if this

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CoNCLUsIoN: These results suggest that the beta-blocking agent alters the cardiorespiratory capacity of children with cancer, even when relatively long time (2 yrs on average) has elapsed after treatment. Their muscle functional capacity tends to be altered, which could affect their capacity to perform physical activities of daily living. The results suggest the need for this population group to engage in programmed exercise training, particularly aerobic training, to achieve full systemic rehabilitation.

Table 1. Comparison of children with bone marrow transplantation (BMT) and controls.

<table>
<thead>
<tr>
<th>Variable</th>
<th>BMT (N = 9)</th>
<th>Controls (N = 13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>11 ± 4</td>
<td>11 ± 4</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>157 ± 23.6</td>
<td>147.8 ± 24.1</td>
</tr>
<tr>
<td>Mass (kg)</td>
<td>44.1 ± 14.9</td>
<td>41.5 ± 15.0</td>
</tr>
<tr>
<td>Transplant type</td>
<td>Allogeneic (n = 4)</td>
<td>Autologous (n = 4)</td>
</tr>
<tr>
<td></td>
<td>Haploidentical</td>
<td></td>
</tr>
<tr>
<td>Disease</td>
<td>Hodgkin lymphoma (n = 2)</td>
<td>Medulloblastoma</td>
</tr>
<tr>
<td></td>
<td>Ewing sarcoma</td>
<td></td>
</tr>
<tr>
<td>Time after BMT (months)</td>
<td>24 ± 29</td>
<td>24 ± 29</td>
</tr>
<tr>
<td>VO2 peak (mL/kg/min)</td>
<td>31.2 ± 10.3</td>
<td>42.4 ± 13.3 *</td>
</tr>
<tr>
<td>Performance during TUDS test (s)</td>
<td>8.0 ± 3.2</td>
<td>6.7 ± 2.7</td>
</tr>
</tbody>
</table>

Abbreviations: ALL (acute lymphoblastic leukemia), AML (acute myeloid leukemia); VO2peak (peak oxygen uptake), Timed Up and Down Stairs test (TUDS). Symbol: *P < 0.05

2551 Board #59 3:00 PM - 4:00 PM
Predicting the Presence of a Positive Coronary Calcium Score From Traditional and Non-Traditional Risk Factors

Clifton L. Greenstone, Stephen Sivo, Joshua Lowndes, Linda Zuckley, Theodore J. Angelopoulos, FACSM, James M. Rippe, FACSM, Rippe Lifestyle Institute, Celebration, FL.

PURPOSE: Coronary calcium (CT-Ca) scores predict rates of cardiovascular events including myocardial infarction. The purpose of this study was to investigate the degree to which positive (≥ 0) CT-Ca scores are determined by the linear composite of independent variables of practical interest and could be readily available in many primary care clinical settings (namely, BMI, CRP, age, and VO2 max).

METHODS: Eighty-nine healthy men (n=74) and women (n=15) without a history of symptomatic coronary heart disease (mean age 53.8 ± 9.0) had their coronary artery disease evaluated as part of a routine annual health assessment program. The assessment consisted of measurement of traditional risk factors, hs-CRP as well as maximal cardiorespiratory fitness (VO2peak). CT-Ca was added at the physician’s request based on intermediate cardiovascular risk (elevated CRP, abnormal lipids, abnormal stress tests, etc.).

RESULTS: Adding age to the analysis of VO2max, CRP and BMI to control for its role with respect to whether a person has CT-Ca >0 reveals that, overall, the fit of the logistic regression model yields significant results (Hosmer and Lemeshow $.77 = 4.66, df = 8, p = .793). Indeed, the composite of the independent variables entered into the logistic regression procedure predicted 24% of the variation in the dichotomized CT-Ca according to the Cox and Snell R²; 32% of the variation, according to the Nagelkerke R².

A review of the b weights for all independent variables suggests that not only does age contribute to the CT-Ca classification, but both the BMI and VO2 max contributed to the logistic equation to a statistically significant degree (see Table 3). So, with age taken into consideration, the contribution of VO2max to CT-Ca classification becomes evident. Overall, the model correctly predicts 69.3% of the observed CT-Ca score classifications (73.5% true negative and 64.4% true positive). Clearly, the predictive accuracy of the model can be improved, but the current model does identify some of the factors which are relevant.

CONCLUSION: These data suggest that CRP, BMI, age and VO2max can be used to predict the likelihood of a patient having a positive CT-Ca score to 64% accuracy. If a score is positive (>0) then the absolute value can be used to predict coronary event risks. Physicians can then use lifestyle measures, medications and further interventions to help modify these identified risks in efforts to prevent coronary related morbidity.
and mortality. More research is needed into what other variables can be added to our current linear regression model to improve our accuracy beyond traditional models like the FRS.

2552 Board #60 4:00 PM - 5:00 PM
Prehabilitation Prior To Knee Arthroplasty Increases Post Surgical Function: A Case Study
Conditioning the body to undergo physical stress is integral in sports. This concept can be applied to conditioning the body prior to stressful events such as joint arthroplasty and is termed prehabilitation.

PURPOSE: The purpose of this case study was to examine the effect of an 8-week prehabilitation intervention on functional ability following total knee arthroplasty (TKA).

METHODS: Two female subjects completed baseline assessments of their functional ability 8 weeks prior to their TKA. Subjects were randomized to either an 8-week prehabilitation intervention designed to increase their strength and range of motion, or a usual care condition. After 8 weeks subjects were re-assessed in the week prior to their TKA. Subjects completed a final assessment of their functional ability 12 weeks after TKA. These assessments of functional ability consisted of the distance covered in a 6-minute walk, the number of times up from a chair in 30-seconds, proprioception and self-reported pain and stiffness using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

RESULTS: Compared to the Control Subject (CS), the data suggests that the 8 weeks of prehabilitation completed by the Exercise Subject (ES) prior her TKA may have had a positive effect on functional outcomes after TKA. The ES exhibited improvement in distance covered during the 6-minute walk (ES: 26% improvement, CS: 2% decline) and greater improvement in number of chair rise repetitions completed in 30-seconds (ES: 44% improvement, CS: 23% improvement). Additionally, knee proprioception improved greater for the ES, compared to the CS (angle reproduction: ES: 267% improvement, CS: 20% improvement; movement detection: ES: 100% improvement, CS: no change from baseline). The ES also reported less pain (ES: 1100% less, CS: 350% less) and less joint stiffness (ES: 100% less, CS: 67% less).

CONCLUSIONS: A prehabilitation intervention designed to increase strength and range of motion appears to result in improved functioning following surgery over usual care among TKA patients. Prehabilitation prior to TKA may contribute to improved recovery after surgery, thus reducing the amount of physical therapy hours.

2553 Board #61 2:00 PM - 3:00 PM
Reduced Functional Capacity of Renal Transplant Recipients as a Major Modifiable Risk Factor in Coronary Artery Disease (CAD) Risk Status
Nicole Morand1, Carol Ewing Garber, FACSM1, Andrew Bostom2, Reginald Gohh1. Northeastern University, Boston, MA. 1Brown Medical School, Providence, RI. Email: morandn@neu.edu

PURPOSE: The purpose of this study was to compare the exercise responses and functional capacity of renal transplant patients to normative predicted values.

METHODS: The subjects of this study were renal transplant patients (RTR) with no contraindications to exercise testing. Subjects underwent a maximal cycle ergometer test, anthropometric measurements, and a health assessment. Heart rate (HR), oxygen uptake (VO2), and minute ventilation (Ve) were measured during exercise. Oxygen pulse (O2P), and body mass index (BMI) were calculated.

RESULTS: The 9 female and 18 male RTR had a mean age of 43±9 years, a BMI 26±9.6, and were > 6 months post transplant. The RTR had a significantly lower HR (153±23.5, p=0.001), O2P (11.5 ± 3.7 mL/bpm; p=0.01), and Ve (59.7±20.6 L/min; p=0.022), compared with normal predicted values (VO2: 33.8±7.2 mL/kg/min, HR: 176±9.6 bpm; O2P: 15.0±7±3.7 mL/bpm; Ve: 76.7±17.8 L/min).

CONCLUSIONS: These results extend previous research in select subjects showing that renal transplant patients have a reduced exercise capacity when compared with the general population. Further work to evaluate methods to improve cardiopulmonary fitness in this high-risk population is needed.

F-27 Free Communication/Poster – Diet or Exercise and Chronic Disease Risk
FRIDAY, JUNE 2, 2006 2:00 PM - 5:00 PM
ROOM: Hall B

2554 Board #62 3:00 PM - 4:00 PM
The Influence of Dietary Fat on HDL-Cholesterol
Bruce Bailey1, Debra K. Sullivan2, Bryan K. Smith3, Joseph E. Donnelly, FACSM1. 1University of Massachusetts Boston, Boston, MA. 2University of Kansas Medical Center, Kansas City, KS. 3University of Kansas, Lawrence, KS. Email: bruce.bailey@umb.edu

A low level of HDL-Cholesterol (HDL-C) is an independent risk factor for cardiovascular disease. Dietary fat consumption may influence HDL-C.

PURPOSE: The purpose of this study was to determine the influence of dietary fat intake on HDL-C.

METHODS: Two hundred and fifty sedentary college students (males n=145, females n=105, age 19±1.1 years) with a BMI between 21-30 kg/m2, were recruited to participate in a 12-week feeding study. Participants were randomly placed into one of three conditions differing in the amount of fat consumed. One condition consumed less than 25% (LOW), another between 28-32% (MOD) and the final condition consumed >35% (HIGH) of calories from fat. Diet was assessed by picture plate waste methods and 24-hour recall procedures. Nutrition Data System for Research was used for all dietary analysis. Blood draws were taken after a 12-hour fast and analyzed for total HDL-C.

RESULTS: Baseline fat consumption was 36±5% of total calories for men and 34±6% for women and did not differ between conditions. Baseline HDL-C was 49±5.9 for men and 59.5±12.0 for women and did not differ between conditions. Over the 12 week period participants in the LOW condition consumed 21±3% of total calories from fat, the MOD condition consumed 31±2% and the HIGH condition consumed 40±3%. Men in the LOW (3.4±8.0 mg/dl) and MOD (3.2±7.0 mg/dl) conditions experienced a significant reduction in HDL-C compared to the HIGH condition (0.2±5.9 mg/dl; p<0.05). HDL-C in women in the HIGH condition increased (2.2±13.3 mg/dl), while women in the MOD (-1.0±4.9 mg/dl) and LOW (-3.2±7.4 mg/dl) conditions decreased. There was no significant difference between conditions for women (p>0.12).

CONCLUSION: These results suggest that reductions in dietary fat consumption may decrease HDL-C in college age men. Although the same conclusions cannot be made for college age women there was a similar trend. Supported by NIH Grant DK58385.

2555 Board #63 4:00 PM - 5:00 PM
Exercise Training, Antioxidant Supplementation and Endothelial Cell Protection
Sue Marsh, Paul Laursen, Betty Pat, Glenda Gobe, Jeff Coombes. The University of Queensland, Brisbane, Australia. Email: smarsh@physiology.uab.edu

Regular exercise is known to have a beneficial effect on endothelial function and prevention of atherosclerosis however the cellular mechanisms underlying the protection remains unclear. Apoptosis induced by oxidative stress has been implicated in atherosclerosis and vascular dysfunction and exercise and/or antioxidant supplementation may provide a beneficial role in cellular protection against this process.

PURPOSE: To examine the efficacy of antioxidant supplementation (α-lipoic acid and α-tocopherol) and/or endurance training on endothelial cell protection.

METHODS: Young male rats were assigned to; 1) sedentary, 2) sedentary and antioxidant supplemented, 3) endurance trained or 4) endurance trained and antioxidant supplemented groups for 14 weeks. Endothelial cells were then isolated from the left ventricle and examined for levels of Bcl-2 protein (a pro-survival protein).

RESULTS: Bcl-2 levels were increased following antioxidant supplementation compared to the control diet (96±5 vs 409±124 arbitrary units, P<0.05) whereas exercise training had no effect (P>0.05) regardless of diet. In vitro administration of α-lipoic acid and α-tocopherol to cultured rat microvascular endothelial cells did not cause any change in Bcl-2, Bax, HSP70, pERK or cell viability (P>0.05). However, α-lipoic acid caused a dose-dependent increase in caspase-3 activity; activity following addition of 1µM α-lipoic acid was significantly higher than the vehicle (0.78±0.10 vs 0.25±0.02 µmol/min/ml respectively, P<0.05) with no subsequent increase in DNA fragmentation (P>0.05). α-tocopherol had no effect on either caspase-3 activity or cell viability.

CONCLUSION: Dietary supplementation with α-lipoic acid and α-tocopherol but not exercise training upregulates cytoprotective proteins in endothelial cells in vivo. These effects are not evident in vitro but the increase in caspase-3 activity at higher concentrations of α-lipoic acid may indicate a need for caution in the use of high doses of this antioxidant.
Pre-PPL 1580.5 ± 184.3, and Post-PPL 1168.1 ± 115.0. There was no significant main effect of exercise or condition on PPL.

**Methods:**

Thirty-two male Sprague-Dawley rats were randomly divided into the following four groups: 1) control (C, n=8), 2) exhaustive exercise (E, n=8), 3) oolong tea (O, n=8), 4) oolong tea-exhaustive exercise (O-E, n=8). The amount of oolong tea supplementation was 0.5 g/d for four weeks. The exhaustive exercise started at 10% grade, 15 min/m for 10 min followed by gradual increases of treadmill speed and times as 25 min/m for 40 min, 28 min/m for 20 min, 31 min/m for 20 min, 34 min/m for 20 min, 37 min/m for 20 min, until exhaustive. Two-way ANOVA was performed to examine the effects of exhaustive exercise and oolong tea supplementation on MDA, SOD, and GPX activities.

**Results:** Exercised duration in E and O-E groups were 69.39±17.1 and 61.21±10.11 minutes, respectively. The results showed that MDA in the exhaustive exercise rat muscle (6.24 ± 0.72 µmol/g protein) was significantly higher (p< 0.05) than C group (2.96 ± 0.75 µmol/g protein). O group (2.92 ± 0.50 µmol/g protein) and O-E group (3.95 ± 0.78 µmol/g protein). SOD activity in exhaustive exercise group (1.02 ± 0.11 U/mg protein) was significantly higher (p< 0.05) than non-exhaustive exercise group (0.95 ± 0.11 U/mg protein). GPX activity of rat muscle in exhaustive exercise group (363.11 ± 0.23 U/g protein) was significantly higher (p< 0.05) than non-exhaustive exercise group (595 ± 0.07 U/mg protein), while SOD activity in Oolong tea supplemental group (1.03 ± 0.11 U/g protein) was valid significantly higher (p< 0.05) than non-Oolong tea supplemental (959 ± 0.06 U/mg protein). Moreover, GPX activity of rat muscle in exhaustive exercise group was significantly higher (p< 0.05) than non-exhaustive exercise group (440.86 ± 0.70 U/mg protein), while GPX activity in Oolong tea supplemental group (629.15 ± 17.97 U/mg protein) was significant higher (p< 0.05) than non-Oolong tea supplemental group (444.82 ± 31.68 U/mg protein). CONCLUSION: It is concluded that exhaustive exercise could result in oxidative stress. However, oolong tea supplementation is beneficial to decrease oxidative stress and increase antioxidant status.

Supported by NSC grant 92-2413-H-134-013
utilization with exercise between the lean and obese participants. Acute exercise can improve postprandial lipemic responses and may also be influential in improving postprandial glucose and insulin responses following a large meal in both lean and obese populations.

This study was supported by the John Peter Smith Sports Fellowship Program.

2560 Board #68 3:00 PM - 4:00 PM
The Influence of Exercise and Dietary Fat Composition on Postprandial Triacylglycerol Concentrations in Healthy Women
Chihoike Ueda1, Stephen F. Burns2, Masashi Miyashita3, David J. Stensel4, Tokyo Medical University, Tokyo, Japan; 4.Loughborough University, Loughborough, United Kingdom.

Email: sensus@hotmail.com

Triacylglycerol concentrations [TAG] are lower after consumption of meals high in monounsaturated fat than after meals high in saturated fat. Prior exercise is also effective in lowering postprandial [TAG]. Thus, the optimal strategy for reducing postprandial [TAG] may be to exercise regularly and to consume monounsaturated rather than saturated fats.

PURPOSE: To examine the combined effects of exercise and fat composition on postprandial [TAG].

METHODS: Five healthy females (age 26.0 ± 3.7 yr, ht 1.63 ± 0.04 m, body mass 56.2 ± 5.1 kg, mean ± SD) completed four, 2-d trials in randomised order: olive oil-exercise, butter-exercise, olive oil-no exercise, butter-no exercise. Each trial was conducted during the follicular phase of the menstrual cycle under standardised dietary conditions. For the exercise trials participants walked/run on a treadmill for 60 min at 60% of maximum oxygen uptake on the afternoon of day 1. On the no-exercise trials participants rested on day 1. On the morning of day 2 participants reported to the lab after an overnight fast and finger prick blood samples were obtained in the fasted state. Participants were asked to control their physical activity levels and diet before each trial. Data were assessed using Student’s t-test for correlated means.

RESULTS: Olive oil-exercise vs butter-exercise significantly decreased [TAG] on the exercise-olive oil manipulation of diet and exercise.

CONCLUSION: These initial data from an ongoing study reveal no difference in plasma [TAG] following manipulation of diet and exercise. However, the trend for lower plasma [TAG] on the exercise-olive oil intervention suggests that further study is warranted.

Figure: Six-hour area under the curve values for plasma [TAG] over time (mean ± SEM).

2561 Board #69 4:00 PM - 5:00 PM
A Bout of Repeated Short Sprints Reduces Postprandial Triacylglycerol Concentrations in Young Men
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PURPOSE: To investigate the acute effects of an exercise session involving repeated short sprints on postprandial triacylglycerol concentrations.

METHODS: Twelve male volunteers (age 22.1 (0.4) yrs, body mass index 25.8 (1.9); body weight 60% of maximum oxygen uptake on the afternoon of day 1. On the no-exercise trials participants rested on day 1. On the morning of day 2 participants reported to the lab after an overnight fast and finger prick blood samples were obtained in the fasted state. Participants then ingested a test meal (1.25 g fat, 1.07 g carbohydrate, 0.20 g protein, and 67 kJ/kg body mass) and a campesterol-containing breakfast beverage was consumed. PPL was measured after consuming a high-fat meal (HFM) containing 1.5 g fat (88% of calories), 0.05g protein, and 0.4g carbohydrate per kg body weight. PPL was measured in four randomized trials with the HFM: baseline (BL), after 1 day exercise (1X), after the third of three consecutive day exercises (3X), and after the fifth of five consecutive days exercise (5X). For the 3X and 5X trials, consecutive exercise sessions were spaced 22-26hrs apart from other acute sessions within respective trials. Physical activity was restricted 48hrs preceding BL and before initiating exercise for 1X, 3X, and 5X. A dietary-centred intervention was implemented before the HFM including a 12h overnight dietary fast. All exercise sessions were treadmill jogging for 60min at 60% individual VO2max. All trials were performed in the luteal phase of the menstrual cycle. To measure PPL response, blood was collected after a 12h fast immediately before the HFM (0h), and at 2, 4, 6, and 8h post-HFM.

RESULTS: Fasting plasma triglycerides (TG) significantly decreased after 3X and 5X compared to BL, and 1X was not different from BL. Fasting total cholesterol and high-density lipoprotein cholesterol and its subfractions were not different compared to BL or among exercise trials. All exercise trials significantly attenuated TG total area under the curve (AUC) compared to BL and 5X further lowered AUC, significantly compared to 1X. Compared to BL, 1X, 3X, and 5X reduced AUC, 21.5%, 28.7%, and 34.6%, respectively. All exercise trials significantly decreased TG incremental area under the curve compared to BL with no difference among exercise trials. 1X, 3X, and 5X decreased AUC, 53.6%, 57.4%, and 56.7%, respectively compared to BL. TG total peak (Peak,) and incremental peak (Peak,) were significantly reduced with 3X and 5X compared to BL. 1X was not different than BL. TG Peak, and Peak, decreased with exercise ranging from 19.4 to 44.1%, with no differences among exercise trials.

CONCLUSIONS: Our data suggests that exercise performed over consecutive days attenuated PPL without changing TC and HDL-C or its subfractions in females. In addition, this study indicates that consecutive exercise sessions accumulate and further decrease PPL beyond the effect caused only by the most recent exercise session. This study was supported by a Faculty Research Grant from Missouri State University.

2562 Board #70 2:00 PM - 3:00 PM
Consecutive Days of Exercise Accumulate and Further Decrease Postprandial Lipemia
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PURPOSE: The purpose of this study was to compare postprandial lipemia (PPL) response after a single session and after consecutive days of aerobic exercise.

METHODS: Nine, recreationally-trained eumenorrheic, female volunteers age 24±1.6 years (mean±SD) and mean VO2max of 43.8±1.3 ml·kg·min-1 were studied. PPL was measured after consuming a high-fat meal (HFM) containing 1.5 g fat (88% of calories), 0.05g protein, and 0.4g carbohydrate per kg body weight. PPL was measured in four randomized trials with the HFM: baseline (BL), after 1 day exercise (1X), after the third of three consecutive day exercises (3X), and after the fifth of five consecutive days exercise (5X). For the 3X and 5X trials, consecutive exercise sessions were spaced 22-26hrs apart from other acute sessions within respective trials. Physical activity was restricted 48hrs preceding BL and before initiating exercise for 1X, 3X, and 5X. A dietary-centred intervention was implemented before the HFM including a 12h overnight dietary fast. All exercise sessions were treadmill jogging for 60min at 60% individual VO2max. All trials were performed in the luteal phase of the menstrual cycle. To measure PPL response, blood was collected after a 12h fast immediately before the HFM (0h), and at 2, 4, 6, and 8h post-HFM.

RESULTS: Fasting plasma triglycerides (TG) significantly decreased after 3X and 5X compared to BL, and 1X was not different from BL. Fasting total cholesterol and high-density lipoprotein cholesterol and its subfractions were not different compared to BL or among exercise trials. All exercise trials significantly attenuated TG total area under the curve (AUC) compared to BL and 5X further lowered AUC, significantly compared to 1X. Compared to BL, 1X, 3X, and 5X reduced AUC, 21.5%, 28.7%, and 34.6%, respectively. All exercise trials significantly decreased TG incremental area under the curve compared to BL with no difference among exercise trials. 1X, 3X, and 5X significantly decreased AUC, 53.6%, 57.4%, and 56.7%, respectively compared to BL. TG total peak (Peak,) and incremental peak (Peak,) were significantly reduced with 3X and 5X compared to BL. 1X was not different than BL. TG Peak, and Peak, decreased with exercise ranging from 19.4 to 44.1%, with no differences among exercise trials.

CONCLUSIONS: Our data suggests that exercise performed over consecutive days attenuated PPL without changing TC and HDL-C or its subfractions in females. In addition, this study indicates that consecutive exercise sessions accumulate and further decrease PPL beyond the effect caused only by the most recent exercise session. This study was supported by a Faculty Research Grant from Missouri State University.

2563 Board #71 3:00 PM - 4:00 PM
Effect of Endurance Exercise Training on Markers of Cholesterol Absorption and Synthesis
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Recent studies have shown that circulating levels of plant sterols (campesterol and sitosterol) are markers of cholesterol absorption, while lathosterol, a precursor in the cholesterol synthetic pathway, is a marker for whole body cholesterol synthesis. Endurance exercise training is known to have favorable effects on plasma cholesterol levels, but it is not known if this is mediated in part by changes in rates of cholesterol absorption or synthesis. To examine this, we measured circulating levels of campesterol, sitosterol, and lathosterol by GC/mass spectroscopy from plasma samples of 30 sedentary subjects (20 women, 10 men, average age ~ 59) before and after 6 months of endurance exercise training. There was no change in sitosterol or lathosterol levels in response to the exercise training intervention. However, there was a trend for an increase in plasma campesterol levels of 20% following the intervention (p = 0.09). Other changes in lipids included the following: there was no change in total or LDL-C levels in response to the exercise intervention; however, HDL-C and the
HDL-C subtraction increased 4.0 mg/dl and 2.2 mg/dl, respectively (p<0.01), and total triglyceride levels decreased by 20 mg/dl (p<0.001). The increase in plasma campesterol indicates that endurance exercise training may have a significant impact on rates of cholesterol absorption. Reduced levels of cholesterol absorption have been linked to the development of the “metabolic syndrome.” As a result, this exercise-induced increase in campesterol levels may suggest a previously unrecognized benefit of exercise training on cholesterol metabolism.

2564 Board #72
4:00 PM - 5:00 PM
Effects of Continuous versus Intermittent Activity Patterns on Postprandial Triacylglycerol Concentrations
Masashi Miyashita, Stephen F. Burns, David J. Stensel. Loughborough University, School of Sport and Exercise Sciences, Loughborough, United Kingdom. (Sponsor: Professor Roland Maughan, FACSM)
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Physical activity guidelines state that health benefits may be gained by accumulating physical activity but a minimum duration of 10 min is recommended for each activity bout. Whether accumulating short (~10 min) bouts of physical activity is beneficial to health remains unclear. PURPOSE: To compare the effects of accumulating ten, three-min bouts of exercise versus one, 30-min bout of exercise on postprandial plasma TAG concentrations.

METHODS: Ten male subjects, aged 25 ± 1 yrs (mean ± SE), completed three, 2-d trials (at least 1 wk apart in a randomized, repeated measures design). On day 1, subjects rested (no exercise) or ran at 70% of maximum oxygen uptake in either ten, three-min bouts (30 min rest between each), or one continuous 30 min-bout. On day 2, after a 10 h overnight fast, subjects rested and consumed test meals (0.69 g fat, 0.95 g carbohydrates, 0.31 g protein, and 46 kin/kg body mass) for breakfast and lunch. Venous blood samples were collected in the fasted state and for 7 h postprandially on day 2.

RESULTS: Postprandial plasma TAG concentrations were significantly lower on the accumulated and continuous trials in comparison to the control trial (two-way ANOVA, main effect of trial, P<0.001). Seven-hour area under the curve values for plasma TAG were significantly lower on the accumulated and continuous trials in comparison to the control trial: accumulated 12.35 ± 2.24 mmol/L, continuous 12.82 ± 2.26 mmol/L, control 13.96 ± 3.09 mmol/L (one-way ANOVA, F<0.001).

CONCLUSIONS: In healthy young men, postprandial plasma TAG concentration is reduced to a similar extent when ten, three-min bouts of exercise are performed during the course of a day in comparison to one continuous 30-min bout of exercise.

2565 Board #73
2:00 PM - 3:00 PM
Cardiovascular Disease Risk in Collegiate Football: Overweight, Obese, but Healthy
Scott D. Zimmermann,1 Thomas S. Altena,1 Cynthia J. Heiss,1 Jessica Mellor,1 J. Dirk Nelson,1 Brian Hughes,2 Jill D. Tracy.1 (1)Missouri State University, Springfield, MO. 2 Central Missouri State University, Warrensburg, MO. (Sponsor: Benjamin F. Timson, FACSM)
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PURPOSE: The purpose of this study was to determine if there is an association between body mass index (BMI) and body composition with fasting lipids and cardiovascular disease risk factors in collegiate football athletes. To determine if 12 weeks of endurance (ET), resistance (RT), or combined (CT = ET + RT) training differentially affects apo-A1, apo-B, and the ratio of total triglycerides to HDL cholesterol (TAG/ HDL-C) in young, healthy men.

METHODS: Participants included 83 male volunteers involved in collegiate football aged 20 ± 0.15 yrs (mean ± SE) representing three competitive levels (NCAA divisions I and II, and NAIA). During the spring practice season, data were collected in the early morning hours after an overnight fast. Height and weight were measured, BMI was calculated, and body composition was assessed via three-site skin folds (SF) using standardized methods. Plasma was assayed for total cholesterol (TC), triglycerides (TG), total high-density lipoprotein cholesterol (HDLTotal-C) and subfractions HDL2-C and HDL3-C. Very low density lipoprotein cholesterol (VLDL-C) and low-density lipoprotein cholesterol (LDL-C) were calculated using the Friedewald equation. All plasma variables are reported as mg/dl.

RESULTS: Mean body weight, BMI, and SS were 104.3 ± 2.2 kg, 30.8 ± 0.6, and 60.6 ± 1.2, respectively. According to BMI, 51.7% of athletes were obese (>29.9), 17.5 ± 0.8, respectively. According to BMI, 51.7% of athletes were obese (>29.9), and 34.4 ± 0.5, respectively. Mean body weight, BMI, and SS were not different among the three athlete groups. Mean plasma TG and TC were 108.8 ± 11.2 and 148.6 ± 3.3, respectively. HDL-C, LDL-C and HDL3-C were 60.6 ± 1.2, 26.5 ± 1.0, and 34.4 ± 0.5, respectively. Mean LDLC and LDL-C were 21.4 ± 2.2 and 67.0 ± 4.1, respectively. We found weak, but significant, positive correlations between BMI and TC (r = 0.295, p<0.007) and BMI and LDL-C (r = 0.295, p<0.007). Similarly, weak, but significant positive correlations occurred between SS and TC (r = 0.225, p<0.015) and SS and LDL-C (r = 0.267, p<0.015). There were no additional significant correlations between blood lipids and BMI or SS. HDL2-C and LDL-C of NCAA division I athletes were 19.5% (p=0.042) and 35.0% (p=0.001) higher, respectively, than the NAIA athletes. In addition, NAIA athletes had significantly lower TC than NCAA divisions I and II by 20.0% (p<0.001) and 16.7% (p=0.007), respectively.

CONCLUSIONS: The present data suggest that collegiate football athletes have healthy plasma TG and lipoproteins with high HDLTotal-C despite the majority classified obese according to BMI. Lipoprotein differences discovered among NAIA and NCAA division I and II divisions may reflect different expectations or genetic backgrounds of athletes recruited for their respective athletic division. Our data suggest low incidence of dyslipidemia with collegiate football, and that the deleterious effects of overweight and obese are minimized with large volumes of exercise.
NOTICE: A series of multiple bouts of Resistance Exercise on Postprandial Triacylglycerol Concentrations

Stephen F. Burns, Chihoko Ueda, David J. Stensel. Loughborough University, School of Sport & Exercise Sciences, Leics, United Kingdom. (Sponsor: Professor Ron Maughan, FACSM)

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Studies have consistently shown that an acute bout of aerobic exercise lowers postprandial triacylglycerol (TAG) concentrations but findings for resistance exercise have been inconsistent and the evidence is inconclusive. This is possibly because the energy expenditure elicited in an acute bout of resistance exercise is typically lower than that elicited during aerobic exercise. One way to increase the energy expenditure of resistance exercise is to perform multiple bouts over the course of a day.

PURPOSE: To examine the effect of multiple bouts of resistance exercise performed throughout a single day on postprandial TAG concentrations.

METHODS: Following University Ethical Advisory Committee approval, 14 healthy males (age 25.4 ± 3.3 years, height 1.76 ± 0.06 m, body mass 73.1 ± 10.0 kg, mean ± SD) volunteered to complete two, 2-d trials, exercise and control, one-week apart. The order of the trials was randomised and balanced. On day one of the exercise trial participants performed five, 45-min bouts of weight lifting. Each bout consisted of 4 sets of 5 repetitions of 5 different exercises at 30–40% of one repetition maximum. There was a 15 min rest interval after the first two bouts, a 105 min lunch break after the third bout and a 15 min rest interval between the fourth and fifth bout. On day one of the control trial participants were inactive. On day two of each trial participants reported to the laboratory in the morning after an overnight fast. A cannula was inserted into an antecubital vein and a baseline blood sample was obtained. Participants then consumed a test meal (0.89 g fat, 1.23 g carbohydrate, 0.4 g protein, 60 kcal per kg body mass). Further blood samples were obtained at hourly intervals for 6 h for the determination of plasma TAG concentration.

RESULTS: Mean (±SD) area under the curve values for total TAG concentration on the control and exercise trials were as follows: control 10.22 ± 4.23 mmol·6h·L⁻¹, exercise 8.93 ± 3.67 mmol·6h·L⁻¹. These differences did not reach statistical significance (P=0.139, Student’s t-test for correlated data). The total area under the 6-h plasma TAG concentration versus time curve was higher in ten out of sixteen participants on the exercise compared with the control trial. Of the remaining four participants, area under the curve values were similar between trials in two cases and higher on the exercise trial in two cases.

CONCLUSION: These data suggest that multiple bouts of resistance exercise may have the potential to reduce plasma TAG concentrations but further data are required to confirm this.
Conclusions: Exercise-induced negative energy balance resulted in a hierarchy of temporal changes within the IGF-I system (IGFBP-1 > IGF-I > IGFBP-3). With a moderate, exercise induced energy deficit of 1.000 kcal·d⁻¹, increasing dietary protein (0.9 vs. 1.8 g·kg⁻¹ body mass) beyond adequate levels does not appear to affect the loss of lean body mass or attenuate alterations in the IGF-I system. 

Board #80 3:00 PM - 4:00 PM

Adrenergic Influence on the Hormonal Response to Exercise in Endurance Trained Men

Anthony C. Hackney, FACSM¹, Akio Vinu², M. Vinu³, K. Karelson⁴, T. Janson⁵, K. Siim⁶, K. Fischer⁷.¹Univ. of North Carolina, Chapel Hill, NC. ²University of Tartu, Tartu, Estonia.

Exercise and competitive situations can provoke tremendous adrenergic responses. How these responses influence and impact upon the endocrine system is poorly understood.

PURPOSE: This study evaluated the influence of adrenergic factors on the hormonal responses to maximal exercise in endurance trained men. This was achieved by testing young healthy men during exercise in conditions of—adrenergic blockade and in well-controlled competition situations which stimulated sympatho-adrenal activity.

METHODS: Subjects (n=7) performed maximal exercise to exhaustion on a treadmill during four conditions administered in random order: (1) control-placebo, (2) after administration of 80 mg propranolol, (3) in a simulated competition after a placebo intake, and (4) in a simulated competition after propranolol intake. Blood samples were obtained before (pre-) and three min post-exercise and assayed for select hormones (cortisol [C], growth hormone [GH], testosterone [T]). The data were analyzed with a multi-factorial repeated measures ANOVA procedure.

RESULTS: All β-adrenergic blockade and competition situations caused augmented post-exercise responses (25-45%) as compared to control placebo condition (p<0.01). Interestingly, the competition resulted in the greater post-exercise C responses than control-placebo or even in the β-blockage conditions (p<0.05); perhaps, due to enhanced subject motivation. GH and T post-exercise responses were slightly, but significantly, higher in the β-adrenergic blockade conditions than either placebo conditions (p<0.05).

CONCLUSION: These results suggest that central adrenergic influences perhaps restrict the C, GH and T responses to maximal exercise. However, with respect to C, the heightened C responses in enhanced an activation of the sympatho-adrenal system responses which overides the potential adrenegic inhibition.

Board #81 4:00 PM - 5:00 PM

Effect of Protein Intake on IGF-I System Responses to a 7-Day Exercise-Induced Negative Energy Balance

Kevin R. Barick, Matthew A. Pikosky, Andrew J. Young, FACSM, Ann Grediagin, Tracey J. Smith, Jeffery S. Staab, Joseph A. Ryan D. Russell, D. Enette Larson-Meyer, FACSM.¹, ²LSU, Baton Rouge, LA. ³Pennington Biomedical Research Center, Baton Rouge, LA. ⁴University of Wyoming, Laramie, WY.

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Decreased daily activity and increased body weight are often associated with estrogen deficiency following menopause. We used a surgical ovariecctomy mouse model to mimic menopause and investigated if estrogen or the estrogen analog, tamoxifen, could reverse these detrimental effects.

PURPOSE: To determine the effects of ovarian hormone removal and replacement on voluntary wheel running and body weight.

METHODS: Adult C37BL/6 mice (10 wk old) were randomly selected to one of three groups: (1) sham-operated controls (SHAM, n=6) (2) ovarioctomized with placebo replacement (O VX, n=5) (3) ovarioctomized with 17β-estradiol replacement (OVX-E2, n=4). One week post-surgery, each mouse was allowed free access to an exercise wheel in their home cage. After 4 wk of free running, placebo or 17β-estradiol time-release pellets were implanted subcutaneously and the mice ran an additional 4 wk. The average distance run per 24 hr of weekly body weight and total wheel activity were measured. Anova. A second study followed. The design was similar to that of the first study except that immediately following ovarioctomies, mice were implanted with placebo, 17β-estradiol, or tamoxifen time-release pellets.

RESULTS: After the initial 4 wk, OVX mice had 21% greater body weights (26.6 ± 0.6 vs 22.0 ± 0.7 g, P<0.001) and voluntarily ran 86% less (1.3 ± 0.3 vs 9.4 ± 0.6 km, P<0.001) compared with SHAM mice. Estradiol replacement reverted the inactivity as the OVX-E2 mice increased their voluntary running to 6.9 ± 1.5 km, equivalent to SHAM mice (8.6 ± 0.6 km) while the OVX mice receiving placebo ran only 0.5 ± 0.2 km per 24 hr (P=0.01) during the 4 wk following implantation. OVX-E2 mice tended to maintain body weight while the OVX mice continued to increase body weight after implantation (25.2 ± 6.0 vs 30.9 ± 2.2 g, P=0.006). In the second study we found that tamoxifen acted as an estrogen-like compound as ovarioctomized mice that received it had high running activity relative to mice receiving placebo (9.1 ± 0.8 vs 3.3 ± 0.3, P<0.001).

CONCLUSION: These results demonstrate that the removal of ovarian hormones causes mice to become less active and gain body weight. Hormone replacement in the form of estradiol or tamoxifen stimulated voluntary wheel running and reversed the weight gain. Tamoxifen acts as an estrogen agonist in some tissue and as an antagonist in other tissue; these data suggest that tamoxifen is an agonist in skeletal muscle and areas of the brain controlling physical activity.

Supported by NIH Grant AG20990.
Susceptibility to Energy-Related Menstrual Disturbances is Reduced with Increased Age
Brandy Weller, Ann Albert, Matthew Johnson, Nancy Williams, FACSMM. Pennsylvania State University, University Park, PA.

PURPOSE: Although energy deficiency is known to disrupt reproductive function in exercising women, no studies have examined whether the susceptibility to menstrual disturbances is altered with increased age. Therefore, the purpose of this study was to determine whether increased age is associated with reduced susceptibility to menstrual disturbances caused by chronic energy deficiency.

METHODS: A subset of twenty-four premenopausal women (12 young and 12 middle aged) from a larger study were matched according to the amount weight lost during a three month diet and exercise intervention. Menstrual status was assessed with daily urine samples and measurement of estrogen (E1G) and progesterone (PgG) conjugates using ELISA. The occurrence of menstrual disturbances, i.e., short luteal phases, inadequate luteal phases, oligomenorrheic cycles, and anovulatory cycles was quantified according to the number of defects/number of cycles observed. Independent samples t-tests were conducted to determine if there was a significant difference between younger and older women in the occurrence of menstrual disturbances.

RESULTS: The results are shown below:

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Menopausal Age</th>
<th>Occurrence of Defects</th>
<th>Weight Loss</th>
<th>% Energy Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young</td>
<td>3.0 ± 0.2</td>
<td>0.92 ± 2.02</td>
<td>4.6 ± 1.4</td>
<td>20.0 ± 17.2</td>
</tr>
<tr>
<td>Middle</td>
<td>2.1 ± 0.4</td>
<td>0.58 ± 0.90</td>
<td>4.6 ± 1.4</td>
<td>37.7 ± 11.3</td>
</tr>
</tbody>
</table>

CONCLUSIONS: Older age was associated with significantly fewer disturbances in response to weight loss resulting from a diet and exercise intervention. These results suggest that factors associated with increased age confer protection against menstrual disturbances caused by energy deficiency.

Board #84
F-29

The Influence of Endurance Training on Multiple Sprint Cycling Performance
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PURPOSE: The aims of the present study were to examine the effects of endurance training on multiple sprint cycling performance and to evaluate the influence of training duration on the magnitude of those effects.

METHODS: Twenty-one physically active male university students were randomly assigned to either an experimental (n = 12) or a control (n = 9) group. The experimental group cycled for 20 minutes each day, three times per week, for six weeks at 70% of the power output required to elicit maximal oxygen uptake (VO2max). Multiple sprint performance was assessed using two maximal (20 x 5 s) sprint cycling tests with contrasting recovery periods (10 s or 30 s). All tests were conducted on a friction-braked cycle ergometer. The effects of endurance training on the various indices of multiple sprint performance were determined using one-way analysis of covariance.

RESULTS: Relative to controls, training resulted in a 0.2 L.min⁻¹ increase in mean VO2 (95% likely range: -0.04 to 0.44 L.min⁻¹). Changes in anaerobic capacity (determined by maximal accumulated oxygen deficit) over the same period were trivial. After training, the experimental group showed substantial improvements, relative to controls, in multiple sprint measures of maximum and mean power output (range: 29 to 52 W). In contrast, reductions in fatigue were trivial (range: -0.6 to -1.5%).

CONCLUSIONS: Six weeks of endurance training resulted in substantial improvements in multiple sprint cycling performance, the magnitude of the improvements being largely unaffected by the duration of the intervening recovery periods.

Board #86
F-29
variables between treadmill and deep water running.

RESULTS: HR, VE, VO₂ max were all significantly lower (p < 0.01) in deep water running than treadmill running. Conversely, RER was significantly higher (p < 0.05) in deep water running than treadmill running.

CONCLUSIONS: This study suggests that deep water running does not elicit the same physiological response as treadmill running for middle aged men exercising at a predetermined RPE. This provides further evidence that exercise mode influences exercise mode efficiency at a predetermined RPE’s. Therefore, higher RPE’s may be required when using water based running as a substitute for treadmill exercise.

2580 Board #88 2:00 PM - 3:00 PM
Metabolic and Performance Profile of Pacing at Peak VO₂ Velocity
Elias Zacharogiannis, Georgios Parassidis, Stavros Tziortzis, Athanasia Smirniotou. University of Athens, Athens, Greece.

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The vast majority of the published studies relative to running endurance performance have in depth described physiological characteristics of the runners, training responses, ergogenic aids, environmental influence and even shoes and running surface impact on running ability. Since the initial study of Robinson et al (1958) there have been few systematic studies to determine how various pacing (CP) strategies influence the outcome of high intensity running. It is proposed that even pacing is the preferred strategy to optimizing performance. Word record runs for the 5km, 10km and the marathon (data from IAAF) were performed with even pacing. There are no systematically collected data regarding the effect of different pacing strategies on performance of 5-10 min maximal exercise duration.

PURPOSE: The aim of this study was to investigate the effect of pacing strategies at peak VO₂ velocity on performance and selected metabolic parameters.

METHODS: Trained subjects (n=12) performed an incremental test to determine vVO₂ max and a maximal run at vVO₂ max at least 48 hours after. In a random order two days after vVO₂ max tests subjects performed the second or third maximal runs. Second trial started with 1km.h⁻¹ faster than vVO₂ max velocity (+1vVO₂ max) for half of the duration of the vVO₂ max trial with the rest of the test 1km.h⁻¹ slower than vVO₂ max velocity. The third pacing trial started 1km.h⁻¹ slower than vVO₂ max velocity (-1vVO₂ max) for half of the duration of the vVO₂ max trial with the rest of the test 1km.h⁻¹ faster than vVO₂ max velocity.

RESULTS: Repeated measures ANOVA showed that +1vVO₂ max pacing strategy produced significantly longer distance (2654±1660m) (p=0.05) compared with 2001 ±839.63 and 1975.83±791.22 for vVO₂ max and -vVO₂ max. Post exercise blood lactate concentration was lower (p<0.05) after +1vVO₂ max (14,41±3,51mmol. 1⁻¹) compared with -1vVO₂ max (16,16±3,52) and vVO₂ max (16,78±3,53). Accumulated oxygen deficit (AOD) was also lower during +1vVO₂ max (30,92±8,39ml.kg⁻¹) compared with -1vVO₂ max (40,36±10,86).

CONCLUSIONS: The results of this study indicate that the duration of maximal effort varies between 5 and 12 min uneven fast pace at the initial stages of exercise will produce better performance (longer distances and exercising time). There are also indications that anaerobic metabolism overall is less stressed with an early slightly fast pacing and that decreased metabolic acidosis may explain improved performance.

2581 Board #89 3:00 PM - 4:00 PM
Differential Response to Aerobic Endurance Training at Different Intensities
Jan Helgerud, Kjetil L. Hoydal, Eivind Wang, Trine Karlsen, Pål R. Berg, Mats Bjerkaas, Thomas Simonsen, Cecilie S. Helgesen, Nina L. Hjorth, Ragnhild Bach, Jan Hoff. Norwegian University of Science and Technology, Faculty of Medicine, Trondheim, Norway.

Email: Jan.Helgerud@ntnu.no

PURPOSE: The purpose of the present study was to compare the effects of aerobic endurance training at different intensities and with different methods based for total work and frequency. Responses in maximal oxygen uptake including the stroke volume (SV) of the heart, lactate threshold, and running economy (CVO₂ min) were analysed. Since we found an inverse relationship between the outcome of high intensity running. It is proposed that even pacing is the preferred strategy to optimizing performance. Word record runs for the 5km, 10km and the marathon (data from IAAF) were performed with even pacing.

METHODS: Forty healthy, non-smoking, moderately-trained male students were trained subjects (n=12) performed an incremental test to determine vVO₂ max, HR and VE. All groups trained 3 d per week for 8 weeks. The training stimulus has not been assessed. Aerobic training response. However, the utility of HRV in optimizing day-to-day training stimulus has not been assessed.

RESULTS: only 2 out of 15 subjects could keep their CV velocity for 20 mins ( mean duration 14±4mins), whereas all the subjects maintained CP for 20 mins during the test. Under CV intensity, VO₂, VE, HR, [La] didn't reach steady state and VCO₂ was not different at different time points. On the other hand, VO₂, VCO₂ didn't change with time in CP; however, there were significant differences in VE, [La] and HR between time points.

CONCLUSIONS: our findings in this study indicated that CP of indoor rowing can be maintained over 20 mins, whereas CV can not. Moreover, interestingly, rowing at CP and CV don’t induce stable physiological responses during exercise. Therefore, linear-model-derived CV and CP are not theoretically steady-state intensities in indoor rowing.

2583 Board #91 2:00 PM - 3:00 PM
Aerobic Training Guided Individually by Daily Heart Rate Variability Measurements
Antti M. Kivimäenla,1 Arto J. Hautala,1 Hanna Kinnunen,2 Mikko P. Tulppo.1 Merikoski Rehabilitation and Research Centre, Oulu, Finland.2 Polar Electon, Kempele, Finland.

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Vagally mediated heart rate variability (HRV) is an important determinant of individual aerobic training response. However, the utility of HRV in optimizing day-to-day training stimulus has not been assessed.

PURPOSE: We tested the hypothesis that individual training program, which is based on daily HRV measurement, may result in higher improvement in aerobic fitness than standard training program.

METHODS: Twenty-five healthy male (age: 33±7 years, VO₂ max: 4.33±0.40 l/min, 55±4 ml/kg/min) participated in the study. Subjects were divided into standard training group (ST, n=8), HRV guided training group (HRV, n=9) and control group (n=8).

Five-week aerobic training period consisted of running sessions lasting 40-min each at either low or high intensity level, 65% and 85% of maximal heart rate, respectively. ST-group trained on 6 days per week including 2 sessions at low and 4 sessions at high intensity. Individual training for HRV-group was based on the changes in vagally mediated high frequency oscillation of R-R intervals (HF, 0.15-0.4 Hz) measured every 5 minutes during exercise. Individual training for ST-group was based on the changes in time points and HR, respectively. In HRV-group, significant increases were observed in both time to
CONCLUSION: Aerobic fitness can be improved effectively by using the magnitude of cardiac vagal outflow as a determinant of aerobic training prescription on a daily basis. HRV measurements provide a powerful tool for individual optimizing of aerobic training.

2584 Board #92 3:00 PM - 4:00 PM The Effect of Five Weeks of Floor Exercises on Endurance Capabilities of the Trunk Musculature Dana R. Johansen, Brian E. Udemarn, FACSM, Christopher J. Durall, University of Wisconsin-La Crosse, La Crosse, WI. Email: johansen.dana@students.uwlax.edu

Low back pain continues to place a significant strain on the health care systems of industrialized societies. Lumbar endurance is a physiological test to evaluate the potential effectiveness of floor exercises as a tool to improve the endurance capacity of the lumbar region. The purpose of this investigation was to examine the effect of a five-week floor exercises intervention on the lumbar endurance of collegiate female athletes.

METHODS: Thirty-five collegiate females (19 treatment group, 16 control group) volunteered for this study. The treatment group consisted of Division III varsity gymnasts at an upper-Midwestern university. The control group consisted of non-varsity athletes. All participants completed pre and post-training trunk endurance tests consisting of the Biering-Sorensen test (for trunk extensors), a static flexion test (for trunk flexors), and left and right side bridge static holds (for trunk lateral flexors). Following pre-testing, the treatment group trained twice a week for five weeks (10 training sessions). Training consisted of feet unsupported trunk extensions and right and left side-bridges. Each repetition was held for 6 seconds. The first ten repetitions were completed with bodyweight resistance alone. Participants able to perform more than ten repetitions were given external assistance to the shoulder girdle (for extension) or the pelvis (for the lateral side bridge) by a training partner. No more than twenty repetitions were completed for each exercise. Trunk flexor exercise beyond the gymnasts’ pre-season conditioning regimen was not included in the training protocol. Mean improvements in the treatment group for the trunk endurance measures were compared to those in the control group using multivariate analysis of variance (MANOVA) at the 5% level of significance.

RESULTS: Improvements in trunk extensor, flexor, and lateral flexor endurance were significantly greater in the treatment group than the control group. Following five weeks of floor exercises, side bridge endurance times improved, on average, 30.4 ± 20.7 seconds, the Biering-Sorensen test improved 9.0 ± 23.3 seconds, and trunk flexor endurance improved 40.2 ± 51.25 seconds.

CONCLUSION: These data suggest that training the trunk musculature twice per week over a five week period, with a relatively simple floor exercise protocol, was an effective stimulus to improve trunk endurance measures in a group of collegiate gymnasts.

2585 Board #93 4:00 PM - 5:00 PM Difficulty in Matching Training Induced Performance Changes to Changes in Fitness and Fatigue Carrie L. Pettyes1, Carl Foster, FACSM; Eric Woitza2, Rich Peint3, Leah Herlache2, Blair D. Johnson2, Carl Foster, FACSM University of Utah, Salt Lake City, UT; University of Wisconsin-La Crosse, La Crosse, WI. Email: cpettsey7@yahoo.com

Previous research has attempted to develop models that lumbar endurance can be used as a predictor for first time low back injury and that poor lumbar extensor static endurance is associated with higher rates of low back pain, decreased proprioceptive awareness, and decreased productivity in the workplace.

PURPOSE: To evaluate the effect of five weeks of floor exercises on endurance of the trunk flexors, extensors, and lateral flexors.

METHODS: Thirty-five collegiate females (19 treatment group, 16 control group) volunteered for this study. The treatment group consisted of Division III varsity gymnasts at an upper-Midwestern university. The control group consisted of non-varsity athletes. All participants completed pre and post-training trunk endurance tests consisting of the Biering-Sorensen test (for trunk extensors), a static flexion test (for trunk flexors), and left and right side bridge static holds (for trunk lateral flexors). Following pre-testing, the treatment group trained twice a week for five weeks (10 training sessions). Training consisted of feet unsupported trunk extensions and right and left side-bridges. Each repetition was held for 6 seconds. The first ten repetitions were completed with bodyweight resistance alone. Participants able to perform more than ten repetitions were given external assistance to the shoulder girdle (for extension) or the pelvis (for the lateral side bridge) by a training partner. No more than twenty repetitions were completed for each exercise. Trunk flexor exercise beyond the gymnasts’ pre-season conditioning regimen was not included in the training protocol. Mean improvements in the treatment group for the trunk endurance measures were compared to those in the control group using multivariate analysis of variance (MANOVA) at the 5% level of significance.

RESULTS: Improvements in trunk extensor, flexor, and lateral flexor endurance were significantly greater in the treatment group than the control group. Following five weeks of floor exercises, side bridge endurance times improved, on average, 30.4 ± 20.7 seconds, the Biering-Sorensen test improved 9.0 ± 23.3 seconds, and trunk flexor endurance improved 40.2 ± 51.25 seconds.

CONCLUSION: These data suggest that training the trunk musculature twice per week over a five week period, with a relatively simple floor exercise protocol, was an effective stimulus to improve trunk endurance measures in a group of collegiate gymnasts.

2587 Board #95 4:00 PM - 5:00 PM Comparison of Three Training Programs for Improving Aerobic Performance in Women Jeffrey S. Staab1, Marilyn A. Sharp1, Bradley C. Lindl, FACSM1, Kevin R. Rarrick2, Barry A. Spiering2, Dissa L. Hatfield3, Linda M. Yamamoto4, Peter N. Frykman5, Everet A. Harman5, David J. Gutkemsa, Jeff S. Volek6, Carl M. Marsh6, FACSM1, William J. Kraemer7, FACSM1, 2Military Performance Division, U.S. Army Research Institute of Environmental Medicine, Natick, MA. 3Department of Kinesiology, University of Connecticut, Storrs, CT. Email: Jeffrey.Staab@us.army.mil

Exercise training programs for fitness and sport are largely comprised of resistance and/or aerobic activity. The singular versus combined effects of resistance and aerobic training to aerobic fitness and performance in women is not clearly understood.

PURPOSE: To evaluate the effectiveness of three training programs and determine the relative contributions of aerobic and resistance training on aerobic fitness and performance of two aerobically demanding tasks.

METHODS: 56 untrained female volunteers (20±2 yrs, 65.0±8.3 kg, 165±7 cm) were randomly assigned to one of four groups matched for weight, height, strength, and VO2 max: Control (n=10; CT); Resistance (n=18; RES); Aerobic (n=13; AER); Combined RES and AER (n=15; CR). Training was performed on three non-consecutive days per week for nine weeks. The RES group used a periodized model, performing three sets of seven upper- and lower-body exercises per session. AER training was comprised of 20-30 min of continuous running (70-85% maximum HR), and progressive interval running. The CR group performed both the RES and AER exercises on the same day (i.e., double the training load). VO2 max was determined using a treadmill running protocol at weeks 0 and 9. Timed two mile run (2MRUN) and two mile load carriage (2MLC) with a 72 lbs backrack were determined at weeks 0, 4, and 9. A repeated measures ANOVA was used for statistical analysis.

RESULTS: Mean (SE)
2MRUN (min)  38.3 (1.4)  34.7 (1.7)  40.1 (1.3)  19.4 (1.0)  Week 9

2:00 PM - 3:00 PM  36.0 (1.5)  38.6 (2.0)  2:00 PM - 3:00 PM  3:00 PM - 4:00 PM  22.1 (1.3)  20.7 (0.9)  21.2 (1.0)  30.1 (1.2)

**RESULTS:** On average, subjects reached 90% VO2peak by the end of each exercise bout (session 2: 90.3± 3.6, session 7 (ST): 90.5± 4.0% VO2peak). Exercising workloads increased throughout training, with an average increase of 10% from the 1st to 6th training session. VO2peak significantly increased (p<0.05) following training (2.3± 0.7 to 2.6± 0.6 l.min-1). Lactate decreased with training following the 3rd bout (3.37± 0.08 vs. 3.29± 0.18 mmol.l-1) and following the 5th bout (2.3± 0.12 vs. 2.3± 0.18 mmol.l-1). Plasma epinephrine significantly decreased with training following the 3rd bout (1.8± 0.04 vs. 0.8± 0.05 mmol.l-1) and the 10th bout (3.11± 0.24 vs. 1.39± 0.03 mmol.l-1). The highest HR reached during exercise significantly decreased following training (2: 179± 6.4, 173± 7.9 beats/min). HR recovery during rest periods decreased on average from 128.1± 3.0 to 122.8± 3.5 beats/min. Plasma free fatty acids (1± 0.01 vs. 0.7± 0.03 mmol.l-1) and glycerol (127± 7.3 vs. 137± 8.7 mmol.l-1) significantly decreased following training.

CONCLUSION: Aerobic capacity was increased and cardiovascular, hormonal and metabolic responses to high intensity exercise were blunted with 2 wk of HIT. HIT at ~90% VO2peak may offer a realistic and practical training protocol to improve aerobic capacity and high intensity performance for the general population.

**Board #96**  2:00 PM - 3:00 PM  **Effects of High- vs Low-Cadence Interval Training on Physiology and Performance of Competitive Cyclists**

**Purpose:** High-resistance interval training produces substantial gains in sprint and endurance performance when added to the usual training cycles of the competitive training phase of a season. Here we report the effect of changing the cadence of the intervals on performance and physiology.

**METHODOLOGY:** We randomised 18 road cyclists to a low-cadence (60-70 min-1) or high-cadence (110-120 min-1) group for 4-5 wk of training. Both groups replaced part of their usual training with eight 30-min sessions consisting of three sets of explosive single-leg jumps (20 for each leg) alternating with three sets of high-intensity cycling sprints (5x30 s with 30-s recoveries between repetitions) performed on a training ergometer with resistance set individually to achieve the desired cadence. Saliva samples were collected before and after each training session to assay testosterone concentration. Performance and physiological measures, obtained on a cycle ergometer before and after the intervention, were mean power in a 60-s time trial and the following measures obtained from a continuous incremental test: peak power, maximum oxygen uptake, fractional utilization of maximum oxygen uptake at 4-mM lactate, and exercise economy.

**RESULTS:** Power output in the interval sets over the training period increased by 11%± 5.4% (mean ± SD) in the low-cadence group and by 8.3% ± 2.1% in the high-cadence group. Testosterone concentration increased in each training session, by 96% ± 25% (mean ± between-session SD) in the low-cadence group and by 62% ± 20% in the high-cadence group. There were substantial enhancements in performance in the low-cadence group (6-11%) and high-cadence group (2-3%). Mean changes (±90% confidence limits) in the low-cadence group relative to the high-cadence group were: +86%± 13% mean power, 2.5%± 4.8%; peak power, 3.6%± 3.7%; maximum oxygen uptake, 3.2%± 3.8%; 4-mM lactate power, 7.0%± 5.9%; fractional utilization, 0.9%± 4.9%; and exercise economy at 50% and 80% of pre-test peak power, 5.1%± 4.9% and 0.2%± 4.1% respectively. **Conclusion.** Low-cadence interval training is probably more effective than high-cadence training in improving performance of well-trained competitive cyclists. The differences in performance could be due to different effects of the two training cadences on economy and maximum oxygen uptake, possibly mediated in part by training-induced changes in testosterone.

**Board #97**  3:00 PM - 4:00 PM  **Seven High-Intensity Interval Training Sessions Increases Aerobic Capacity and Blunts the Metabolic and Hormonal Responses to Intense Exercise**

**Purpose:** Our aim was to investigate the effects of a short, high-intensity interval training (HIIT) program on aerobic and metabolic performance and to quantify the short-term changes in the cardiovascular, metabolic and hormonal responses to exercise at ~90% VO2peak.

**METHODOLOGY:** VO2peak was measured in 56 participants (30 females, 50 males, X = 46.6±10.1 yr) who completed 1, biweekly indoor stationary cycling classes on their own road bike outfitted with a Power Tap Pro® power meter. MSSP was defined as the average power during an eight-minute test which was administered at the beginning (pre) and end (post) of the training intervention. Individual training ranges were calculated from the pre-MSSP in accordance with Carmichael Training Systems. Laboratory assessments of PThet, Pmax and VO2max were made on 24 of the participants the same weeks MSSP was evaluated.

**RESULTS:** Following training, MSSP increased 9.2% (195.4± 56.6 vs. 213.8± 57.2 W, p= 0.05) and PThet increased 12.9% (178.3± 47.1 vs. 201.5± 47.6 W, p= 0.05). MSSP was 7.5% higher at PThet. Pmax increased ~6.7% (315.2± 65.3 to 336.5± 65.9 W), and VO2max increased ~6.5% (46.2± 10.7 to 49.1± 10.5 ml.kg-1.min-1). MSSP and PThet were highly correlated (r = 0.98) as was MSSP and VO2max (r = 0.90).

**CONCLUSION:** The results of this research indicated that: (a) the field test is a valid measure of fitness and changes in fitness, (b) provided data for the establishment of training ranges, and (c) a biweekly power-based training program can elicit significant changes in fitness.

**Board #98**  2:00 PM - 3:00 PM  **Maximal Steady State Power following Eight Weeks of Power Tap Cycling Training**

**Purpose:** To determine the oxygen consumption (VO2) utilized during on-sight (no previous knowledge about how to climb a specific route) climbing in regard to the maximal oxygen consumption (VO2max) of climbers. VO2 was measured in two highly trained male rock climbers (23 and 30 years) during a 12 meter indoor climbing route which was climbed as many times as possible without breaks between the climbs. The climbing difficulty was quantified 7c+ on the French numerical scale ranging from 5 to 9. The second part of the study consisted of a treadmill VO2max test.

**RESULTS:** The two subjects reached 74% and 83% of their VO2max respectively, when climbing. The VO2max was 59.6± 53.7 ml.min-1.kg-1 for the two subjects. The subject reaching the highest percentage of his VO2max during climbing, had the lowest VO2max Heart frequency (HR) during climbing was 93% and 95%, respectively, of their maximal heart frequency (HR).

**CONCLUSION:** These results indicate that maximal aerobic capacity may be highly important in on-sight rock climbing, even though rock climbers traditionally is considered to mainly use small muscle groups in their upper body when climbing.

**Board #99**  2:00 PM - 3:00 PM  **Aerobic Capacity in Top Athlete Rock Climbers, a Case Study**

**Purpose:** Rock climbing is a growing sport world wide, but little research is done concerning the aerobic capacity of this group of athletes.

**METHODOLOGY:** To determine the oxygen consumption (VO2) utilized during on-sight (no previous knowledge about how to climb a specific route) climbing in regard to the maximal oxygen consumption (VO2max) of climbers. VO2 was measured in two highly trained male rock climbers (23 and 30 years) during a 12 meter indoor climbing route which was climbed as many times as possible without breaks between the climbs. The climbing difficulty was quantified 7c+ on the French numerical scale ranging from 5 to 9. The second part of the study consisted of a treadmill VO2max test.

**RESULTS:** The two subjects reached 74% and 83% of their VO2max respectively, when climbing. The VO2max was 59.6± 53.7 ml.min-1.kg-1 for the two subjects. The subject reaching the highest percentage of his VO2max during climbing, had the lowest VO2max Heart frequency (HR) during climbing was 93% and 95%, respectively, of their maximal heart frequency (HR).

**CONCLUSION:** These results indicate that maximal aerobic capacity may be highly important in on-sight rock climbing, even though rock climbers traditionally is considered to mainly use small muscle groups in their upper body when climbing.
Adaptation to Training in Developing Male and Female Road Cyclists Within and Across Competitive Seasons

Tammie R. Ebert, David T. Martin, Brian Stephens, James A. Victor, Warren McDonald, Robert T. Withers, FACSM.1, 2Australian Institute of Sport, Belconnen, Australia. 1Queensland Academy of Sport, Brisbane, Australia. 2Flinders University, Adelaide, Australia.

Longitudinal monitoring of competitive road cyclists is required to document the magnitude of adaptation possible for important fitness traits. In addition, physical and physiological adaptations in cyclists who eventually become professional cyclists may reveal pre-requisites for success.

PURPOSE: To determine the magnitude of change in fitness traits within and across competitive seasons in a group of highly competitive developing cyclists (<25 yr).

METHODS: Cyclists (Males: body mass: 65.9±3.7 kg; VO_{2peak}: 75.1±4.2 ml·kg⁻¹·min⁻¹; maximum aerobic power (MAP): 461±47 W; Females: body mass: 59.1±4.8 kg; VO_{2peak}: 62.4±3.8 ml·kg⁻¹·min⁻¹; MAP: 311±27 W) completed a maximal graded exercise test at the start and end of the competitive season over a period of 2-5 years (M, n=25 tests). The graded exercise test began at 100 W (Males) and 125 W (Females) and increased 25 W each minute (males) or every 3 min (females) until fatigue. Oxygen consumption was measured throughout the test and anaerobic threshold (AT) parameters were determined. For each fitness variable the percentage change within a season (pre to post) and across seasons (minimum to maximum) were calculated.

RESULTS: For males, VO_{2peak} tended to declined within a season (~2%) but increases occurred for MAP (5%) and AT power output (8%). Body mass remained stable throughout the competitive season whereas changes in relative MAP were entirely due to increases in absolute power output. Across seasons, males showed a 4% improvement in VO_{2peak} and 10-16% improvement in MAP and AT power. On average, females exhibited a 3% increase in VO_{2peak} and a 7% increase in MAP across seasons.

CONCLUSIONS: These data are unique as they describe the physiological adaptations that can be expected in highly competitive developing cyclists engaging in heavy training and race programs (~2,000-30,000 km and 60-80 races per year) over a period of 2-5 years. Increases in power output within a season is more evident in well-trained, developing road cyclists than changes in peak oxygen consumption or reductions in body mass. It is possible that physiological adaptations observed in this study are specific to the intensity and volume of the training and racing programs endured. Thus, additional research is required to document the effects of different training loads on long term physiological adaptations and performance.

Effects of a 14-Week Swimming Program on Aerobic Fitness in College Recreational Swimmers

Peter J. Chornontowski, Elizabeth F. Nagle, Robert J. Robertson, FACSM, Kevin J. McLaughlin. University of Pittsburgh, Pittsburgh, PA.

Swimming has been recommended by the American Heart Association and National Institutes of Health as an appropriate modality to improve overall fitness. The physical and health outcomes of a fitness swimming program are numerous and include cardiovascular, metabolic, and musculoskeletal benefits. Studies examining the benefits of a fitness swimming intervention on components of health-related fitness have not been explored using a college age population.

PURPOSE: The purpose of this study was to examine the effect of a 14-week fitness swimming program on aerobic fitness and swimming time in eight men and twenty-seven women (aged 18-23, 20.1±1.87 yrs).

METHODS: A laboratory orientation session was conducted to allow subjects to practice the maximal aerobic power (VO_{2max}) treadmill test. Following the orientation session, two 12-minute freestyle swimming trials (T1 and T2) and two 50 yd. timed freestyle swimming trials (T1sp and T2sp) were conducted on consecutive class days. Within the first two weeks subjects completed the actual VO_{2max} treadmill test. During the last two weeks of the class, subjects completed the 12-minute swim (T3), 500 yd. swim (T4), and the VO_{2max} treadmill test on non-swimming days. The 14-week swimming program consisted of an instructed swimming program 3 days per week for 60 minutes conducted in a 25 yard pool. Data were analyzed using the Wilcoxon signed rank tests for significance.

RESULTS: Maximal oxygen consumption increased 3.8% for the combined sample, but was significant only in the female sample (male, 0.2%; female, 6.1%). The 12 minute swim test evidenced a 13% significant increase in both male and female samples (male, 9.3%; female, 14.7%). The 500-yard swim test evidenced a 10.9% significant increase in both the male and female samples (male, 7.2%; female, 12.4%). Self-report data indicated that subjects did not significantly increase physical activity in addition to swimming class during the 14-week fitness program.

CONCLUSION: These findings indicate that the 14-week swimming fitness program increased both swim performance and treadmill measured maximal aerobic power. The findings suggest that a fitness swimming program can serve as a beneficial aerobic conditioning modality for improving cardiovascular fitness in college aged men and women. Supported by the National Swimming Pool Foundation.
CONCLUSIONS: The average heart rate was 70% of HR max, mean HR decreased throughout the duration of the 100-mile trail race while RPE increased. Therefore, changes in RPE are not indicative of changes in HR for runners participating in an ultra marathon race.
The Metabolic Cost of Double Leg versus Single Leg Cycling
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Single leg cycling drills are often employed by cyclists and triathletes as a means of improving cycling efficiency. However, the intensity at which these drills are performed is poorly defined. Furthermore, it is not known if single leg pedaling drills actually impact double leg pedaling efficiency.

**PURPOSE:** To compare the metabolic cost of single and double leg pedaling using oxygen consumption (VO₂), heart rate (HR), and lactate (LA).

**METHODS:** Seven trained triathletes (age: 33±0.3 yrs) performed incremental max tests on a electronically loaded cycle ergometer to determine peak VO₂ and anaerobic threshold. A workload (watts) of 60% of the anaerobic threshold workload was employed for both the single and double leg pedaling trials. Subjects performed one trial consisting of a five minute warm-up at 25 watts, followed by three minute stages consisting of double leg pedaling (DL), single right leg pedaling (SRL), single left leg pedaling (SSL), and seated rest. Gas exchange data were collected using open-circuit spirometry and heart rate by telemetry. LA samples were obtained at the end of each three minute stage. Subjects maintained a cadence of 85 rpm throughout all trials.

**RESULTS:** Statistical analysis by ANOVA (p<0.05) revealed no significant difference in VO₂ between DL (1747 ± 265 mL), SRL (1849 ± 349 mL), and SSL (1781 ± 338 mL) trials. Heart rates of 12 ± 8 bpm (DL), 137 ± 13 bpm (SRL), and 135 ± 12 bpm (SSL) were not significantly different with the exception of the DL vs SSL trials. Lactate values (mMol) of 3.3 ± 0.6 for DL, 4.7 ± 0.55 for SSL, and 4.9 ± 0.81 for SRL, were not significantly different between single leg trials, but were significantly different between DL vs SRL and SSL trials.

**CONCLUSION:** Performing the same amount of work with one leg as compared to two legs mandates a greater relative intensity of the smaller muscle mass. Although the aerobic contribution is similar between single and double leg trials, an increased lactic acid contribution attests to the elevated anaerobic contribution of single leg cycling. The finding that HR was significantly different between DL and SSL only, suggests that leg dominance may play a role in cycling efficiency. Single leg cycling provides a greater metabolic stimulus at the same absolute workload as compared to double leg cycling.

**Board #109**

3:00 PM - 4:00 PM

Validation of the 5K Run Age & Weight Handicap Model
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**PURPOSE:** To determine if the 5K run age and weight handicap (SKH, previously developed by the present authors) eliminates the age and weight bias for male and female runners.

**METHODS:** We recorded age, run times (RT) and weight values for 275 men and 126 women at two regional 5K races. We then used the SKH to calculate each runner’s RTadj, the run time corrected for age and weight. The correlation coefficients between age & weight vs. RT & RTadj were used to assess the extent to which bias was removed by the SKH. To avoid the confounding effect of effort, we also examined sample subsets consisting of faster runners.

**RESULTS:** When all runners were considered, the SKH did not appear to reduce or eliminate the age and weight bias for men but did for women. When slower runners (i.e., joggers, "fun" runners) were removed from the sample, the age & weight vs. RTadj correlations approached zero for both genders, compared to the corresponding (i.e., joggers, or “fun” runners) were removed from the sample, the age & weight vs. RTadj correlations approached zero for both genders, compared to the corresponding parameters were low-to-moderate.

**CONCLUSIONS:** The SKH appears to remove the biases associated with age and weight for men and women.

**Board #110**

4:00 PM - 5:00 PM

Exercise Training is Associated with Improved Levels of C-Reactive Protein in Middle-Age Obese Men
Do Kyung Kim, Won Hah Park. Samsung Medical Center, Seoul, Republic of Korea.
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**PURPOSE:** Obesity and fitness are both independently associated with cardiovascular event and mortality. Regular exercise has been well known to prevent from cardiovascular diseases in obesity, but the underlying mechanisms are not completely understood. Inflammatory marker such as plasma C-reactive protein (CRP) is associated with an increased risk of developing coronary artery diseases. Thought previous studies reported that physical activity and cardioprotective fitness are associated with CRP based on cross-sectional study, there is few data to impact on CRP after regular aerobic exercise training in obesity. The aim of this study is to examine the effects of walking as aerobic exercise training on C-reactive protein (hs-CRP) in obesity.

**METHODS:** Study participants included 60 middle-ages (45-58 yrs) were randomly assigned into the exercise training with low-energy diet group (n=32, BMI 29.4±2.6) or the control group (n=28, BMI 28.6±2.3) who given general information about health diet and exercise. Exercise group was instructed to continue prescribed walking exercise at 50 - 80% of maximal heart rate for 30 to 60 minutes a day, over 200 mins a week, 3-5 days per week for 4 months.

**RESULTS:** After 4 months, the BMI (29.4±2.6 to 27.2±2.3, p<0.001) %BF (30.2±4.9 to 25.7±4.6, p<0.001), VO2peak (30.7±4.5 mL/kg/min to 36.9±6.5 p<0.001), LDL-C (156.3±32.5mg/dl to 121.7±28.5 p<0.001) and hs-CRP (0.150±0.13mg/dl to 0.082±0.05, p<0.001) were significantly improved in exercise group. However, there is no significant improvement in control group (BMI: 28.6±2.3 to 28.9±2.5, p=0.921), %BF (29.3±3.9 to 29.8±4.2, p=0.390), VO2peak (31.0±5.1 to 30.8±4.8, p=0.024) and hs-CRP (0.146±0.078 to 0.135±0.17, p<0.193).

**CONCLUSION:** Regular aerobic exercise training improved fitness and decreased plasma hs-CRP in obese, which could contribute to decrease risk of cardiovascular disease.

**Board #111**

3:00 PM - 4:00 PM

Fitness-Related Changes Resulting from a 6-Week Fire Academy Course for Recruit Firefighters
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Because firefighting often requires heavy physical work under adverse, potentially dangerous conditions, fitness is an important factor in effective job performance. Perceptions of fitness may impact the extent to which firefighters initiate or maintain a regular program of physical activity.

**PURPOSE:** To describe the relationships between perceived and actual measures of fitness before and following a 6-week Certified Firefighter II (Academy) course which included a physical training regimen.

**METHODS:** During the Academy course recruit firefighters (N=68, 27.1 yrs) performed 30 min of progressively challenging physical training 4 wk for 6 wks. During Weeks 1 & 6, measures of muscular endurance (modified YMCA bench press test, push-up test, squat test), cardiovascular endurance (1.5 mi run time) and body composition (% body fat (%BF) determined from skinfolds, waist to hip ratio) were obtained along with perceptions of fitness [Perceived Physical Fitness Scale (PPFS); Abadie, 1988].

**RESULTS:** Significant (P<0.001) changes were seen for: (a) muscular endurance (30% increase), cardiovascular endurance (14% increase), and body composition (12% decrease in body fat); (b) resting heart rate, resting blood pressure, and hip/ waist measures; and (c) perceptions of health and fitness (15% improvement). Correlations between perceived fitness and muscular endurance (bench press, push-up, squat-up), cardiovascular endurance, and %BF were (0.36, 0.54, 0.27), -0.42, and -0.24, respectively at Week 1, and (0.22, 0.42, 0.21 ns), -0.36, and -0.28 during Week 6 (P<0.05 unless indicated by ns).

**CONCLUSIONS:** A relatively brief Academy course that contained a physical training program resulted in significant improvements in performance related fitness parameters used in recruit firefighters. There was a concomitant change in the perception of fitness levels, although the correlations between the perceived and actual fitness parameters were low-to-moderate.

**Board #112**

3:00 PM - 4:00 PM

The Relationship Between Physical Activity, Cardiovascular Fitness, Muscle Strength and Age-related Change In Body Composition
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Maintaining muscle mass (MM) and bone mineral density (BMD) are the critical factors for independent living in elderly people. To maintain MM and BMD, a high level of daily activity or endurance training with a moderate intensity is recommended to improve functional capacity and health in elderly Japanese. The present study examined the association between physical activity, cardiorespiratory fitness, muscle strength and age-related change in body composition in middle-aged Japanese men and women.
improve cardiovascular fitness. However, it is unclear whether being physically active and to improve the cardiovascular fitness can suppress the age-related decrease of MM and BMD. Higher intensity training, such as resistance training, may be necessary.

**PURPOSE:** To investigate the relationship between physical activity (PA), cardiovascular fitness (CF), muscle strength (MS) and age related change in MM and BMD.

**METHODS:** 207 female subjects (19-78yr) participated in this study. MM and BMD for the whole body were determined by using DXA. Maximal oxygen consumption (VO2max), handgrip strength and total weekly physical activity evaluated by the International Physical Activity Questionnaire (IPAQ) were determined as the indices of the CF, MS, and PA, respectively. Participants were divided into three age groups: 19-39yr, young-aged group; 40-59yr, middle-aged group; over 60yr, old-aged group. They were also divided into two subgroups according to the level of CF, MS and PA at each age group: high (HCF) and low (LCF) CF group, high (HMS) and low (LMS) MS group, and high (HFA) and low (LFA) PA group. We used the Japanese standard score (CF and MS) and the intermediate value of all participants (PA) to divide the groups. A two-way ANOVA experimental design with a post-hoc test was adopted to analyze the data.

**RESULTS:** Total MM and BMD decreased with aging (p<0.05), while the factor of age was significant in both ANOVA tests (p<0.05) than in LMS in the middle-aged (HMS vs. LMS; 37.5 ± 4.0 vs. 33.5 ± 3.5, p<0.05) and old-aged group (HMS vs. LMS; 37.5 ± 3.5 vs. 32.6 ± 2.9, p<0.05). Quantitatively similar results were obtained for BMD.

**CONCLUSIONS:** There was a significant difference between HMS and LMS in terms of MM for each age group, but there was no difference in the level of CF and/or PA in all age groups. This suggests that it is necessary to improve or maintain muscle strength by resistance training to keep muscle mass and BMD at high levels. Also MM and BMD could not be maintained at high level only by improving cardiovascular fitness and increasing physical activity.

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**2605 Board #113 4:00 PM - 5:00 PM**

**Effectiveness of Rep Reebok on Muscular Strength, Endurance, and Body Composition in Healthy Adults**

Alison M. Fabro, Wendy E. Repovich, FACSM. Eastern Washington University, Cheney, WA.

The fitness industry is evolving to, as participants demand new, innovative ways to build or maintain the components of fitness. Group exercise is one of the most popular ways to provide programs and many of the companies at the forefront of the industry market themselves as research-based but little published data supports that claim.

**PURPOSE:** This study was designed to investigate whether the Rep Reebok group exercise, resistance-training program taught by a certified instructor was effective in gaining muscular strength, muscle endurance, and increasing lean body mass in healthy, trained adults, age 25-55.

**METHODS:** Twenty-five active members (17 = female; 8 = male) of 24Hour Fitness completed the study. Following pre-testing for 1RM chest press and press, the YMCA submaximal muscular endurance test and body composition using skinfolds, they all participated in the Rep Reebok program two to three times per week for six weeks. Rep Reebok is a 55-60 minute class intended to provide a full-body workout using dumbbells and barbells with weight plates in a group setting providing class camaraderie and valuable instruction by a knowledgable exercise leader. All participants were post-tested on the same variables within one week of the end of the class. A student’s t-test was used to compare pre- and post-test values for all variables. summary of **RESULTS:** The group experienced significant improvements in all variables: upper body muscle strength (t = 3.16, p = .004), lower body muscle strength (t = 4.20, p = .001), upper body muscular endurance (t = 6.48, p = .001), lower body muscular endurance (t = 3.49, p = .002), and body composition (t = 3.483, p = .002).

**CONCLUSIONS:** These results suggest that previously trained adults who regularly participate in Rep Reebok at least two times per week will demonstrate physiological adaptations to resistance training within six weeks.

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**2606 Board #114 2:00 PM - 3:00 PM**

**The Relations Among Body Mass Index, Percent Body Fat, and Cardiorespiratory Fitness**

Allen W. Jackson, FACSM,1 James R. Morrow Jr., FACSM,1 Steven N. Blair, FACSM.1 University of North Texas, Denton, TX.1 The Cooper Institute, Dallas, TX.

Body mass index (BMI) is used to classify weight status (underweight, normal weight, overweight, obesity) in clinical and research settings. Recent data are inconsistent in regard to the adverse health effects of BMI-defined overweight and obesity. BMI’s relation with adiposity may attenuate its relations with health outcomes and risk factors for chronic disease morbidity and mortality.

**PURPOSE:** 1) To determine relations among BMI, hydrostatically determined percent body fat (PFAT) and cardiorespiratory fitness (CRF); 2) To develop a regression equation using readily measured values of gender, age (yrs), BMI (w/ht) to estimate PFAT (EPPAT); and 3) To determine the relation between EPFAT and CRF.

**METHODS:** The study sample included 28,673 participants (Men=23,543; Women=5,130) who participated in a clinical evaluation of health and fitness at The Cooper Clinic (Dallas, TX) between 1970-2002. Clinical measures included height and weight from which BMI was computed as kg/m², PFAT using hydrostatic weighing techniques, and CRF quantified as the duration of a maximal treadmill exercise test using a modified Balke protocol.

**RESULTS:** For the entire sample, the correlations (r) for BMI were .48 (p<0.0001) with PFAT and -.28 (p<0.0001) with CRF. The partial r, controlling for gender and age, were .44 (p<0.0001) and -.40 (p<0.0001). With PFAT as the criterion, a regression equation was developed using gender (Men=0, Women=1), age, and BMI as the predictors. The multiple correlation (R) was .71 (p<0.0001, SEE = 5.1%). Gender specific analyses using age and BMI as predictors (Men: R = .68, SEE = 5.0%; Women: R = .71, SEE = 5.6%) produced similar results. A unique cross validation sample (n=1510) verified the consistency of the regression equation (R = .76, p<.0001, SEE = 5.2%). The r between EPFAT and EPPAT was -.54 (p<0.0001), similar to that between CRF and PFAT (r = -.59, p<0.0001).

**CONCLUSIONS:** BMI using measured height and weight had moderate to low relations with PFAT and CRF. A cross validated regression equation using gender, age, and BMI can be used to estimate PFAT. The relation between EPPAT and CRF was significantly higher than the relation between BMI and CRF, a known risk factor for all-cause mortality.

Supported in part by NIH grant AG06945.

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**2607 Board #115 3:00 PM - 4:00 PM**

**Changes in Body Composition of College Females Following 12 Weeks of Concurrent Aerobic Dance Exercise and Resistance Training**

Johanna L. Ruff, Dena P. Garner. The Citadel, Charleston, SC.

Separately, aerobic and resistance training programs have resulted in positive effects on body composition. One latest exercise trend focuses on combining aerobic and resistance training components in one exercise session. Current aerobic dance classes often incorporate aerobic and resistance training elements, thus qualifying as concurrent training. Physiologic effects of concurrent training and effects of the order of this training, specifically on body composition, have largely been unexplored.

**PURPOSE:** To identify changes in body composition, utilizing air displacement plethysmography, of two groups of college women following twelve weeks of concurrent training with different sequencing of training.

**METHODS:** Forty-eight female students were assigned to one of two groups. The first group (RA), 32 females (20-39yrs) participated in a 5-10 minute warm-up, 5-10 minutes of resistance training, utilizing exercise bands, followed by 20-30 minutes of aerobic training. The second group (AR), 16 females (20-39yrs) participated in a class that began with a 5-10 minute warm-up, 20-30 minutes of aerobic training then 5-10 minutes of resistance training, utilizing exercise bands. Subjects participated in classes 3 days a week for 12 weeks. Body composition was measured using air displacement plethysmography with predicted residual volumes pre- and post-study. Independent t-tests were used to determine significant differences between the RA and AR groups as a result of concurrent training. Dependent t-tests were used to determine pre-post changes for the experimental groups.

**RESULTS:** When groups (RA & AR) were combined and analyzed, a significant difference was found in percent body fat (pre, 30.86±6.22 vs. post, 29.87±6.58%, p=0.05) and lean body mass (pre, 91.32±15.66 vs. 92.07±15.57%, p=0.05). In addition, when comparing differences within each group, both RA and AR groups showed significant differences in percent body fat (RA percent body fat pre, 31.34±7.00 vs. post, 30.47±7.43%; RA fat weight pre, 44.48±22.18 vs. post, 43.18±22.08lbs.; AR percent body fat pre, 29.83±7.27 vs. post, 28.68±4.41; AR fat weight pre, 38.90±10.18 vs. post, 37.30±10.06lbs.; p<0.05). However, when comparing the two groups for differences in the sequence of training effect on physiological factors, no significant differences were found with any variable.

**CONCLUSION:** Twelve weeks of concurrent aerobic and resistance training in college-age females resulted in increased lean weight and decreased percent body fat. However, no differences were found for the sequencing effect on physiological factors.
CoNCLUsIoNs:

PUrPose:

speeds in the 25ft, 100ft and 6-min tests were also similar between groups (p > 0.05). Perceived fatigue was assessed using the Modified Fatigue Impact Scale and extensors (flex/ext) were assessed using isokinetic dynamometry. Leg muscle variety of factors including low physical fitness. Measures of

CoNCLUsIoNs:

PUrPose:

complete recovery could not occur after a weekend rest. As an increase of the prevalence of haematuria in well-trained cyclists. However, the sprint cycling would lead to a decline in blood cells counts and hemoglobin as well cells counts, hemoglobin, HCT, MCH, and MCHC were found to decrease after eight cyclists were found to develop haematuria after the one week training. Blood specific gravity, protein, glucose, ketones, nitrites, and red blood cell was also performed. (MCH), and mean corpuscular hemoglobin concentration (MCHC). Urinalysis including

CoNCLUsIoNs:

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This study was to examine the effect of a single bout and a one-week interval high-intensity uphill sprint training in well-trained cyclists. METHODS: Eight well-trained male cyclists (mean SD age; 19.1 ± 1.1 years; body mass 78.4 ± 8.0 kg; body height 177.9 ± 5.1 cm; training experience 1.8 ± 1.0 years) participated in this study. Prior to and after a single bout uphill sprint cycling, venous and capillary blood samples were collected to assess creatine kinase (CK), urea nitrogen (BUN), blood counts, hemoglobin, haematocrit (HCT), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC). Urinalysis including specific gravity, protein, glucose, ketones, nitrites, and red blood cell was also performed. Similar measurements were also taken during the one week interval uphill sprint training. RESULTS: There were no changes in BUN levels after a single bout uphill sprint cycling despite the increase in blood lactate and CK concentrations (P < 0.05). Six of eight cyclists were found to develop haematuria after the one week training. Blood counts cells, hemoglobin, HCT, MCH, and MCHC were found to decrease after training and did not return to normal concentrations after the weekend recovery. CONCLUSION: The results suggested that a one-week interval high-intensity uphill sprint cycling would lead to a decline in blood cells counts and hemoglobin as well as an increase of the prevalence of haematuria in well-trained cyclists. However, the complete recovery could not occur after a weekend rest.

CoNCLUsIoNs:

PUrPose:

Physiological Characteristics of Female College Freshmen in Relation to Current and Previous Athletic Experience

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Previous research has found weight gain among females entering their freshmen year of college. Most research in this area has compared current athletes to nonathletes. However, evaluating former athletes may provide greater insight into physiological changes during the transition from high school to college. PURPOSE: To evaluate the physiological differences between female freshman collegiate athletes (CA), former high school athletes (FA), and nonathletes (NA) when entering their first semester. METHODS: Participants included 45 collegiate freshman females (18.4 ± 0.4 years) enrolled in a general education health and wellness course in the fall semester. Physiological variables measured included: VO_{2max}, isometric peak force (IPF), bone mineral density (BMD), body composition (BC), height (HT), and body weight (BW). The freshmen were divided into 3 groups: 1) fall collegiate athletes (N= 163), 2) former 3 sport high school athletes (N= 15), and 3) nonathletes (N= 14). During the first 2 weeks of classes, a treadmill VO_{2max} was conducted using a Bruce protocol. IPF was measured using a Smith machine and a Quattro Jump force plate. BMD and BC were estimated using dual energy X-ray absorptiometry (DXA). MANOVA and ANOVA (P < 0.05) were used to compare the three groups in VO_{2max}, IPF, BMD, lean body mass (LBM), percent body fat (BF), BW, and HT. RESULTS: Results revealed CA had significantly greater VO_{2max}, IPF, BMD, LBM, BW, and percent body fat (BF) than both NA and FA showed significantly greater VO_{2max}, IPF, BMD, and LBM than FA. However, the body weight and cardiorespiratory fitness (CRF) are widely recognized as important determinants of health status. Current research continues to ascertain the influence that each of these factors exerts on important health issues such as CVD risk. PURPOSE: Our purpose was to determine the extent to which CRF accounts for differences in markers of CVD risk in normal weight (BMI < 25 kg/m²) and obese (BMI ≥ 30 kg/m²) individuals.

Methods:

Two hundred forty-five adults (143 males, 102 females, age range 18 to 76 yrs) participated in a community-based health and fitness assessment program in the Southeast and were partitioned by BMI (144 normal, 101 obese). Each participant completed a continuously graded treadmill exercise test to volitional fatigue and time on the treadmill was used to estimate CRF. Resting systolic (SBP) and diastolic (DBP) blood pressures were measured and fasting blood samples were analyzed for: total cholesterol (TC), high-density lipoprotein cholesterol (HDLC), triglycerides (TG), and blood glucose (BG).

RESULTS: Significant differences between BMI groups included (p < 0.05 for all): CRF, SBP, HDL-C, TG, and BW. Next, we included CRF as a covariate and group differences in CVD risk markers were reassessed using ANCOVA procedures. All BMI group differences in CVD risk markers remained significantly different after statistically controlling for CRF (p < 0.05 for all). Correlational analysis indicated that CRF accounted for no more than 18% of the variation in any of the measured CVD risk markers.

CONCLUSION: These findings support the contention that excess body weight is associated with greater CVD risk. Accounting for differences in CRF does not change the elevated CVD risk status observed with excess body weight.
CoNCLUsIoNs

METHODS: A total of 244 students (54% female), enrolled in a university required wellness course, reported eating frequency, height, and weight via an online survey. Each student also performed the YMCA 3-minute Step Test, in a group setting, with heart rates measured for one full minute immediately upon completion of stepping.

RESULTS: The mean age and BMI of all subjects was 19.3 (SD=1.78) and 23.9 (SD=4.29), respectively. Men had a BMI of 24.9 and women had a BMI of 23.1 (p=0.001). The survey also revealed that 30% of the students eat breakfast at two days per week, 30% eat breakfast three to four days per week, and 40% consume breakfast five to seven days of the week. Mean heart rates of the subjects upon completion of step test was 103.6 beats per minute (SD=19.7) with males averaging a heart rate of 96.9 bpm and females at 109.2 bpm (p<0.001). When grouped by breakfast consumption frequency (0-2 days, 3-4 days, 5-7 days), one-way ANOVA revealed no significant difference in heart rate response (p=0.115).

CONCLUSIONS: This study seems to indicate that frequency of breakfast consumption does not predict heart rate response (i.e., fitness) in college students. Also, another point of interest was the finding that the majority of students eat breakfast only four or less days each week.

PURPOSE: To determine if wearing the SenseWear Armband increased physical activity participation in college students. The armband is an unobtrusive device worn on the back of the arm that assesses physical activity and energy expenditure in a free-living environment.

METHODS: Participants were 72 students enrolled in a required wellness lecture with a physical activity lab at North Dakota State University. Subjects were in one of three groups: the “class” group (n=20), which attended a weekly structured activity with a physical activity lab at North Dakota State University, Fargo, ND. (Sponsor: Dr. Larry Durstine, FACSM) Email: stitesk@mailbox.sc.edu

PURPOSE: To determine the number of steps taken during 30 min walking on an indoor floor surface (FL) compared to motorized treadmill (TM), both on level grade, in college-aged individuals. Subjects were instructed prior to each condition to walk “briskly” for the 30 min. Gender differences and relative exercise intensity (HR and RPE) were also examined.

METHODS: Twenty-eight (16 females) college-aged (20.6±1.3 y) volunteers participated. Steps were counted by WalkMate pedometer, placed used per manufacturer directions; stride length was calculated as an average of ten strides. Each subject walked 100 steps to determine pedometer accuracy. HR via polar monitor and perception of effort (Borg 6-20 scale) were assessed at 15 min and at the end of the 30 min walking sessions. TM speed was determined after selecting a “brisk” walking pace. Values are reported as mean±SD with statistical significance at the .05 level.

RESULTS: Pedometer counts for the 100 steps were within 2% accuracy; mean stride lengths for males and females were 30.1±2.5 and 27.8±3.1 in, respectively. No significant differences in counted steps were observed for either treatment condition or gender comparison (FL: 3.55±.356 vs 3.449±.220; TM: 3.461±.330 vs 3.599±.157 steps; females vs males). Males walked at a significantly faster speed on the TM compared to FL (3.72±.021 vs 3.22±.018 mph) while females did not (3.41±.24 vs 3.20±.24 mph). HR values for males were significantly higher on TM compared to FL (121.6±17.8 vs 106.8±17.1 bpm) and “light” in relative intensity (58 vs 57% of predicted HRmax).

CONCLUSIONS: These results agree with directly measured 30 min step counts for older (59-80 yr) healthy individuals (Tudor-Locke et al., 2002) but contrast to estimates (3,800-4,000 steps) of Welk et al. (2000) and Wilde et al. (2001). 1,300 steps for unsupervised 30 min walking. Step counts were independent of these commonly used surfaces. Although “brisk” walking in college-aged individuals meet step count recommendations, relative intensity is not moderate. A physiological measure such as HR with step count recommendations would ensure the recommended “moderate” intensity needed for health/fitness benefits.
MetHoDs: resULts: in exercise lasting more than 2 hours. However, whether CHO feeding affects cycling appears to delay the onset of fatigue and enhance endurance performance, especially running at similar heart rates in college-aged women.

and combination phases. Additionally, kickboxing elicited a lower VO_

2

min

resulted in average heart rates were 63 ± 15% of heart rate reserve. When the 22 min routine was divided into segments (arms only, legs only, arms+legs), the legs only and arms+legs segments elicited higher intensities compared to the arms only segments. Average caloric expenditure was 7 kilocalories/min; thus, over 300 kilocalories would be expended during a 45 min workout, meeting the recommendation for weight management.

CONCLUSION: To elicit intensities recommended for improving cardiorespiratory fitness, noncontact kickboxing exercise routines should be designed to include predominantly leg exercises combined with some arm movements, and limit exercises that use arms only.

RESULTS: Intensity during the kickboxing routine averaged 49 ± 10% of oxygen uptake reserve, which is the lower end of the range recommended by the American College of Sports Medicine. Average heart rates were 63 ± 15% of heart rate reserve. When the 22 min routine was divided into segments (arms only, legs only, arms+legs), the legs only and arms+legs segments elicited higher intensities compared to the arms only segments. Average caloric expenditure was 7 kilocalories/min; thus, over 300 kilocalories would be expended during a 45 min workout, meeting the recommendation for weight management.

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CONCLUSION: To elicit intensities recommended for improving cardiorespiratory fitness, noncontact kickboxing exercise routines should be designed to include predominantly leg exercises combined with some arm movements, and limit exercises that use arms only.
RESULTS: Weighted jump roping proved to be a very strenuous activity, with subjects working between 85-92% of HRRmax and 72-75% of VO2max. HRR and RPE increased significantly with increasing weight combinations, while VO2 and caloric expenditure remained constant. Oxygen pulse values significantly decreased across conditions, indicating that a pressor response may have occurred due to the high degree of muscular effort in the hands and forearms.

CONCLUSION: Weighted jump roping proved to be a very difficult activity that may not be sustainable for long periods of time, as some subjects were unable to complete all of the trials. The results of this study indicate that there is no benefit to adding weights to the handles of the jump rope for increasing caloric expenditure or exercise intensity during an acute bout of exercise.

2622 Board #130
3:00 PM - 4:00 PM
The Effect of Endurance Exercise in Japanese Middle-Aged Obese Women Assessed by Plasma Adipocytokine Levels
Taketaka Hara1, Yoshihiro Matsumura2, Yasushi Nakaoka1, Hayato Nakaoka1, Takashi Suzuki1, Wang Limxi1, Takahiro Yoshikawa1, Shigeo Fujimoto2. 1Osaka city university, Osaka, Japan. 2Matsushita Electric Works Ltd., Osaka, Japan. Osaka city Sports Promotion Association, Osaka, Japan. Email: m1392192@med.osaka-cu.ac.jp
Adipose tissue secretes various protein (adipokine) and secret disorder of adipocytokine strongly relate to many diseases. Physical exercise is recommended for prevention of a life-style related disease, but the relationship between adipocytokine and physical exercise is not well known.

PURPOSE: To investigate the effect of endurance exercise for plasma adipocytokine levels in middle-aged obese women. Method: Seventeen middle-aged obese women subjects (53.6±6.7 years, 70.4±8.0kg, body mass index 28.6±3.6, %fat 37.8±6.8) were participated in this study. Experimental bout was 3 months. Subjects were undergone 1 day/90min/day exercise program with endurance exercise (aerobic dance, step exercise and ball exercise etc), and we advised to perform walking exercise as every day as possible. Result: Average steps in subjects for 3 months was 8762±296steps/day. Body weight, body mass index, percent body fat and diastolic blood pressure were significantly decreased, and shuttle stamina test (endurance performance) and stepping test (quickness performance) were significantly improved. Plasma PAI-1 levels (pre: 30±11.5µg/ml, post: 20.5±10.8µg/ml, p<0.05) and homeostasis model assessment (HOMA-IR; pre: 196.1±11.1, post: 173.7±10.9, p<0.05) were significantly decreased respectively. Moreover, delta PAI-1 was significantly correlated with delta percent body fat (r=0.504, p<0.05). On the other hand, plasma adiponectin (pre: 10.9±2.6µg/ml, post: 10.0±3.2µg/ml) and leptin (pre: 14.3±6.6µg/ml, post: 15.6±3.2µg/ml) were increased significantly with increasing weight combinations, while VO2 and caloric expenditure remained constant. Oxygen pulse values significantly decreased across conditions, indicating that a pressor response may have occurred due to the high degree of muscular effort in the hands and forearms.

CONCLUSION: The endurance exercise on Japanese middle-aged obese women improved insulin resistance without plasma adiponectin and leptin intervention, in addition it related to prevention of vascular disorders by plasma PAI-1 levels.

2623 Board #131
4:00 PM - 5:00 PM
Comparison of Quadriceps Femoris Activation during Elliptical and Treadmill Exercise in Athletes with Patellofemoral Pain Syndrome
Kathleen M. Knutzen, FACSM, Ryan Rodriguez, Lorraine Brillia, FACSM, Lori deKubber. Western Washington Univ., Bellingham, WA. Email: Kathy.Knutzen@wwu.edu
Patellofemoral Pain Syndrome (PPFS) is a common knee disorder and while the causative mechanisms are not clearly defined, the functional role of the Vastus Lateralis (VL) and Vastus Medialis Oblique (VMO) in controlling patellar tracking has been targeted as contributing. In treating PPFS, many physicians recommend exercise on an elliptical trainer to avoid the impact of overground or treadmill running.

PURPOSE: To compare VL and VMO muscle activation while exercising on an elliptical cross trainer (EL) and a treadmill (TM) in subjects with PPFS.

METHODS: Ten males and seven female athletes diagnosed with PPFS by the team physician volunteered as subjects (Age 21±1.6 yr; Weight 80.3±15.6 kg). Following a standardized warm-up, subjects completed two randomized exercise sessions on the EL and TM ranging from 6 to 9 minutes. Electromyographic (EMG) activity of the VL and VMO was sampled (100Hz) at baseline and at 65% of heart rate reserve obtained through a systematic workload adjustment every 3 minutes. A repeated measures ANOVA was applied to evaluate differences in the average EMG generated during the support phase for each machine.

RESULTS: As would be expected, there were significant increases (p<0.05) in VL and VMO activation from the baseline values to 65% HRR for both the TM (VL: -68.3±35.0 µV; VMO: -63.4±58.4 µV; VO2: -68.5±22.6 µV; VO2: -64.1±16.0 µV) and the EL (VL: -63.4±58.4 µV; VMO: -61.3±21.7 µV; VO2: -64.1±51.6 µV; VO2: -62.5±54.6 µV). Initial baseline values were significantly higher for both VL and VMO while exercising on the EL as compared to TM, however increases from baseline to 65%HRR in VL and VMO activity occurred at greater rates on the TM (VL:+60%; VMO:+11%) compared to El(VL: +21%; VMO:+8%).

CONCLUSIONS: These results suggest that there are differences in muscle activation patterns on the TM versus the EL comparing baseline to 65% HRR exercise. The higher involvement of the quadriceps muscles early in the exercise session on the elliptical as compared to the treadmill resulted in the lower initial involvement followed by higher rates of increase seen in the same muscles on the treadmill may influence exercise prescription for individuals with PFPS.

2727 Board #2727
3:00 PM - 4:00 PM
Development of a Metabolic Equation for Elliptical Crosstrainer Exercise
Heidi M. Pederson1, Lance C. Dalleck1, Len Kravitz1, Robert A. Roberts2. 1University of Wisconsin - Eau Claire, Eau Claire, WI. 2University of New Mexico, Albuquerque, NM.

PURPOSE: To develop an accurate metabolic prediction equation for elliptical crosstrainer (ECT) exercise.

METHODS: Forty male and female subjects (mean ± SD, age: 30 ± 7 years; height: 173 ± 11 cm; weight: 72.3 ± 13.8 kg; body composition: 18.3 ± 6.9 %) completed two randomized testing sessions. Steady-state oxygen uptake (VO2) was measured while subjects exercised on the ECT at nine separate workloads during each testing session. Steady-state VO2 measurements from the last 2 min of each workload were used to develop a metabolic prediction equation for ECT exercise.

RESULTS: Multiple regression analysis was used to predict steady-state VO2 from ECT resistance, ETC cadence, and subject body mass, resulting in the in the following model (R² = 0.783):

\[\text{Steady-state VO2} = 3.5 + 1.5(\text{Cadence}) + 1.22(\text{Resistance}) - 0.11(\text{Weight})\]

Both the standard error of the estimate (SEE) and total error (TE) for the prediction of steady-state VO2 under all ECT workload combinations, was 2.8 mL·kg⁻¹·min⁻¹ (see figure). The correlation coefficient between predicted and measured steady-state VO2 values was r = 0.89. A dependent-t test revealed significant mean differences (p<0.05) between predicted (21.2 mL·kg⁻¹·min⁻¹) and measured (21.6 mL·kg⁻¹·min⁻¹) VO2 measurements, although these differences were not interpreted to be practically significant.

CONCLUSIONS: SEE and TE values for the developed ECT metabolic equation are similar to those reported in previous studies investigating the accuracy of metabolic equations for other exercise modalities. These findings support the use of the equation developed in the present study to predict steady-state VO2 for ECT exercise.
Board #134
4:00 PM - 5:00 PM
Accuracy of an Elliptical Crosstrainer Equation for Estimating \( V_{O_2}\max \) in Physically Inactive and Overweight Individuals
Lance Dalleck, Len Kravitz. University of Wisconsin - Eau Claire, Eau Claire, WI.

PurPose: To determine the accuracy of an equation to predict maximal oxygen uptake \( (V_{O_2}\max) \) from a submaximal elliptical crosstrainer test (Dalleck et al. 2008) in overweight and sedentary individuals.

Methods: Nineteen apparently healthy, but physically inactive and overweight subjects (10 men and 9 women, mean ± SD age, height, weight, body mass index (BMI), and elliptical cross trainer \( V_{O_2}\max \): \( 23.7 ± 4.6 \) yr, \( 171.5 ± 9.2 \) cm, \( 91.5 ± 10.2 \) kg, \( 31.1 ± 2.7 \), and \( 34.5 ± 7.1 \) mL·kg\(^{-1}\)·min\(^{-1}\), respectively) completed an elliptical crosstrainer submaximal (three 5-min submaximal stages) and \( V_{O_2}\max \) test, separated by a 15-minute rest period.

Results: The following equation was applied to data from the overweight and inactive group:

\[
V_{O_2}\max = 73.767 + 7.383(\text{Gender}) - 0.317(\text{Weight}) + 0.003957(\text{Age}^2)(\text{Cadence}) - 0.006452(\text{Age})(\text{Heart rate at Stage 2})
\]

The standard error of the estimate and correlation for the predicted maximal oxygen uptake values were \( R^2 = 0.83 \), \( p < 0.05 \), respectively. The correlation coefficient between the predicted and measured \( V_{O_2}\max \) values was \( r = 0.89 \). Dependent \( t \)-test revealed no significant differences \((p = 0.057)\) between predicted \((35.5 \text{ mL·kg}^{-1}\cdot\text{min}^{-1})\) and measured \((34.5 \text{ mL·kg}^{-1}\cdot\text{min}^{-1})\) \( V_{O_2}\max \) measurements.

Conclusion: Results indicate that the elliptical crosstrainer protocol and equation developed previously in healthy and active subjects can be extended to obese, inactive populations for obtaining accurate estimates of \( V_{O_2}\max \) in non-laboratory based settings.

Board #135
2:00 PM - 3:00 PM
Physiological Comparison of TreadClimber versus Treadmill and Elliptical Trainer Exercise
Colleen L. Brenman, Ronald W. Deitrick, FACSM, Michael J. Welikonich, Lauren M. Puzen. University of Scranton, Scranton, PA.

New exercise equipment aimed at faster weight loss, with reduced impact forces, is especially with regard to energy costs continues to serve as the physiological standard of comparison for these new devices especially with regard to energy costs.

Methods: Thirteen (males=7, females=6) college-aged (20.1 ± 1.7 yr) volunteers performed a maximal graded exercise treadmill (GXT) test to assess aerobic power. Following this, three 10-minute sub maximal steady state exercise bouts were performed on separate occasions using the three modes of aerobic exercise in a manner that elicited the desired “hard” RPE intensity. During each sub maximal bout, oxygen consumption \( (V_{O_2}) \), heart rate \( (HR) \), and heart rate \( (HR) \) were measured continuously while systolic blood pressure \( (SBP) \) was taken at the midpoint and at the end of the exercise. RPE was taken every two minutes to ensure a constant level. ANOVA (alpha level=0.05) was used for statistical analysis.

Results: Subjects were above average in maximal aerobic power \((\text{males}=48.7±12.7, \text{females}=45.2±13.9 \text{ mL·kg}^{-1}\cdot\text{min}^{-1})\) while being average in body composition \((\text{BMI} \text{ males}=22.5±1.8, \text{females}=24.9±2.7 \text{ kg·m}^{-2})\). To achieve the desired RPE intensity, subjects exercised at 6.7±1.0 mph 0% grade (TM), 100 watts at 63.7±4.4 rpm (ET), and 3.5±0.4 mph resistance of 8 (TC). Significant VO\(_2\) differences existed between the conditions with the highest being TM and the least being ET with the midrange being TC (38.2±3.9 vs. 31.2±5.1 vs. 28.6±3.9 \text{ mL·kg}^{-1}\cdot\text{min}^{-1} \text{ VO}_{2\text{max}} \text{ TM vs ET vs TC}, respectively). HR results were significantly different between the conditions, being average in VO\(_2\) results \((174.8±9.8, 171.5±12.1, 148.4±14.4 \text{ bpm} \text{ TM, ET, and TC})\) while systolic BP \((\text{SBP})\) was significantly higher for TC \((149.2±15.9)\) compared to TM \((135.2±4.4)\) and ET \((132.7±4.4)\).

Conclusions: When using perceived exertion as the marker for relative exercise intensity, TC consumed 25% less oxygen and thus fewer kcal than TM, perhaps due to reduced weight bearing similar to that of ET. While SBP was significantly higher during TC, the cardiovascular stress as indicated by double product was about the same as the other two modes of exercise because of a significantly lower HR. Compared to TC and ET, treadmill exercise is better in terms of energy expenditure rate with less of an increase in blood pressure than TC.
2630 Board #138 2:00 PM - 3:00 PM
Comparison of the Jaeger Oxygen Mobile Unit with Two Standard Laboratory Metabolic Carts

PURPOSE: Advancements in metabolic oxygen consumption measuring technologies simplify and improves the accuracy of metabolic VO2 measurements. Educational and clinical laboratories use these technologies and rely on their accuracy to perform measurements for their studies and provide clinical diagnosis. Accurate field measures of oxygen consumption are needed to estimate cardiorespiratory fitness outside of the laboratory environment.

METHODS: A concurrent validation of the Jaeger Oxygen Mobile Unit (JOMU, Viasys Healthcare, Yorba Linda, CA) with two standard laboratory metabolic carts, the Vmax Spectra system (Vmax, Viasys Healthcare, Yorba Linda, CA) and the Parvomedics TrueOne2400 Metabolic Cart (Parvo, Parvamedics, Sandy, UT). In 13 trained male subjects, metabolic oxygen uptake values were measured, including ventilation ($V_e$) and fractions expired of oxygen and carbon dioxide (Fo2 and FeCO2 respectively) which were sampled for calculation of O2 uptake ($VO2$) and CO2 production ($VCO2$). Peak values, including peak ($VO2peak$), were also recorded. The JOMU ran in series with the Vmax and the Parvom. Measurements were collected at 50 watt intervals (50-250 Watts) for five minute intervals during a five stage incremental exercise test on a bicycle ergometer. Values during the fourth and fifth minutes were recorded and averaged.

RESULTS: There were no significant differences (p<.05) found in measured $VO2$, $VCO2$, $FeCO2$, and $FeO2$ values between JOMU and Vmax during the five stages and at $VO2peak$ (mean and SD: 52.31 ± 4.94 vs. 49.95 ± 8.39 ml/min/kg), respectively. There were no significant differences in measured $VO2$, $VCO2$, $FeCO2$, between JOMU and Parvom during the first four stages (p<.05), however significant differences in $VO2$, $VCO2$, $FeCO2$, and $FeO2$ (all p<.05) were found during the fifth stage and at $VO2peak$ (52.31 ± 4.94 vs. 57.32 ± 5.89 ml/kg). The source of variation at peak was likely due to the differences noted in $Ve$ between these two devices.

CONCLUSIONS: These results indicate that the JOMU is a valid and reliable metabolic oxygen consumption measuring device that can estimate oxygen uptake in the field.

2631 Board #139 3:00 PM - 4:00 PM
Comparison of the Vacu-Med Motorized Syringe with the Douglas Bag Method in Measuring Ventilation, $VO2$ and $VCO2$
Jennifer A. Wismann, Scott V. Baker, J.W. Yates, FACSM. University of Kentucky, Lexington, KY.

Oxygen consumption ($VO2$) measurement has progressed from the use of Douglas bags (DB) to an assortment of automated metabolic carts employing different methods for measuring $VO2$, carbon dioxide production ($VCO2$), and minute ventilation ($V_e$). The accuracy of the metabolic carts has been repeatedly investigated using a variety of measurement techniques which are not always exchangeable. The importance of measuring $VO2$ in our field and the need to assess the accuracy of a variety of metabolic systems has led to the development of a commercially available metabolic calibrator.

PURPOSE: To evaluate the performance of a mechanical calibration system for accuracy against the standard, DB method.

METHODS: The mechanical calibrator was compared to the DB technique over a wide physiological range that was within the capability of the calibrator, spanning possible $VO2$ values of 500-3200 ml/min. Room air and calibration gas (21.15% CO2 and 0.03% O2, and balance N2) were mixed in the pumping syringes of the calibrator and evacuated into the DB. The gas in the DB was analyzed for volume and concentration, and $Ve$, $VO2$, and $VCO2$ were calculated. The DB values were compared to the calculated values from the mechanical calibrator using software provided by the manufacturer. Statistical differences between measured and predicted values were determined for $Ve$, $VO2$, and $VCO2$ using a one-sample student t-test in SPSS. Linear regressions were then used to locate the source of error for each variable.

RESULTS: The mechanical calibrator over-estimated $VO2$ values by a mean of 107.4±98.5 ml/min (p<0.001), which was a 4.9±8.2% error. There appeared to be a trend in $VO2$ error, as the mechanical calibrator became increasingly inaccurate in $Ve$ increasing $Ve$. Consequently, a regression equation was developed for $VO2$ values exceeding $VO2peak$ 950 ml/min. With the use of this correction equation, the mechanical calibrator underestimated $VO2$ values with a -0.23% error. $VCO2$ was under-produced by the calibrator with a mean of 6.9±6.9 ml/min (p<0.001), with -1.65±9.23% error. Furthermore, the mechanical calibrator underestimated $VCO2$ produced by a mean of 0.98±.78 l/min (p<0.169), calculating to -1.40±2.76% error.

CONCLUSION: For $VO2$ values exceeding 950 ml/min, a regression equation is needed is needed to correct for the high $VO2$ values produced by the calibrator. $VCO2$ and $Ve$ errors are within acceptable standards for evaluating metabolic carts.

2632 Board #140 2:00 PM - 3:00 PM
Valid EX of the LifeStyler EX Activity Monitor
Carolyln Albright, Cherilyn N. Hultquist, Dixie L. Thompson, FACSM. University of Tennessee, Knoxville, TN.

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The accuracy of physical activity monitors must be determined before use as objective measuring tools in research.

PURPOSE: To examine the accuracy of the LifeStyler EX activity monitor as a step counter, method of calculating resting metabolic rate (RMR), and in measuring energy expenditure (EE) during activity.

METHODS: Ten males and 10 females had their RMR measured using indirect calorimetry (IC). Subjects then performed a 9-stage treadmill test at increasing speeds from 2 to 6 mph. Speeds were increased 0.5 mph at the end of each 4-minute walking stage or 6-minute running stage. A 2-min rest period was taken between each stage. Steps were hand tallied (HT) and EE was measured by IC during activity. Subjects wore 2 LifeStylers, one of each side of the waistband.

RESULTS: There were no measurement differences between LifeStylers for any stage (p>0.05). A difference in step counts between the LifeStyler and HT was found only at speeds of 2.0 mph (p=0.006; mean difference = 33.2±8.66 steps) and 2.5 mph (p=0.002; mean difference = 73.5±2.95 steps). These step differences reflect an undercounting of 8.4 and 1.7 percent for those speeds, respectively. The LifeStyler underestimated net and gross EE compared to IC at all treadmill speeds (p<0.05) for both genders. The average difference in EE for all stages was 4.41±5.52 kcal for net and gross EE, respectively. The LifeStyler significantly underestimated RMR compared to IC for both genders (p<0.001; mean difference = 194.22±145.48 kcal/day).

CONCLUSION: The LifeStyler EX underestimated RMR for males and females and consistently underestimated EE for both genders during treadmill walking and running. Step counts were only inaccurate at slow walking speeds, but the level of undercounting steps was small in comparison to many previously investigated pedometers.

2633 Board #141 3:00 PM - 4:00 PM
Determination of Exercise Intensity On The Ramp® Exercise Device
Timothy P. Zachrich, Lauren N. Snyder, Amy L. Morgan, FACSM, Lynn A. Darby, FACSM. Bowling Green State University, Bowling Green, OH.

Email: zachrich@bgsu.edu

It has been suggested that exercising on The Ramp® exercise device will improve cardiovascular (CV) fitness.

PURPOSE: To determine whether exercising on The Ramp® exercise device provides adequate intensity to improve CV fitness, according to the guidelines set by the American College of Sports Medicine (ACSM).

METHODS: Fourteen apparently healthy, active, college-aged individuals (n = 7 female, n = 7 male; 22.9±2.1 year; average VO2= 58.4±7.3) completed a graded maximal treadmill exercise test in which oxygen consumption ($VO2$), heart rate (HR), and rating of perceived exertion (RPE-Borg) were measured. On a separate day, participants exercised according to The Ramp® video tape instructions. VO2, HR, and RPE were recorded each minute.

RESULTS: No subjects reached the required 65-80% of their VO2max (24.4% ± 8.9%) or HRmax (51.1% ± 6.8%). Females, on average, were exercising at a slightly higher percent of VO2max and percent of HRmax than males. This resulted in the females exercising at 26.15% higher percentage of VO2max and 6.4% higher percentage of HRmax than males; however, these differences were not statistically significant. During the video, VO2 and RPE responses were similar for males and females (VO2: M= 11.7.2±5, P= 13.6 ± 3.6 ml/kg/min; RPE: M= 7.1 ±1.8, P= 7.0 ± 1.3).

CONCLUSIONS: There are three ways to gauge exercise intensity: 1) percent of HRmax and VO2 max using the zero-to-peak method; 2) percent HRreserve and VO2 reserve, which factors in resting VO2 and resting HR; 3) RPE. Since pre-exercise HR was measured instead of resting HR, and resting VO2 was not measured, accurate calculations of HRreserve and VO2 reserve were not possible. RPE during the exercise video reached an average of 7.0 ± 1.6, where six equals "no exertion at all" and 20 equals maximal exertion. In addition, RPE during graded exercise tests may not consistently translate to the same intensity using different modes of exercise. Using the zero-to-peak method of percent HRmax and VO2 max, subjects did not reach the recommended percentages prescribed by the ACSM (2006). The video used for this study was the basic entry level exercise video, and the additional, more intense instructional videos may provide the intensity level appropriate for improving CV fitness.

2634 Board #142 4:00 PM - 5:00 PM
Accuracy of Two Fitness-Related Global Positioning Systems for Measuring Distance While Running
Daniel J. Keef, Mandi N. Dupain. Millersville University, Millersville, PA. (Sponsor: Don W. Morgan, FACSM)

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Fitness-related Global Positioning Systems (GPS) could be used by researchers as a tracking tool for quantifying distance traversed. The 95% accuracy of these devices claimed by their manufacturers, however, has never been tested.

#1362-1849-WEDNESDAY, MAY 31 | #1850-2268-TUESDAY, JUNE 1 | #2269-2726-FRIDAY, JUNE 2 | #2727-2915 - SATURDAY, JUNE 3
PURPOSE: To examine the accuracy of two brands of fitness-related GPS units, the Garmin Forerunner 201 and TomTom Ironman Platinum Model 58081, during running.

METHODS: Twenty-two subjects (13 men, 9 women) were asked to run two 5-km bouts around a 400 meter track within one week. During one 5-km run, the subject wore the Garmin unit on his/her upper arm (GA) and the TomTom unit was clipped to the waist (TW). During the other 5-km run trial, the Garmin unit was strapped to the wrist (GW) and the TomTom unit was affixed to the upper arm (TA). All GPS units were positioned on the left side of the body. The order of the two trials was randomly selected but occurred at the same time of day.

RESULTS: The mean values (±SD) for the GA, GW, TA, and TW were 5.15 (± 0.16), 5.18 (± 0.01), 5.15 (± 0.07), and 4.83 (± 0.10) km, respectively. All four unit placement sites were shown to be significantly different (p < 0.05) than the 5-km distance. The accuracy of these devices, however, was determined to be between 96% and 97%.

CONCLUSION: Fitness-related GPS devices provide a fairly accurate representation of distance traveled during running on a flat surface.

2635 Board #143 2:00 PM - 3:00 PM
Tri-axial accelerometry as a simple means to estimate fast running speeds
John Wilson1, Olivia Haddow1, Jonathan Clark1, Laura Irwin2, Chris Easton1, Barry Fudge1, Beng Kayser1, Yannis Pitsiladis2, 1International Centre for East African Running Science (ICECARS), University of Glasgow, Glasgow, United Kingdom. 2University of Geneva, Geneva, Switzerland.

Little is known about the energy cost of running in the field as most research has been conducted in laboratory settings. Assessment of physical activity using accelerometry is becoming more frequent mainly due to the ease of its use and relatively low cost. Previous studies have failed to observe a linear relationship between accelerometer counts and fast running speeds. For example, activity counts leveled off at approximately 10,000 counts/min at a running speed of 9 km/hr when measured using uni-axial accelerometry (Brage et al. Med. Sci. Sports Exer. 35: 1447-1454, 2003).

PURPOSE: To determine the relationship between activity counts measured by tri-axial accelerometry and 1) running speed, 2) heart rate (HR), and 3) oxygen uptake (VO2).

METHODS: Eight trained subjects completed a maximal discontinuous incremental running test on a motorized treadmill (Woodway PPS55 Med, Weil am Rhein, Germany) at speeds corresponding to 8, 10, 12, 14, 16, 18, and 20 km/hr, or until volitional exhaustion. Subjects completed 3 min of exercise at each running speed, followed by 3-5 min recovery. Activity counts (tri-axial accelerometer, 3dNX2, BioTel Ltd, Bristol, UK), HR (Suunto t6, Suunto Oy, Vantaa, Finland), and gas exchange variables (breath-by-breath using a quadrupole mass spectrometer, QP9000, Morgan Medical, Gillingham, Kent, UK) were measured throughout exercise.

RESULTS: Activity counts increased linearly with treadmill running speeds (r = 0.985, p < 0.001) (Figure 1). In addition, activity counts during running were significantly correlated with HR (r = 0.988, p < 0.001) and VO2 (r = 0.990, p < 0.001).

CONCLUSIONS: The finding of a linear relationship between activity counts measured by tri-axial accelerometry and running speeds up to world-class marathon running pace raises the intriguing possibility that this technology could be used for metabolic monitoring of endurance athletes during free-living, training and competition when combined with other easily obtained measures (e.g. HR and foot-ground contact times).

Supported by BioTel Ltd, Bristol, UK

2636 Board #144 3:00 PM - 4:00 PM
GPS-Based Prediction of Energy Expenditure for Slow and Fast Outdoor Walking
James M. McKenzie, Tommy F. Manning, Daniel P. Heil, FACSM. Montana State University, Bozeman, MT. Email: jmckenziete@montana.edu

GPS monitors may prove to be an invaluable tool for investigations for Free-Living Activities but first need to be assessed as valid research instruments.

PURPOSE: The purpose of this study was to determine the accuracy of GPS monitors for estimating energy expenditure (EE) for slow and fast outdoor walking and to evaluate differences in the predictive ability of wrist and waist-worn GPS monitors.

METHODS: Thirteen subjects (28.4 ± 2.8 yrs, 67.2 ± 12.2 kg, 171.7 ± 9.4 cm) volunteered to complete a 2.4 km course at self-selected slow and fast walking paces. The course started at 1500m and featured 60 m elevation gain and 60 m elevation loss. The course distance was measured using a calibrated measuring wheel. Heart rate was monitored to identify intensity for each pace, insure constant intensity at each pace, and verify a distinction between fast and slow paces for each subject. Each subject carried two WAAS-Enabled GPS monitors, one wrist-worn and one waist-worn, as well as a portable metabolic unit to measure EE (total mass = 2.35 kg). GPS accuracy was reported as ± 5 m for all trials. Time for each trial was measured using a stopwatch. Equations were used to estimate the energy cost of running from speed and grade (Minetti, 2002), as well as the energy cost of wind resistance (Pugh, 1970) to calculate the total EE (EEtot) for walking. Metabolic data collected was converted from VO2 and VCO2 into Kcals using the equation by Weir (1949). Comparisons between EE and EETot were made using repeated measures ANOVA.

RESULTS: Prior to data analysis, two outliers were removed due to exceedingly large values for EETot (130.4 ± 15.4 Kcals) and EE (107.4 ± 25.8 Kcals) which were significantly different (p<0.01) when both GPS monitors and speeds were considered. There was no significant difference between the two GPS monitors for predicting total EE (126 ± 24.3 and 132 ± 3.1 Kcals). Intensity distribution of documented runs (p=0.20), EE during fast walking (124.7 ± 22.1; p=0.11), or EE during slow walking (132.9 ± 26.7; p=0.041). Using only wrist-worn GPS data, EE (132.7 ± 26.7 Kcals) and EE (130.1 ± 25.3 Kcals) were made using repeated measures ANOVA.

CONCLUSIONS: The WAAS-enabled GPS monitors significantly over-predicted EE except when the analysis was limited to fast-paced walking. GPS monitor placement should not be a concern for future studies, as both the wrist and waist-worn GPS monitors provided similar estimates for EE across all conditions. Due to variance in the GPS signal, GPS monitors appear better suited to estimate EE for fast walking (or possibly slow walking), rather than slow walking.

2637 Board #145 4:00 PM - 5:00 PM
Accelerometer Based Sensor Technology in Running Training
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Nowadays short, long to ultra-long runs are becoming more popular in both leisure time fitness as well as in professional sports. Several scientific studies on endurance capacity of runners have been published, but only few report true physiological parameters of actual completed running loads under field conditions.

PURPOSE: This study aimed to find out how running distance and velocity results using innovative running computer with accelerometer based sensor technology can be used in detection of running amount and intensity.

METHODS: A group of 27 male (M) (31±6 yrs, 181±16 cm, 78±7 kg) and 23 female (F) (28±5 yrs, 167±5 cm, 59±5 kg) participants were measured throughout a training period of 6 months. Running volume (Rv) and velocity (v) were measured using accelerometer based sensors placed on top of a running shoe. Additionally heart rate (HR) was monitored during all running training. Standardised physiological measurements in pre- and post-training phase were conducted using a maximal graded load test (GLT) on a treadmill. Descriptive and group-specific parametric statistical data analysis (ANOVA) was applied.

RESULTS: On the basis of their individual running performance in pre-GLT test at 4 mmol/l (v) lactate was used to classify the group in good (E1 VO2max = 65±9 (M: n=3), 67±4 (F: n=2) lactate and less (E2 VO2max = 53±3 (M: n=3), 49±6 (F: n=2) lactate) trained runners. Mean Rv ranged between 20(E2) and 50(E1) km respectively during the (2) and (1) h per week. Mean v of all running sessions (n=2016) ranged between 2.5(E2) and 3.2(E1) m/s and was completed with an average HR of 149(E1) and 151(E2) bpm. Intensity distribution of documented runs and mean HR were as follows: E1 completed >70 % of total running volume with intensity less than 80 %v max. In contrast to group E1, group E2 runners showed a broader range of all training intensity zones. Proportions of high intensive training were significantly higher in E2 (p<0.01). Percentage distribution of heart rate relating to intensity categories of single runs showed lower proportions (~ 5 %) of intensity zones less than 80 %v max in male compared to female athletes.

CONCLUSIONS: Clear differences between intended training and solved running load were observed. Recording of distance, velocity in conjunction with a heart rate monitoring provided useful data to runners and helped athletes to a better adjust their training running. #1362-1849-WEDNESDAY, MAY 31 #1850-2288—THURSDAY, JUNE 1 #2269-2726—FRIDAY, JUNE 2 #1727-2915 - SATURDAY, JUNE 3
Variations in gait speed and gait variability together accounted for 49% of the variance in error score, with gait speed accounting for 42%. The results for pedometer percent accuracy for the groups split by gait speed and gait variability are displayed in the table below.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Accuracy (%)</th>
<th>Median Accuracy (%)</th>
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</thead>
<tbody>
<tr>
<td>Slow walkers</td>
<td>88.2</td>
<td>90.0</td>
</tr>
<tr>
<td>Fast walkers</td>
<td>95.5</td>
<td>98.2</td>
</tr>
<tr>
<td>High variability</td>
<td>92.5</td>
<td>98.9</td>
</tr>
<tr>
<td>Low variability</td>
<td>88.2</td>
<td>90.0</td>
</tr>
</tbody>
</table>

Additional results indicated that the pedometer counted 89% of the actual steps taken. Gait speed was determined from the 100m walk. To measure gait variability, participants walked on a paper walkway with ink pads on their shoes, and step length was recorded simultaneously from the extensor carpi ulnaris of the dominant forearm and the contralateral frontal lobe using a dual wavelength spectrometer (MicroNIR, NIM Inc., PA). Delta values were calculated as the difference between the resting value just before initiation of contraction and the maximum value observed during the test and/or recovery period. Values for the two protocols were pooled (N = 12) for statistical analysis.

**RESULTS:** During trials 1 and 2, Mox and Mbv were shown a consistent decrease (-0.306±0.069, -0.270±0.082, -0.306±0.086 and -0.315±0.054 respectively), whereas Cox and Cbv demonstrated a continual increase (0.069±0.027, 0.076±0.036, 0.076±0.036 and 0.033±0.015 respectively). The intraclass correlation coefficients for the Cox, Cbv, Mvx and Mbv were 0.86 (p<0.001), 0.82 (p<0.004), 0.60 (p=0.083) and 0.32 (p=0.281) respectively. No significant differences were observed between the mean values of the two sessions for each of the variables (p=0.106, 0.372, 0.639, and 0.216 for Cox, Cbv, Mvy, and Mbv). Bland-Altman analysis indicated no outliers for the center measurements, whereas there was one outlier for the Mbv. The half recovery time for Mox (an index of muscle aerobic capacity) demonstrated moderate reliability (ICC = 0.72, p<0.025).

**CONCLUSIONS:** The evidence indicates that: (1) the Cox, Cbv and Mox responses, as well as half recovery time for Mox, measured by MIRs are reproducible, and (2) the consistency of the measurements is higher in cerebral compared to muscle tissue.

Funding: First author was supported by Ministério da Educação / CAPES, Brazil.
The ACSM and CDC currently recommend accumulating 30 minutes or more of moderately intense exercise on most days of the week. Moderate intensity is defined in various ways both absolutely and relatively, but no studies to date have determined how constraining ratings of perceived exertion might impact self-selected intensities from two types of treadmill exercise: ungraded jogging and graded walking.

**PURPOSE:** Determine how ungraded jogging and graded walking at the same moderate level of perceived exertion (RPE) might differ in terms of heart rate, oxygen consumption, VO2, and pain.

**METHODS:** Twelve participants (5 male, 7 female, mean age = 21.2 years, mean BMI = 24.9) were tested for aerobic fitness using a multi-stage, incremental treadmill protocol to determine VO2max (mean = 36.2 ml kg⁻¹ min⁻¹). Participants were then asked to complete two trials of moderately intense exercise on the treadmill. Each trial included a graded warm-up that allowed for a moderate intensity (RPE of 13 on the Borg 6-20 scale) to be achieved and maintained 30 minutes for graded walking (WALK) at a constant speed and grade. Treadmill speed and grade were varied throughout the trial to elicit the desired RPE response.

**RESULTS:** Data were analyzed using pairwise comparisons and reported as means and standard deviations. Measurements of RPE (WALK: 12.6±2.74; JOG: 12.6±2.82) indicated no significant differences (p=0.05) between trials suggesting the manipulation to produce similar perceived exertion was successful. HR (WALK: 146±20 beats x min⁻¹; JOG: 168±18) and VO2 (WALK: 20.9±5.4 ml kg⁻¹ x min⁻¹; JOG: 26.5±7.0) were significantly higher (p=0.05) for the ungraded jogging trial. No significant differences (p=0.05) were observed for pain (WALK: 1.9±2.4; JOG: 2.1±2.3).

**CONCLUSIONS:** These findings provide evidence that similar perceptions of effort during graded walking and ungraded jogging do not produce similar cardiovascular and metabolic workloads. These data suggest that, for a given level of perceived effort, jogging provides a greater stimulus for fitness benefits and caloric expenditure without increasing reported pain in this young, relatively unfit sample. This research suggests that jogging provides a superior cardiovascular and metabolic stimulus for health and fitness benefits when compared to graded walking conducted at the same level of exertion.

**2643 Board #151 4:00 PM - 5:00 PM**

**Partial Vascular Occlusion Significantly Altered RPE, Pain, and Lacate during Resistance Exercise**

Daniel B. Hollandier, Gregory V. Reeves, Robert R. Knaemer, FACSM, Jordan D. Clavier, Michelle Francois, Jennifer J. Jeunme, James Tryniecki, Southeastern Louisiana University, Hammond, LA. (Sponsor: Robert R. Knaemer, FACSM)

Recent studies utilizing partial vascular occlusion during resistance exercise demonstrated that low workloads with partial occlusion resulted in local muscle ischemia and subsequent increase in muscle sympathetic neural activity similar to moderate heavy loads. Perceptual responses to an ischemic environment are unknown.

**PURPOSE:** The purpose of the present investigation was to employ partial occlusion and describe how peripheral manipulation of muscle oxygen delivery impacted RPE, pain, and lactate levels.

**METHODS:** Three exercise conditions of light resistance with partial occlusion (LRO), moderate resistance with no occlusion (MR), and partial occlusion without exercise (OO) were performed by 7 subjects (21.7 ± 5 yrs) once a week for 4 weeks. Three sets of single-arm biceps curls and single-leg calf presses with partial vascular occlusion by an inflatable cuff placed proximal to the working muscle were completed to failure, with one-minute isometric rest periods. Workloads approximating 30% and 70% 1RM for each exercise were performed for the LRO and MR trials. RPE and pain changes were assessed on a 0-10 scale, immediately after each set. RPE and pain were determined when they became noticeably greater than the pre-exercise RPE and pain level. When a participant reached a 12 RPE and pain of 6 with no pain significantly different. Lactate concentration was determined at the end of the study.

**RESULTS:** MANOVAs with Bonferroni corrections were performed on RPE and pain and demonstrated that both noticeable differences and reaching a rating of 6 on RPE and pain were significantly different per trial and exercises (P<0.001). Univariate tests demonstrated that MR and LRO trials were different than the OO trial and that only the LRO conditions were the ratings of 6 for pain significantly different. Lactate concentration was determined at the end of the study.

**CONCLUSIONS:** These exercise conditions combined with partial vascular occlusion elicits similar RPE and pain response compared to a moderate resistance exercise trial.

### Table 1: Mean ± SE Repetitions to Reach Pain and RPE of 6

<table>
<thead>
<tr>
<th>Set</th>
<th>Reps to Pain</th>
<th>Reps to RPE 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.0 ± 0.6</td>
<td>1.8 ± 0.7</td>
</tr>
<tr>
<td>2</td>
<td>2.8 ± 0.3</td>
<td>2.6 ± 0.2</td>
</tr>
<tr>
<td>3</td>
<td>3.2 ± 0.5</td>
<td>3.1 ± 0.4</td>
</tr>
</tbody>
</table>

Pain is associated with reduced exercise adherence and the meaning of pain has been theorized to influence pain response.

**PURPOSE:** This investigation examined participants’ cognitive appraisals of the harmful or beneficial nature of delayed-onset muscle pain and the relationships among these appraisals, delayed-onset muscle pain ratings, and self-reported exercise behavior.

**METHODS:** Participants (N=113; 58.4% women) described their cognitive appraisals of delayed-onset muscle pain, their most recent delayed-onset muscle pain experience, and their self-reported delayed-onset exercise behavior. In addition, a subset of the participants (n=63; 71.4% women) completed 3 sets of 10 eccentric repetitions with their non-dominant arms to induce delayed-onset muscle pain, which was measured by pain intensity and pain unpleasantness at 48 hrs post-exercise.

**RESULTS:** Few participants viewed delayed-onset muscle pain as generally representing harmful muscle damage (2.7%) so analyses were restricted to the most common appraisals of the delayed-onset muscle pain as representing beneficial muscle adaptation (64.6%) and as representing a combination of both harmful damage and beneficial adaptation (28.9%). These cognitive appraisals of delayed-onset muscle pain were not related to total self-reported leisure exercise, but the appraisals significantly explained 6.8% of recalled muscle pain intensity, F(1,184) = 6.09, p < .05, and 4.4% of recalled muscle pain unpleasantness from the participants’ most recent delayed-onset muscle pain experience, F(1,184) = 3.85, p < .05. More specifically, the delayed-onset muscle pain as representing both harmful damage and beneficial adaptation was related to higher pain ratings than viewing the pain as representing only beneficial adaptation. However, cognitive appraisals were not related to the induced muscle pain intensity or pain unpleasantness at 48-hrs post-exercise.

**CONCLUSIONS:** These healthy participants largely viewed delayed-onset muscle pain as representing beneficial muscle adaptation and their cognitive appraisals were not related to self-reported leisure time exercise behavior. The relationships between cognitive appraisals and recalled or actual delayed-onset muscle pain ratings were divergent, which may have been due to collecting appraisals of delayed-onset pain in an abstract sense instead of collecting specific appraisals of the induced delayed-onset muscle pain. Future studies comparing the meaning and effects of personally-experienced delayed-onset muscle pain within healthy and clinical samples is warranted.
1-RM at the criterion RPE of 4, 6 and 8. Paired sample t-tests were used to compare pre- and post-training percent 1-RMs at each criterion RPE.

RESULTS: 1-RM for LP increased (p = .001) from the orientation trial (90.25 ± 29.76 kg.) to completion of the 12-week resistance exercise (121.8 ± 29.64 kg.). At the criterion RPE of 4, pre-exercise percent of 1-RM was 36.84 ± 21.23 and post training percent of 1-RM was 61.08 ± 14.91. At the criterion RPE of 6, pre-exercise percent of 1-RM was 54.72 ± 10.56 and post training percent of 1-RM was 74.07 ± 11.14. At the criterion RPE of 8, pre-exercise percent of 1-RM was 72.58 ± 12.22 and post training percent of 1-RM was 86.65 ± 8.43. Percent 1-RM was different (p = .001) from pre- to post-training at each criterion RPE.

CONCLUSIONS: To our knowledge, the OMNI-RES has not been used to track strength training responses in older men and women. In the current investigation, at the same level of effort (i.e. RPE 4, 6 and 8), there is a post-training increase in leg press strength based on the percent 1-RM accomplished. This demonstrates that the OMNI-RES is a valid metric to track training induced changes in muscle strength.

2647 Board #155 2:00 PM - 3:00 PM Free Communication/Poster – Exercise Testing

FRI, JUNE 2, 2006 9:00 AM - 12:00 PM
ROOM: Hall B

POLYNOMIAL FUNCTION IDENTIFIES THE LACTATE MINIMUM BY A VARIETY OF COMBINATIONS OF INTEGRAL STAGES
Rafael Soltero, Emerson Pardono, Thiago Alhayde, Carmen S. G. Campbell, Herbert G. Simões. Catholic University of Brasilia, Brasilia, Brazil. Email: isotero@ucb.br

PURPOSE: To compare lactate minimum (LM) velocities, identified by visual inspection as well as by modeling the blood lactate (lac) response through a second grade polynomial function (PP) in a variety of combinations of incremental stages.

METHODS: Fourteen physically active men (25.5 ± 4.7 years; 73.6 ± 8.2 Kg; 174.6 ± 6.0 cm; 12.5 ± 3.9 % body fat) performed the following running track tests 48 hrs apart: 1) mean velocity on a 1600m time trial (Vm1600m); 2) after 10-min of recovery from 6.0 cm; 12.5± 3.9 % body fat) performed the following running track tests 48 hrs apart:

PURPOSE: To investigate the reliability of pain measurement and perception using a pressure-induced pain device, and to examine the effects of submaximal isometric contractions on pressure pain perception in men and women.

METHODS: Pain perception was assessed using a pressure stimulus consisting of a 1 kg weight mounted on a plastic edge and placed on the forehead for two minutes. Subjects pressed a viewing device when they first felt pain (pain threshold) and pain ratings were reported every 20 seconds using a 0-10 scale. At the first session, reliability of pain measurement using the pressure-induced pain device was assessed by measuring pain perception before and after a 30-minute rest period. At the last two sessions, pain perception was measured before and after the performance of a submaximal isometric contraction of the elbow flexor muscles 25 minutes after the first pain assessment. These last two sessions were randomized with subjects performing an isometric contraction at 25% of their maximal voluntary contraction force until task failure or for two minutes.

RESULTS: Pain thresholds and pain ratings were similar before and after 30 minutes of rest for men and women (p > .05). However, women had lower pain thresholds (p = .0019) and higher pain ratings (p = .04) than men before and after the 30-minute rest. Pain ratings decreased for both men and women following the submaximal fatiguing contraction at task failure (p = .001) but not after the 2-minute contraction. Pain threshold increased for both men and women following the submaximal fatiguing contraction at task failure (p = .001) but not after the 2-minute contraction.

CONCLUSION: 1) Pain thresholds and pain ratings were repeatable with the pressure-induced pain device after 30 minutes. 2) Pain perception is more likely to decrease following a low intensity submaximal contraction held to task failure than after 2 minutes, and 3) Women have higher pain ratings and lower pain thresholds than men at rest and after the performance of submaximal voluntary contractions.

2648 Board #156 3:00 PM - 4:00 PM The Effects of Different Upper Body Positions on Physiological Response during Maximal and Submaximal Cycling
Chun-chung Chou1, Hsien-Chang Pan1, Jung-Chung Lir1. National Taichung Institute of Technology, Taichung City, Taiwan Republic of China.

To assess the reliability and validity in measuring aerobic fitness of the protocol of running speed variance by heart rate control (RSVinc.) on treadmill could be a new material to assess aerobic fitness under sub-maximal running intensity.

PURPOSE: To determine whether different positions on cycling ergometer may affect the results obtained from exercise testing is not a goal. This is aimed to study how to compare physiological variables from different upper body positions, i.e. upright position (UP) and an aero position (AP), at maximal and submaximal exercise on cycling ergometer.

METHODS: Ten healthy males (age 23.3 ± 1.0y; weight 75.6 ± 6.7 kg; VO2 max 72.6 ± 7.3 kg) with no habitual training were recruited to participate in this experiment. By counter-balanced design, all subjects completed 2 exercise tests under different positions respectively on different days, which were maximal test and 30 minute graded-submaximal exercise test (45% VO2 max 10 min, 55% VO2 max 10 min, 65% VO2 max 10 min) in both UP and AP. Physiological responses (VO2 max, VO2 EL, VE, HR) were obtained for analysis.

RESULTS: In maximal test with UP, subjects had significantly greater VO2 max (41.4 ± 4.9 vs. 37.1 ± 4.6 ml/kg/min, p < .05), VO2EL (263.3 ± 19.7 vs. 111.3 ± 24.6 ml/min, p < .05), HRmax (185.6 ± 6.6 vs. 180.7 ± 8.5 beats/min, p < .05) and time to exhaustion (671.7 ± 56.9 vs. 651.6 ± 55.7 sec, p < .05) responses than with AP. In submaximal test at 45% VO2 max, it is noted that subjects had significantly greater oxygen uptake (VO2) (19.9 ± 3.37 vs. 20.85 ± 3.59 ml/kg/min, p < .05) and heart rate (HR) (124.4 ± 12.9 vs. 128.3 ± 12.0 beats/min, p < .05) in AP than in UP. In submaximal test at 55%VO2 max and 65%VO2 max, there was no significant difference between two positions.

CONCLUSIONS: Different body positions affect physiological responses when they are tested at maximal and 45% VO2 max submaximal exercise intensities in cycle ergometer. For maximal exercise testing, UP should be employed in order to achieve individual maximal physiological response on cycle ergometer.

2649 Board #157 4:00 PM - 5:00 PM The Reliability and Validity of Running Speed Variance by Heart Rate Control (RSVinc.) on Treadmill
Soun C. Wang1, Bi N. Lin1, Yu S. Wang2, Yen C. Huang3, Hsin L. Chen1, Chung F. Wu1, Ting Y. Wang3, Wen H. Cheng1. University of Cheng Cheng, Chiayi County, Taiwan Republic of China.1National Taichung Institute of Technology, Taichung City, Taiwan Republic of China. Email: grscw@ccu.edu.tw

NOWADAYS, the exercise equipment manufacturers have added heart-rate-monitor controlled programs to their equipment popularly. To compare common performance in running studies, like maximum oxygen uptake or critical velocity, which always let subjects to exhaustion however using the function of heart rate control on treadmill could be a new material to assess aerobic fitness under sub-maximal running intensity.

PURPOSE: To assess the reliability and validity in measuring aerobic fitness of the protocol of running speed variance by heart rate control (RSVinc.) running at 80% of age-predicted maximum heart rate on treadmill.

METHODS: Subjects were 44 volunteer Taiwan college students (28 males and 16 females, age: 20.82±2.75 years, height: 168.93±5.7 cm, weight: 62.90±9.87 kg) who were asked to run twice by the RSVinc. protocol on treadmill one day apart at least. The RSVinc. protocol asked subjects and sum up 3 minutes at 6 km/h. When the end of warming up, subjects’ heart rate were over 120 beats/min, the velocity start at 9 km/h otherwise at 10 km/h then turned up or down 0.5 km/h every 30 seconds to keep constant heart rate at 80% of age-predicted maximum heart rate. All participants (21 males and 5 females) were asked to undergo a graded treadmill test using the modified Bruce testing protocol, in order to acquire the measure of VO2 max. Using the linear regression of time and running distance to determine RSVinc. and compare the reliability and validity by Pearson Product Moment correlation coefficient.

RESULTS: Treadmill RSVinc. (2.08±0.44 m/s; male: 2.73±0.53 m/s; female: 2.08±0.44 m/s) was associated with VO2 max (49.80±7.06 ml/kg/min, male:
51.38±5.58 mL/kg/min, female 40.78±5.50 mL/kg/min) at r values at 73, 79 and 75, respectively (p<0.05). The test-retest reliability of $R_{SV_{max}}$ (2.58±0.62 mL/min, male: 2.84±0.58 mL/min, female: 2.13±0.39 mL/min) was significant correlation to the first time ($r$ = 0.95, 0.93 and 0.94, respectively, p<0.05) and no significant difference between two test (p>0.05).

CONCLUSIONS: Running at 80% of age-predicted maximum on a treadmill, using $R_{SV_{max}}$ is a reliable and valid protocol for measuring aerobic fitness and this measure is highly recommended for its practical usage on the treadmill for its easy execution and simple test procedures.

2650 Board #158 2:00 PM - 3:00 PM
Maximal Lactate Steady State Prediction Through Polynomial Modeling of the Three Stage Lactate Minimum Test
Emerson Pardono, Rafael da Costa Sotero, Wolsysson Hyane, Marcio Rabelo Mota, Carmen Silvia Grubert Campbell, Herbert Gustavo Simões. Catholic University of Brasilia, Brasilia, Brazil. Email: epardono@hotmail.com

PURPOSE: This study compared the maximal lactate steady state (MLSS) and lactate minimum (LM) intensities as determined by modeling the blood lactate (lac) response through a second grade polynomial function (PF) in a variety of combinations of incremental stages.

METHODS: Eleven male cyclists (27.2±4.5 yrs, 173.7±5.6 cm, 69.5±10.8 kg and 12.0±5.5 percent of body fat) performed an incremental test (IT - Lode Excalibur) after eight weeks of recovery from a 16-week Wingate test for lact elevation. The initial load of IT was 75W with 30 increments at every three minutes. Both lact (YSI 2700S) and rate of perceived exertion (RPE) were measured at the end of each stage. The LM intensity was determined visually (VLM) as well as by modeling the lac response through PF by using: 1) all stages (LMP: 2) the first stage, RPE<13, and point of exhaustion stages (LMP_max); 3) the three lowest lact concentration stages (LMP_adj1); 4) the final, RPE>13, and RPE>16 stages (LMP_sub). The MLSS was determined as the highest exercise intensity at which a variation not higher than 0.05 mmol/L of lac was observed during the last 20 minutes of 30-min exercise sessions.

RESULTS: The MLSS (204.7±15.2W), VLM (199.8±15.2W), LMP_adj (190.4±12.9W) and LMP_sub (192.1±27.2W) were not different and strongly correlated to each other. MLSS intensity, however, was different both from LMP (188.5±20.9W) and LMP_max (183.6±18.9W) (p<0.05).

CONCLUSIONS: The modeling of lac response through PF during IT with three sub-maximal stages (based on either RPE or stages with lower lac levels) produced exercise intensities that did not differ from MLSS.

2651 Board #159 3:00 PM - 4:00 PM
Identifying Determinants of the Plateau in VO2 at VO2max
Todd A. Astroline1, Lance C. Dalleck2. 1California State University–San Marcos, San Marcos, CA. 2University of Wisconsin–Eau Claire, Eau Claire, WI. Email: astroline@csusm.edu

A plateau in oxygen consumption ($\Delta VO_2$) is the primary criterion used to confirm that maximal oxygen uptake (VO2max) is attained during incremental exercise to fatigue. However, it is still unresolved what causes individuals to express a plateau in VO2max.

METHODS: Subjects (N = 30, mean age and VO2max equal to 26.9±9.8 yrs and 3.4±0.8 L/min, respectively) were separated into three groups: endurance-trained (ET) (n = 9), recreationally-active (Rec) (n = 11), and strength/sprint-trained (STR) (n = 10). During three separate visits, subjects completed incremental treadmill exercise during which heart rate and breath-by-breath gas exchange data were obtained. Percent body fat (%BF) and fat-free mass (FFM) were measured using a three-site skinfolds (SKF) model. Force production of the knee extensors and flexors was assessed using isokinetic dynamometry.

RESULTS: VO2max was significantly higher (p < 0.05) in ET (52.1±4.3 mL/kg/min) versus Rec (45.9±3.8 mL/kg/min) and STR (45.7±3.2 mL/kg/min). Change in VO2 at VO2max was not different (p > 0.05) in ET (33.0±27.3 mL/min) compared to Rec (30.2±24.1 mL/min) and STR (44.2±23.8 mL/min). No correlations (p > 0.05) were found between VO2max and VO2max (r = 0.05), FFM (r = 0.12), and muscular strength (r = 0.08). In ten subjects, the slope of VO2 versus time during the last 30 s of gas exchange data was not significantly different from zero, indicating attainment of a plateau in VO2 at VO2max for all subjects. However, when the last 60 s of gas exchange data were analyzed, four subjects revealed slopes significantly different from zero; therefore, the VO2 plateau occurred in only six of ten subjects.

CONCLUSIONS: Incidence of a plateau in VO2 at VO2max is not due to factors related to training status or physical fitness of subjects, but is altered by analysis and interpretation of exchange data. It is recommended that sampling interval is the primary factor determining incidence of a plateau in VO2 at VO2max in the majority of subjects exercising to volitional fatigue. Sampling interval and $\Delta VO_2$ at VO2max must be carefully selected by researchers to increase prevalence of a plateau in VO2 at VO2max, and the slope of VO2 versus time or workload should also be employed as a more objective criterion to ascertain attainment of a plateau in VO2 at VO2max.

2652 Board #160 4:00 PM - 5:00 PM
Does Menstrual Cycle Influence Exercise Testing Based on Lactate and Cardiorespiratory Measures?
Gerhard Smekal. Institute for Sports Science, Department of Sports Physiology, Vienna, Austria. Email: gerhard.smeikal@univie.ac.at

PURPOSE: The research literature suggests that menstrual cycle influences changes in energy supply, metabolic, and cardiorespiratory responses. Therefore, the aim of this study was to examine whether variables commonly used in exercise testing are influenced by menstrual cycle phases.

METHODS: Nineteen eumenorrheic women performed two 1 min stage incremental tests on a cycle ergometer during two different phases of menstrual cycle, the follicular phase (FP) and the luteal phase (LP). Our study variables, power output, oxygen uptake (VO2), heart rate (HR), minute ventilation (VCO2), respiratory exchange ratio (RER), ventilatory equivalents for oxygen and carbon dioxide (VE/VO2, VE/VCO2) and blood lactate concentration (LA) were evaluated at rest, at exhaustion during different thresholds of aerobic-anerobic transition and at all stages of the incremental tests. The threshold determination consisted of: 1) an individual anaerobic threshold (IAT) 2) a three phase-model with two lactate thresholds (LTP) and 3) a three phase model with two respiratory thresholds (AT and RC) and 4) the heart rate turn point (HRTP).

RESULTS: Comparing power output, VO2, LA, HR and RER we did not find any significant differences at rest, at maximal load, at any threshold and at any stage of the incremental tests between LP and FP. We observed higher values for VO2, LA, VE/VO2, LA, and VE/VCO2 at rest, at several thresholds and several stages of incremental tests in the LP (several of these changes were significantly different). This study determined the steady state oxygen uptake kinetics at different work rates during sub-maximal steady state conditions.

CONCLUSIONS: Evaluating power output, VO2, HR, LA and RER we were not able to find any changes in menstrual cycle at rest, at exhaustion, at thresholds or in any stage of incremental tests. These data do not support the view of an essential influence of the menstrual cycle on energy supply during exercise. Like others, we observed a higher ventilatory drive in the LP when compared to FP of the menstrual cycle.
CoNCLUsIoN: The purpose of this research was to validate a HR monitor VO₂ max predictions which incorporated RHR and HRV. Method: Twelve females and 17 males (mean age = 25.38 ± 5.55 yr) were tested. Mean predictions of VO₂ max made after 3 min of rest were 46.10 ± 10.13 and 45.38 ± 9.07 ml·kg⁻¹·min⁻¹, respectively. The intraclass reliability coefficient for predictions made after 3 min of rest against testing days was high (R=0.96) with no meaningful differences between the means. Similar test-retest reliability results were found for predictions after 10 min of rest. Mean measured VO₂ max was 44.98 ± 8.51 ml·kg⁻¹·min⁻¹. Validity statistics for predictions made after 3 minutes of rest were r = 0.45 (p=0.02), SEE 7.72 ml·kg⁻¹·min⁻¹, and E 10.04 ml·kg⁻¹·min⁻¹. Validity statistics for predictions made after 10 minutes of rest were r = 0.43 (p=0.02), SEE 7.68 ml·kg⁻¹·min⁻¹, and E 10.04 ml·kg⁻¹·min⁻¹.

CONCLUSIONS: These results demonstrate that VO₂ max predictions made by equations including RHR and HRV were reliable but not valid.
RESULTS: Volunteers achieved a maximal oxygen uptake (VO2max) averaging 56.1±6.35 mL·kg⁻¹·min⁻¹, attaining the AT at 71.3±9.9% of the VO2max. All HR-based methods were able to identify the HR slow component resulting, on average, in 76.9±15.1, 80.6±13.2 and 68.6±14.9% of the VO2max for EM, AH and CV respectively. Although no significant differences have been found, the highest correlations with the AT were attained by EM (0.67% p<0.05) and CV (0.58%<p<0.05), and further, except for AH, EM (p=0.44) and CV (p=0.67) were not different from the real AT.

CONCLUSION: The HR-based methods were well correlated to AT, presenting acceptable reliability and validity. Besides the large applicability of a HR-based method, the HR kinetics analysis could easily be used for determining the AT.

2659 Board #167 2:00 PM - 3:00 PM Validation of a Step Test to Predict VO2max
Tiffani L. Harkrider, David W. Hill, FACSM; University of North Texas, Denton, TX.

Email: tiffani.harkrider@advancedegonomics.com

Measurement of maximal oxygen uptake (VO2max) requires expensive equipment and presents a certain risk. To reduce the cost and to minimize the risk, submaximal tests are often used to predict a value for VO2max rather than directly measuring the VO2 during exhaustive exercise. One such test (Siconolfi et al., Am J Epidemiology, 1985) is widely used. However, despite its popularity, its use may be questioned because it was validated against a criterion VO2max that was obtained using cycle ergometer exercise.

PURPOSE: Our purpose was to re-examine the validity of the Siconolfi step test by comparing predicted VO2max values to values measured during maximal incremental treadmill tests.

METHODS: Twenty women, aged 18 to 55 yr, and 16 men, aged 22 to 47 yr, performed a maximal grade-incremental treadmill test and a submaximal Siconolfi step test, in random order. In treadmill tests, VO2 was obtained using a MedGraphics system (St. Paul, MN, USA). All participants demonstrated a plateau in VO2. In step tests, heart rate was determined using a Polar monitor (Polar Electro OY, Kempele, Finland), and VO2max was predicted using equations from Siconolfi et al. (1985).

RESULTS: Predicted VO2max (women, 30.3±5.5, and men, 39.9±7.6 mL·kg⁻¹·min⁻¹) were lower than (p<0.01) but correlated with (r=0.88 and 0.86, p<0.01) measured VO2max (40.0±6.4 and 47.1±8.3 mL·kg⁻¹·min⁻¹). A more accurate estimate of VO2max (R²=0.79, SEE=3.8 mL·kg⁻¹·min⁻¹) was obtained by correcting the Siconolfi values as follows: VO2max = 12.7+0.883 x Siconolfi VO2max.

CONCLUSIONS: It was concluded that a short (3 to 11 min) step test can be used to generate reasonably accurate predictions of VO2max if this simple correction is performed.
La and VE from T1 were significantly related to TP's from T2.

CONCLUSIONS: The Lamin was significantly different from both TP's for La and VE from both incremental exercise tests whereas TP's for La and VE were highly reproducible. The T2 and the Lamin did not provide any additional information, T1 was sufficient to describe exercise performance in healthy young subjects.

2662  Board #170
2:00 PM - 3:00 PM
A Test for Determining Physical Working Capacity at the Rating of Perceived Exertion Threshold
Michelle Mielke1, Moh H. Malek1, Terry J. Housh, FACSM, Jared W. Coburn2, Richard J. Schmidt2, Joseph P. Wein, FACSM2, Travis W. Beck3, Glen O. Johnson, FACSM4. 1University of Nebraska-Lincoln, Lincoln, NE. 2California State University-Fullerton, Fullerton, CA. 3Des Moines University, Des Moines, IA. 4Email: mmielke@unlserve.unl.edu

PURPOSE: Various physiological parameters have been used to develop tests to estimate the power output associated with the onset of fatigue during cycle ergometry. The purpose of the present study was to use ratings of perceived exertion (RPE) to determine the physical working capacity at the RPE threshold (PWC_RPE). PWC_RPE was compared to other fatigue thresholds determined from the measurement of heart rate (the physical working capacity at the heart rate threshold PWC_HRT), oxygen consumption (the physical working capacity at the oxygen consumption threshold: PWC_VO2), and the ventilatory threshold (VT).

METHODS: Seven adult volunteers (mean age ± SD = 24 ± 2 years) performed an incremental (300W increase every 2 minutes) test to exhaustion on an electronically braked ergometer for the determination of V̇O2max and VT. Standard open circuit spirometry (Parvo Medics metabolic cart) was used to collect and analyze expired gas samples. The subjects also performed four randomly ordered eight-minute workloads at different power outputs (ranging from 100 to 265W) for the determination of PWC_RPE, PWC_VO2, and PWC_HRT. Ratings of perceived exertion were obtained using the Borg 6-20 scale. Heart rate values were monitored using a Polar Heart Watch System.

RESULTS: A one-way repeated measure ANOVA with Tukey post-hoc comparison indicated that PWC_RPE (mean ± SD = 90 ± 21W; 48 ± 12% of V̇O2max) was significantly less (p<0.05) than PWC_HRT (mean ± SD = 138 ± 29W; 73 ± 9% of V̇O2max) and VT (mean ± SD = 145 ± 38W; 58 ± 10% of V̇O2max). There were no differences between PWC_RPE and PWC_VO2 (mean ± SD = 114 ± 44W; 61 ± 19% of V̇O2max). The RPE was determined using the Borg 6-20 scale.

CONCLUSIONS: The results of this study indicated that there are differences among fatigue thresholds determined from heart rate and oxygen consumption measurements and that the mathematical model used to estimate PWC_RPE and PWC_HRT can be applied to ratings of perceived exertion to determine PWC_RPE during cycle ergometry. Theoretically, the PWC_RPE provides an estimate of the maximal power output that can be maintained for a prolonged period of time without a fatigue-induced increase in the perception of effort.

2663  Board #171
3:00 PM - 4:00 PM
The Relation Between Metabolism Fitness And Step-Test Index in Different Ranges of Age
Ching-Hung Lin1, Hsiang-Wei Kung2, Fang-Chun Lin2, Ming-Chieh Wu1, Chia-Hua Kao3,1, Yuan Ze University, Taoyuan, Taiwan Republic of China. 2Taipei Physical Education College, Taipei, Taiwan Republic of China. (Sponsor: John L. Ivy, FACSM, FACSM) Email: r00325@saturn.yzu.edu.tw

The Step-test index is a well-known indicator of cardiopulmonary fitness test. Recently, whole-body glycemic control ability has been viewed as an index of metabolic fitness. However, the relationship between the step-test index and glycemic control is not well understood.

PURPOSE: To determine the relationship between the step-test index and whole-body glycemic control at different age ranges.

METHODS: Three hundred and forty-seven subjects were assigned into three groups: below 30 years old (A group), between 31 to 40 years old (B group), and over 41 years old (C group). An oral glucose tolerance test (OGTT) was performed following an overnight fast. A step-test (STEP) was then performed. Blood samples were taken from each time point during OGTT, and analyzed serum triglyceride (TG) and cholesterol (CHOL) levels. Data were analyzed by Pearson correlation.

RESULTS: The results of study showed a positive relationship between STEP and the glucose area under curve (GAUC) for all subjects (r = 0.21 & 0.23, p<0.05). The index of the STEP test was negatively correlated to GAUC in groups A and B (r = -0.22 & -0.32, p<0.05), but there were no significant correlations in group C. Moreover, GAUC was positively correlated to serum triglyceride and cholesterol levels in group C (r = 0.26 & 0.31, p<0.05).

CONCLUSION: The Step-test index increases with aging, but glucose tolerance declines with aging. The physical fitness index does not provide a complete picture of individual health. Thus traditional health fitness tests should be combined with metabolic fitness in order to convey an accurate health status.
Predicting Lactate Threshold in Cyclists Using Ventilatory Thresholds

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Lactate threshold (LT) is an important reference point in setting training intensities for endurance athletes. Ventilatory threshold (VT) has been used as a noninvasive estimate of LT, but appears to underestimate training intensity for many athletes who often report training at intensities above VT for prolonged periods. Determining LT can be time-consuming and invasive.

PURPOSE: Thus, the purpose of this study was to evaluate whether metabolic and heart rate data obtained during a noninvasive, maximal graded exercise test could be used to more accurately predict LT.

METHODS: Nineteen trained cyclists (10 men, 9 women, 35 ± 2 years) performed a graded exercise test on a bicycle ergometer to determine maximal oxygen consumption (max VO$_2$ = 55 ± 2 ml kg$^{-1}$·min$^{-1}$) and heart rate at the ventilatory threshold (HR$_{VT}$). Ventilatory threshold was determined using the V-slope method. Cyclists returned to the laboratory on a different day to perform a lactate threshold test, consisting of 8 min stages at power outputs below, at, and above the ventilatory threshold. Steady-state heart rates were measured during each 8 min stage, and a fingerstick blood sample was obtained during the last min of each stage to measure blood lactate. The heart rate associated with the lactate threshold (HR$_{LT}$) was determined using the D-max method (Cheng et al., 1992).

RESULTS: The correlation between HR$_{VT}$ and HR$_{LT}$ was 0.68, indicating 46% shared variance. The best-fitting model to predict HR$_{LT}$ included HR$_{VT}$, gender, body weight, and an interaction between gender and body weight. For male cyclists, HR$_{LT}$ = 177.34 + (0.44 x HR$_{VT}$) + (1.03 x body weight in kg). For female cyclists, HR$_{LT}$ = 94.85 + (0.44 x HR$_{VT}$) + (0.10 x body weight in kg). Using this model, R$^2$ was 0.70.

CONCLUSIONS: For trained cyclists, HR$_{VT}$, obtained during a maximal graded exercise test, may be adjusted to more accurately predict a training heart rate that corresponds to the lactate threshold. Endurance performance is determined by a number of factors, including the intensity of exercise that may be sustained without accumulation of lactic acid. Thus, a more accurate assessment of lactate threshold may aid cyclists in their training and, potentially, enhance performance.

Testing Aerobic Capacity in Healthy Obese Men and Women

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For health and fitness reasons, obese people should exercise. To design adequate exercise programs and to document progress, tests are required.

METHODS: 1) To determine how well the Astrand-Rhyming test (ARR) and the 12-min walk-run test (12mWRt) predict the true maximal oxygen intake (VO$_2$max) of obese people as measured during a maximal progressive bicycle ergometer test (gold standard, GS). 2) To establish the safety and practicality of the 3 tests.

Estimating Exercise VO$_2$ Using Backward Extrapolation of Post-Exercise VO$_2$

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Under some conditions it is not practical to measure VO$_2$ during exercise. In such situations actual VO$_2$ is often estimated using post-exercise VO$_2$ measures via backward extrapolation (BEX). While BEX has been shown to provide accurate estimates of VO$_2$ during maximal exercise, its accuracy for estimating submaximal values is not well established.

METHODS: This study was conducted to determine if BEX can provide accurate estimates of VO$_2$ max across a range of intensities, and to examine the effect of varying post-exercise sampling periods on estimates of actual VO$_2$. Fourteen college aged students, 9 men and 5 women, performed a maximal GXT on a cycle ergometer, and then tests at 40%, 60%, and 80% of VO$_2$max
between the highest-versus-lowest quartile for Maximal dynamic strength obtained OR = 1.944 (95% CI = 1.239 - 3.050), and highest-versus-second lowest quartile, OR = 1.816 (95% CI = 1.140 - 2.919), p < 0.05.

CONCLUSION: Balance; handgrip strength, maximal dynamic strength, independent of age, were predictors of performance in IADL, in this population of elderly women.

2673  Board #181  4:00 PM - 5:00 PM
Adapting the 20 Metre Shuttle Run to a Submaximal Protocol to Predict Peak VO2
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PURPOSE: The purpose of this study was (1) to compare the peak oxygen uptake (VO2peak) predicted from the Leger 20 Metre Shuttle Run test (LT) with measured VO2peak in healthy subjects, and (2) to develop prediction equations for VO2peak using body mass index and heart rate responses at submaximal intensities from the LT.

METHODS: Seventeen female (mean age ± SD: 21 ± 3 yrs) and 17 male subjects (23 ± 2 yrs) completed a ramped maximal exercise treadmill test (RT), a graded maximal treadmill test (GT) and the LT with a minimum of two days rest between testing sessions. Both the RT and LT involved increases in speed every minute (i.e., stage).

The GT was used to confirm VO2peak from the RT, VO2peak was determined during the RT and GT using metabolic gas analysis. The VO2peak from the LT was estimated from the prediction equations developed by Leger et al. (1988), Leger and Gaudoury (1989), and Stickland et al. (2003). Data were analyzed using multiple regression and ANOVA. Significance was determined when p < 0.05.

RESULTS: The LT stages completed were 7.5 ± 1.5 for females and 10 ± 2.3 for males. Throughout exercise and at peak, no significant differences in heart rate were found between the RT and LT and VO2peak from the RT was significantly higher than the GT for both males and females (p < 0.01). The regression equation from Leger et al. (1988) under predicted VO2peak in males and over predicted VO2peak in females (p < 0.05). The Leger and Gaudoury (1989) regression equation accurately predicted VO2peak in females (p > 0.05), but under predicted VO2peak in males (p < 0.05). The regression equation of Stickland et al. (2005) over predicted VO2peak in both males and females (p < 0.05). Multiple regression analysis using body mass index (X1), heart rate at rest (X2), minute 1 (X3), minute 2 (X4), and minute 3 (X5) from RT and LT indicated a significant relationship for males (p < 0.05; c2 = 0.76; SEE = 3.5) and females (p < 0.05; c2 = 0.62; SEE = 2.9). The following equations were developed to predict VO2peak from submaximal LT intensities:

Males: 15 + (-0.72X1) + (-0.17X2) + (-0.01X3) + (0.03X4) + (0.067X5) Females: 9.3 + (0.25X1) + (0.11X2) + (0.14X3) + (0.28X4) + (0.05X5)

CONCLUSION: These results indicated that most LT predictive equations under- or over-estimate VO2peak. The findings of this study also suggest that body mass index and submaximal heart rate responses from the LT may be used to predict VO2peak.

2674  Board #182  2:00 PM - 3:00 PM
Absence of Relation Between 12-Minute and 500 Yard Swim and Treadmill Determined Maximal Aerobic Power
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As measures of swimming performance, estimates of maximal aerobic power and energy expenditure during swimming can provide useful tools to gauge improvements in training progress. While a swimming flute or tethered swimming protocol using respiratory metabolic instruments to measure oxygen consumption in water may yield the most valid results, this procedure is often costly and technically difficult to administer. Cooper proposed the 12-minute swim as an alternative to the 12-minute run to predict and classify VO2max. However, studies to examine accuracy of such a swimming performance test in college age samples have not been conducted.

PURPOSE: The purpose of this investigation was to examine the relation between 12-minute and 500 yard swim tests and VO2max in seventeen male and thirty female college recreational swimmers (18-27 yrs) participating in a University of Pittsburgh fitness swimming class.

METHODS: On separate non-swim training days, subjects participated in two treadmill tests (one orientation and one actual) to determine VO2max. On separate days following the treadmill tests, two swimming trials (one practice and one actual) of 500-yard freestyle and 12-minute swims were conducted. During treadmill testing, oxygen consumption and heart rate (HR) were measured each minute. For swimming trials, distance covered in a 12-minute swim and total time for the 500-yard swim were obtained. In addition, HR was measured immediately following all swim trials.

RESULTS: Mean (± standard deviation) values included the following: VO2max (46.25 ± 10.66 ml kg• min^-1), 12-minute swim (601.9 ± 115.5 seconds), and 500 yard swim time (595.12 ± 129.88 seconds). First order correlations indicated a lack of a significant relation between VO2max (ml kg• min^-1) and both 12-minute (r = -0.176) and 500 yard freestyle swims (r = 0.111).
CONCLUSION: The findings suggest that the expected link between swim performance tests and treadmill measured VO2 max was not supported in the sample examined.

Supported by the National Swimming Pool Foundation

2675 Board #183 3:00 PM - 4:00 PM Poor Agreement between Ventilation Thresholds and Fat-oct in Well Trained Marathon Runners

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Recent research indicates that the ventilation or lactate threshold coincides with maximal fat oxidation (Fat-oct) in cyclists. In comparison to cycling, fat oxidation rates are much greater with treadmill running. However, it is unknown whether the relationship and agreement between ventilation/lactate threshold and fat oxidation are the same in runners as in cyclists.

PURPOSE: The aim of the present study is investigate the relationship and agreement between the ventilation thresholds and fat oxidation indices in a group of well trained marathon runners.

METHODS: Twelve marathon runners (age=36±5 yrs, weight=72.6±5.2 kg, VO2max =57.4±6.0 mL-O2 kg-1 min-1) with a marathon best time of 2:56:22 min participated in the study. Each runner completed a GXT for the measurement of VO2max and assessment of VT1 and VT2. The GXT began at a speed corresponding to a velocity of 2.5 min slower than their best marathon time and increased to a rate of 18 m·min-1 every 2 min. The exercise intensity which elicited Fat-oct and where fat oxidation was reduced to a minimum (Fat-oct) was determined using a modified submaximal exercise protocol. Each runner completed a submaximal exercise test that began at 128 m·min-1 and increased by 16 m·min-1. The duration of each stage was ~4.6 min to allow for steady state criteria to be reached. The test ended once an RER of 1.00 was obtained.

Indirect calorimetry was used to calculate Fat-oct and Fat-oct. The analysis of the relationship and agreement between variables utilized Pearson correlations and paired T-tests, respectively (p<0.05).

RESULTS: The agreement between VT1 (70.5±7.3% VO2max, 191±36.8 m·min-1) and Fat-oct (66.1+9.94% VO2max, 131±21.5 m·min-1) was poor with a mean difference of 9.38±8.38% and 59.9±35.2 m·min-1, respectively. There was a significant difference in agreement for VT2 of Fat-oct (90.9±9.7% VO2max and -21.0±28.4 m·min-1) with VT1 (V2-T1=80.7±7.34%VO2max and -21.0±28.4 m·min-1) with a mean difference of -10.9±9.57%VO2max-1 and -21.0±28.4 m·min-1, respectively. There was a significant difference between VT1 and VT2. The GXT began at a speed corresponding to a velocity of 2.5 min slower than their best marathon time and increased to a rate of 18 m·min-1 every 2 min. The exercise intensity which elicited Fat-oct and where fat oxidation was reduced to a minimum (Fat-oct) was determined using a modified submaximal exercise protocol. Each runner completed a submaximal exercise test that began at 128 m·min-1 and increased by 16 m·min-1. The duration of each stage was ~4.6 min to allow for steady state criteria to be reached. The test ended once an RER of 1.00 was obtained.

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CONCLUSION: Our study indicates that there are no significant relationships between ventilation thresholds and indices of fat oxidation. VT1 occurs at higher exercise intensities than Fat-oct. Conversely, VT2 occurs at lower exercise intensities than Fat-oct. These thresholds are not interchangeable and more importantly, the findings of the present study suggest that the relationship and agreement between ventilation thresholds and fat oxidation indices are different in cyclists and runners.

2676 Board #184 4:00 PM - 5:00 PM Factor Structure of a Self-Report Measure of Functional Ability

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PURPOSE: The Multidimensional Task Ability Profile (MTAP) is a 111-item computer-administered self-report pictorial activity and task sort, which utilizes captions and drawings depicting progressively demanding functional activities of daily living and work. The MTAP is used to assess perceived functional abilities and document change in functional status in a variety of clinical and fitness settings. The purpose of this study was to explore the factor structure of the MTAP.

METHODS: A retrospective analysis was conducted using existing MTAP data (one completed MTAP test per participant) obtained from a sample of patients (n=1327) completed MTAP test per participant) obtained from a sample of patients (n=1327) undergoing physical rehabilitation for a variety of musculoskeletal complaints. A rotated component matrix using the principal component analysis extraction method and varimax with Kaiser normalization was used to evaluate the factor structure of the MTAP. Factors with eigenvalues of greater than 1 were considered for detailed examination.

RESULTS: The factor analysis yielded six factors that explained 71.4% of the total variance, respectively. Two factors involved spinal function, including forceful use of the spine, static and supportive use of the low back in flexion, static and supportive use of the low back in extension, and sustained maximum flexion of the low back, which accounted for 21.4%, 12.0%, 5.6%, and 4.0% of the total variance, respectively. Two factors involved extremity function, including hand-eye coordination and lower extremity tasks, which accounted for 16.9% and 11.4% of the total variance, respectively.

CONCLUSIONS: In a sample of patients with musculoskeletal disorders, the MTAP assesses multiple factors related to physical function of the spine and extremities. Confirmatory factor analyses with additional samples are needed to verify the results of this study. Considering the findings of the present study, along with data obtained from previous work, the psychometric properties of the MTAP appear to be sound.

2677 Board #185 2:00 PM - 3:00 PM Physiological Responses to Stochastic Intermittent Running

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Although coaches and strength and conditioning specialists attempt to make training programs more sports specific, consideration for the stochastic nature of running during actual athletic events is limited in research.

PURPOSE: To assess physiological responses in a series of stochastic intermittent runs comparing with those in a series of periodic intermittent runs.

METHODS: Six subjects (two males and four females: 29.2 ± 11.3 years old) performed two different treadmill protocols: periodic protocol (PP) and stochastic protocol (SP). The PP consisted of eight 10-sec intermittent runs (1st and 8th bouts at 133.3 m·min-2, 2nd and 7th bouts at 186.7 m·min-2, and 3rd to 6th bouts at 240.0 m·min-2). Each bout was accompanied with acceleration and deceleration phases and two adjacent bouts were mediated by 40-sec walking at 80 m·min-2. Total duration of the protocol was 10 min. The SP had an identical duration and work-rest ratio to the PP while the order and interval of the intermittent runs were randomized. In each condition, blood lactate concentration (LA) was measured before and after the protocol and change in LA (ΔLA) was determined. Oxygen uptake (VO2), minute ventilation (VE) and heart rate (HR) were measured every 10 sec during the protocols and perceived exertion (RPE) was measured immediately after the respective bouts in the protocols. Mean, peak value, and coefficient of variation (CV) were determined for VO2, VE, HR, and RPE.

RESULTS: The ΔLA (n = 5) was 0.5±0.4 mmol·L-1 (0.0 to 0.2 to 2.4±0.9 mmol·L-1 in the PP and 0.6±0.5 mmol·L-1 (2.6±1.2 to 3.1±4.4 mmol·L-1) in the SP (p<0.05). Four of the five subjects increased the LA in the SP while all subjects reduced the LA in the PP. The SP also revealed greater fluctuations in HR (p<0.05) and a trend towards greater mean, peak, and fluctuations of VO2 and VE (p<0.05).

CONCLUSIONS: A stochastic intermittent running protocol induced greater physiological disturbance on several variables than an equivalent periodic protocol. Future research should investigate physiological responses to stochastic work which typifies many sports and exercises.
CONCLUSION: The relative MP outputs and FI values derived during the 20- WAT were significantly different; however, with the addition of predicted relative power outputs for the final 10 seconds to the observed 20 seconds of relative power outputs no significant differences existed between the two protocols. Therefore, when compared to the 20-WAT, the 20-WAT may be considered a valid alternative when used with the predictive non-linear regression equation to derive the final relative power output values.

2679 Board #187 4:00 PM - 5:00 PM
Perceived Exertion During Running and Cycling at the Ventilatory Threshold

Ratings of perceived exertion (RPE) obtained during incremental exercise tests may be anchored by perceptions associated with the ventilatory threshold (VT). Not surprisingly, then, the RPE at the VT appears to be stable across exercise modes, even though the threshold is associated with different absolute and relative energy demands in the different modes. However, previous studies evaluated responses only during incremental exercise tests.

PURPOSE: The purpose was to compare RPE elicited during 5-min bouts of running and cycling exercise at the intensities at which the VT had been identified in incremental tests.

METHODS: Seven women (mean ± SD, age 22 ± 1 yr, height 168 ± 6 cm, weight 64 ± 9 kg) and eight men (23 ± 1 yr, 174 ± 7 cm, 83 ± 17 kg) performed incremental treadmill and cycle ergometer tests to determine the VT. Then, they performed four 5-min runs at the running VT and four 5-min rides at the cycling VT. RPE were obtained using the Borg 6–20 scale. Values for RPE and other measures were collapsed across trials and sex and analyzed using t-tests.

RESULTS: After 5 min of running at the VT, velocity was 145 ± 16 m·min⁻¹ or 62 ± 6% of peak velocity; VO₂ was 2481 ± 1290 ml·min⁻¹, 35 ± 22 ml·kg⁻¹·min⁻¹, or 87 ± 44% of peak VO₂; and heart rate (HR) was 152 ± 13 b·min⁻¹ or 80 ± 5% of peak HR. After 5 min of cycling at the VT, work rate was 100 ± 37 W or 48 ± 13% of peak power; VO₂ was 1634 ± 445 ml·min⁻¹, 22 ± 4 ml·kg⁻¹·min⁻¹, or 66 ± 11% of peak VO₂; and HR was 138 ± 19 b·min⁻¹ or 74 ± 8% of peak HR. There were significant differences (p < 0.05) between responses to running and cycling in intensity as a % of peak intensity, absolute and relative VO₂, HR, and HR as a % of peak HR, and an apparent difference (p = 0.09) in VO₂ as a % of peak VO₂. However, RPE during running at the VT (9.9 ± 0.6) and RPE during cycling at the VT (10.2 ± 2.1) were highly correlated (r = 0.83, p < 0.01) but did not differ (t = 0.99, p = 0.34).

CONCLUSION: Individualized prescription of exercise intensity by the RPE at the VT can be used across many exercise modes.

2680 Board #188 2:00 PM - 3:00 PM
A Comparison of VO₂max and Metabolic Variables between Treadmill Running and Treadmill Skating
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PURPOSE: The purpose of this study was to determine differences in VO₂max and metabolic variables between treadmill running and treadmill skating. This study also examined VO₂max responses during a continuous skating treadmill protocol and a discontinuous skating treadmill protocol.

METHODS: Sixteen male high school hockey players (16 ± 1 yoa), all above average fitness level, participated in this study. All subjects participated in three tests: 1) discontinuous skating treadmill test, 2) continuous skating treadmill test, and 3) running treadmill test. The order in which subjects performed the discontinuous skating treadmill and continuous skating treadmill tests was randomized. Minute ventilation (Vₐ), oxygen consumption (VO₂CO₂), carbon dioxide production (VCO₂), respiratory exchange ratio (RER), and heart rate (HR) were averaged every 15 seconds up to VO₂max for each exercise test.

RESULTS: There was a significant difference (p < .05) for VO₂max (ml·kg⁻¹·min⁻¹) and maximum VO₂ (L·min⁻¹) between the running treadmill protocol and discontinuous skating treadmill protocol. There was also a significant difference for maximum RER between the discontinuous and continuous skating treadmill protocol and between the discontinuous skating treadmill protocol and running protocol. Maximum heart rate (HR) was also significantly different for the running, continuous, and discontinuous skating treadmill protocols.

CONCLUSIONS: VO₂max responses were higher for running than skating at the same intensity. VO₂max responses were higher for running than skating at the same intensity. However, skating at a lower intensity may be a valid alternative to running and cycling for endurance training.

2681 Board #189 3:00 PM - 4:00 PM
Stroke Analysis During A Maximal Swimming Speed Test in Children And Adults
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Propulsion is one of the central issues in front crawl swimming regarding the process of stroke analysis. The dynamic relationship between stroke frequency, stroke length and the study of swimming speed, have been extensively used to characterize the competitive swimming technique and its efficiency. While stroke rate is generally related to fat mass; final velocity and resistive forces have been related to body mass and body surface area. There is still little information about differences in swimming performance between children and adults related to stroke characteristics.

PURPOSE: To examine the contribution of stroke frequency, stroke length, stroke index and total distance, on swimming performance, during a maximal speed test in children and adults from different swimming groups.

METHODS: We studied 32 male swimmers, 23 children 9 to 13 years old and 9 adults 18 to 23 years of age. Subjects were measured by weight and height. Swimmers performed a maximal 15m front crawl swim test in two series (S): S1: 15m-lap only with the arms (legs supported) and S2: 15m-lap front crawl (with both arms and legs).

RESULTS: S1: 15m-lap only with the arms, V (m/s) was higher in adults (1.67 ± 0.08 vs. 1.41 ± 0.14 and 1.14 ± 0.06, p < 0.01). Stroke index (SIDX) and total distance (TD) were higher in C than in A and B swimmers (1.55 ± 0.18, 0.94 ± 0.20, 0.70 ± 0.07 for SIDX and 50.05 ± 2.60, 42.26 ± 1.47, 34.25 ± 1.81 for TD, respectively, p < 0.001). Only TD and SIDX showed a significant correlation with stroke frequency multiplied by stroke length. Group A was divided according to sex (n=6) and age (n=10). Group B included children who completed S2 in less than 12s, group B (n=10) was made with the rest of children and group C (n=9) with adults. Descriptive statistics, one-way ANOVA and post-test comparisons were performed.

CONCLUSIONS: Age, weight and height were similar in A and B children groups and lower than in adults (p<0.01). Adults were faster than A and B groups in S1 (9.81 ± 0.45 vs 11.73 ± 1.10 and 14.34 ± 1.40, p<0.01) and S2 (9.02 ± 0.47 vs 10.72 ± 1.01 and 13.23 ± 0.76, p<0.01). V (m/s) was higher in adults (1.67 ± 0.08 vs 1.41 ± 0.14 and 1.14 ± 0.06, p < 0.01). Stroke index (SIDX) and total distance (TD) were higher in C than in A and B swimmers (1.55 ± 0.18, 0.94 ± 0.20, 0.70 ± 0.07 for SIDX and 50.05 ± 2.60, 42.26 ± 1.47, 34.25 ± 1.81 for TD, respectively, p<0.001). Only TD and SIDX showed a significant correlation with the frontal crawl maximal time score during the test, in all subjects (coefficient -0.172 and 0.321, respectively, R=0.989, R²=0.997, p<0.001). This correlation was also significant when the analysis was made by A, B and C groups (R = 0.995, 0.998 and 0.997, p<0.001).

CONCLUSIONS: Total distance seems to be the best predictor of swimming performance in this subjects, while stroke index and the rest of variables were not significant.

2682 Board #190 4:00 PM - 5:00 PM
Heart Rate Behavior at Above the MLSS in Patients with CAD and in Healthy Subjects
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PURPOSE: Previous studies have demonstrated that in patients with coronary artery disease (CAD) an upward deflection of the heart rate performance curve (HRPC) can be observed and that this upward deflection and the degree of the deflection is correlated with a diminished stress dependent left ventricular function. The aim of this investigation was to evaluate the relationship between HRPC and exercise intensity during the incremental test and the constant load test at and above the maximal lactate steady state (MLSS, MLSS+).

METHODS: Incremental and constant work load tests were performed in patients with CAD (N = 47, age: 58.69 yrs, height: 172.63 cm, body mass: 79.10 kg; healthy subjects (HS): N = 15, age: 59.18 yrs, height: 177.64 cm, body mass: 76.10 kg; physical education students (PES): N = 18, age: 22.33 yrs, height: 179.41 cm, body mass: 75.52 kg)
mass: 74±5 kg). Each subject performed an incremental test on a cycle ergometer in an upright position to the limit of tolerance at an initial level of 20 Watt (W) and increments of 10 W, 15 W, 20 W and 25 W (adjusted for individual functional capacity), added every min to the limit of tolerance. The degree and the direction of the HRPC expressed as factor \( k_\text{HR} \) was significantly related (\( r = 0.65, \ P < 0.001 \)) to the increase in HR in the following order of training status: HR during field conditions simultaneously. In leisure time fitness activities as well as in professional sport the imbalance between running load and recovery as well as overload of training are of great interest.

**PURPOSE:** This study aimed to investigate the influence of running training load on subjective mood state using portable running computer.

**METHODS:** Within a study of 6 months 27 male (M) (31±1 yrs, 181±6 cm, 78±7 kg) & 23 female (F) (28±6 yrs, 167±5 cm, 59±5 kg) runners performed heart rate (HR) controlled exercise and followed running volume (Rvol) using accelerometer based sensors during training. Prior and post running athletes carried out a training optimiser test (OT) which is based on measurements of HR and HR variability (HRV) in an orthostatic test. OT-related training status was rated from 1 (recovered) to 9 (overtrained). All subjects completed a questionnaire of subjective mood state (M) in conjunction to each OT. Answers were analysed using binary structural analysis and further reduced to three-stage hierarchic-multidimensional structure of two domains: motivation (b/o) and load (b onload).

**RESULTS:** between 1 (negative MS) and 9 (positive MS) refer to a stanie-transformation scale. Descriptive and non-parametric statistics were conducted to all answers. Individual cases were investigated using time series analyses (moving average, cross-correlation).

**RESULTS:** On the basis of individual running performance subjects were categorised in groups of good (E1 VO\text{vol max} = 65.9 (M: 67.6, F: 57.4) (4: 57.5 ml/kg/min) and less (E2 VO\text{vol max} = 53.6 (M: 33, F: 46.1) ml/kg/min) fitness runners. Mean OT results during the training period did not differ in E1 and E2. There was a large variation in individual results of MS (e.g. recreation (62±1)). Negative relationship (p<0.05) between HRvol and load items (decrefence, recreation, sleeplessness, strain) were found in both groups. Significant correlation for the whole group between OT results and binary factors as well as high sig. but low negative coherences of MS to load (p < 0.001) were found. Single case studies for OT status versus Rvol pointed out a sig. time-lagged response of 10 days for one subject with a narrow status range (10-6-9) and 20 days in another subject with a broad status range (271-13). A high variability of OT status and MS corresponds to actual lower Rvol.

**CONCLUSIONS:** In this study no clear and general coherences between Rvol and MS were found. However, some individual cases showed a response of OT status according to training load.

### Poster #191 2:00 PM - 3:00 PM
**Running Load, Training Status and Mood State Using Computerised Testing**
Ulrich Hartmann, Margot Niessen, Rajai Laukkanen, FACSMS, Hannu Kinnunen, Faculty of Sport Science, Technical University, Munich, Germany; Polar Electro Oy; Kempele, Finland.

Novel innovative technologies provide tools to study running distance, velocity and heart rate during field conditions simultaneously. In leisure time fitness activities as well as in professional sport the imbalance between running load and recovery as well as overload of training are of great interest.

**PURPOSE:** To compare changes in police and firefighters fitness levels over a six year period (1998-2004) to aid in the development and implementation of intervention and/or preventive health programs. A comparison of these data could also show differences between the physiological demands of each profession.

**METHODS:** Changes in the results from an annual fit-for-duty testing program of 33 firefighters and 31 police officers were compared. Over a six year period, age (yrs.), bodyweight (BW) (kg), systolic blood pressure (SBP) (mmHg), diastolic blood pressure (DBP) (mmHg), bodyfat percentage, and VO2 max (ml/kg/min) were compared.

**RESULTS:** Average of age of each group increased by 6 years. Firefighters mean BW increased by 1.8 kg (83.6 kg±8.4 kg), mean SBP increased by 2.6 mmHg (125.6 mmHg±125.2 mmHg), mean DBP increased by 1.3 mmHg (81.1 mmHg±82.4 mmHg), mean bodyfat percentage increased by 2.6% (18.9±2.1%), and mean VO2 max decreased by 1.8 ml/kg/min (44.9 ml/kg/min±43.1 ml/kg/min). Police officers mean BW increased by 3.1 kg (93.2 kg±96.3 kg), mean SBP increased by 4.1 mmHg (128.9 mmHg±133 mmHg), mean DBP increased by 4.9 mmHg (82.4 mmHg±87.3 mmHg), mean bodyfat percentage increased by 1.4% (22.34%), and mean VO2 max decreased by 3.5 ml/kg/min (44.6 ml/kg/min±41.1 ml/kg/min). None of these changes were statistically significant (p<0.05).

**CONCLUSION:** Firefighters show a trend towards higher levels of physical fitness and overall health when compared to police officers. Firefighters also showed lower increases in mean BW, SBP and DBP and a smaller decline in mean VO2 max. Police officers showed less of an increase in mean bodyfat percentage when compared to firefighters, but their mean bodyfat percentage was still 1.9% higher. These results may be due to many factors such as (1) differences in leisure time while “on-duty” (2) emphasis on physical fitness by supervisors (3) subtle differences in in-service programs and (4) on-the-job duties and stress levels. These differences may point to a need for individualized intervention and education programs along with possible changes in work schedules to allow for exercise and stress relief.

### Poster #192 4:00 PM - 5:00 PM
**Male and Female Student versus Student-Athlete Division III Fitness Comparisons**
Lauren M. Puzen, Ronald W. Detrick, FACSMS, University of Scranton, Scranton, PA.

Participants in Division III varsity sports receive no financial incentives and rarely play professionally. Compared to professional and elite college athletes, scant research is available regarding the fitness status of Division III student-athletes.

**PURPOSE:** To compare the aerobic fitness and body composition of Division III (D3) athletes and non-athletes (NA) with gender held constant. D3 consisted of an equal number of randomly selected males and females representing 11 varsity sport teams. Muscle fitness and flexibility were also assessed as part of an overall fitness profile.

**METHODS:** Sixty (30 D3, 30 NA) college-aged (19.5±1.3 yr) volunteers completed a computerized MiroFit fitness profile including measurements of height and weight (BMI: males=25.2±3.4 vs 26.1±4.1 kg/m²; females=22.8±2.1 vs 23.6±2.7 kg/m²; D3 vs NA, respectively), an Astrand-Rhyming sub maximal multi-stage (5 workloads) bicycle ergometer test designed to reach a minimum HR of 135 bpm, and skinfolds at 3 sites for body fat estimation (Jackson and Pollock, 1985). Heart rate during each workload was determined via Polar monitor. Duplicate skinfold measurements agreed within 2 mm. Two-arm isometric bicpes strength was also determined. Statistical analyses included independent t-tests with significance set at the .05 level.

**RESULTS:** Aerobic fitness was not significantly different for gender comparisons between D3 and NA (predicted VO\text{vol max} = 48.0±9.6 vs 40.9±10.6; females=43.6±8.9 vs 47.8±9.7 ml O2/kg/min). Percent fat for males was significantly lower for D3 than NA (10.4±4.3 vs 14.6±5.5). Male skinfolds for the chest and abdomen were significantly greater for NA compared to D3 (chest: 12.9±2.7 vs 8.7±2.4 mm; abdomen: 23.4±9.1 vs 16.4±5.7 mm). Female percent fat was not significantly different for D3 compared to NA (20.6±3.5 vs 22.4±5.7). Female skinfolds (mm) for thigh and triceps were significantly greater in NA compared to D3 (thigh: 28.4±7.1 vs 23.8±5.8; triceps: 20.6±6.6 vs 17.3±2.3). Biceps strength values were not significantly different for either gender group comparisons (males: 98.7±15.8 vs 102.5±25.4; females: 29.9±13.3 vs 49.2±8.8; lb; D3 vs NA).

**CONCLUSIONS:** Although not significantly different from NA, aerobic fitness and percent fat values for Division III athletes, both males and females, were above 50% percentile (Aerobic Research Institute, 1994), being highest for female athlete aerobic fitness (78% percentile), and compared to D3 (58% percentile). Based on these findings, we conclude that participation in Division III varsity sports provides health-related fitness benefits.
PURPOSE: To determine the effect of BS on CR fitness, we evaluated CR fitness following BS in a morbidly obese population.

METHODS: Fourteen patients (12 women, 2 men; mean ± SD age = 46 ± 11 years) who underwent Roux-en-Y gastric bypass surgery were studied. As part of their pre- and post-surgical screening, maximal graded exercise testing with concomitant oxygen consumption (VO₂) measurement was conducted. Pre- and post-BS tests were compared to determine changes in CR fitness.

RESULTS: Select demographic and CR variables pre- and post-surgery are shown in the Table. Significant decreases in body weight and BMI and increases in treadmill time and maximal VO₂, expressed as ml/kg/min or metabolic equivalents (METs), were noted following BS (mean follow-up time > 139 days (range = 32-396 days)). The CR benefits of BS appeared to be time-dependent; patients having follow-up testing > 100 days (mean ± SD = 221 ± 109.4) post-surgery demonstrated significantly greater decreases in body Weight and Increases in CR fitness as compared with those who had earlier (mean ± SD = 57 ± 16.9 days) follow-up.

Table: Changes in body composition and cardiorespiratory variables following bariatric surgery

<table>
<thead>
<tr>
<th>All Patients</th>
<th>Pre-surgery</th>
<th>Post-surgery</th>
<th>Difference</th>
<th>Pre-surgery</th>
<th>Post-surgery</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (pounds)</td>
<td>317.7 ± 106.3</td>
<td>174.5 ± 54.8</td>
<td>-143.2 ± 54.8</td>
<td>282.8 ± 98.3</td>
<td>169.2 ± 50.0</td>
<td>-113.6 ± 50.0</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>47.5 ± 6.4</td>
<td>34.2 ± 7.4</td>
<td>-13.3 ± 7.4</td>
<td>43.4 ± 6.1</td>
<td>30.2 ± 5.3</td>
<td>-13.2 ± 5.3</td>
</tr>
<tr>
<td>VO₂max (ml/kg/min)</td>
<td>1.9 ± 0.5</td>
<td>2.7 ± 0.5</td>
<td>0.8 ± 0.5</td>
<td>1.2 ± 0.5</td>
<td>2.4 ± 0.5</td>
<td>1.2 ± 0.5</td>
</tr>
<tr>
<td>Treadmill Time (min)</td>
<td>11.7 ± 1.7</td>
<td>17.7 ± 2.4</td>
<td>6.0 ± 2.4</td>
<td>14.0 ± 2.4</td>
<td>20.9 ± 2.4</td>
<td>6.9 ± 2.4</td>
</tr>
</tbody>
</table>

+p < 0.05 pre- versus post-surgery; *p < 0.05 between groups, #p < 0.05 within groups

CONCLUSION: Bariatric surgery results in a marked weight loss and increased CR fitness, as determined by direct measurement of VO₂ max. These improvements appear to be time-dependent; thus, exercise testing should be conducted after adequate recovery from BS (>100 days) to achieve optimal CR results. Testing too soon after BS (i.e., during early convalescence) may camouflage potential improvements in functional capacity.

2687 Board #195 3:00 PM - 4:00 PM
Muscle Deoxygenation and Power Output during Triple Wingate Tests
Ann C. Snyder, FACSM, Robert W. Wilson, Jason C. Dorman. University of Wisconsin - Milwaukee, Milwaukee, WI.

Many exercise performances require multiple bouts of high intensity work performed in a short period of time, such as repeated short uphill climbs in cycling or sprints in soccer, football or basketball.

PURPOSE: We examined the power output and muscle oxygenation (deoxygenation and reoxygenation) variables of three repeated Wingate (WIN) tests to determine the fatigue characteristics of the tests.

METHODS: Eleven elite-level speed skaters performed three repeated 30 sec Wingate tests with 3.5 minutes of recovery in between each test, set at a resistance of 7.5% of their body weight. The pedaled with no resistance when resting in between the three trials. Power output was determined by computer software (SMI Power 5.2). Muscle oxygenation values were determined using near-infrared spectroscopy (NIRS, Infraspec™ Tissue Spectrometer, Hutchison Technology Incorporated, Hutchinson, MN).

RESULTS: Peak power declined between the three tests (WIN1 = 1003.9 ± 144.9, WIN2 = 966.8 ± 119.1, WIN3 = 851.4 ± 126.2 watts) but was only significantly (P < 0.05) different between WIN1 and WIN2. However, total work was significantly lower with each successive test (WIN1 = 256.2 ± 22 sec, WIN2 = 217.3 ± 22 sec, WIN1 = 198.2 ± 218 sec), while mean peak heart rate for the three exercise tests was virtually the same (WIN1 = 174.3 ± 10.0, WIN2 = 173.9 ± 10.3, WIN3 = 173.7 ± 8.5 b/min*). Muscle oxygenation level was similar following the three WIN tests (WIN1 = 5.0 ± 7.0, WIN2 = 6.8 ± 8.0, WIN1 = 7.1 ± 9.1%), however, the time to maximal deoxygenation (DOX) was progressively greater with each test (WIN1 = 21.7 ± 3.5, WIN2 = 23.4 ± 3.0, WIN3 = 25.1 ± 3.4 sec) with WIN1 significantly faster than WIN3. The time required to return muscle oxygenation level significantly with each successive test (WIN1 = 40.6 ± 12.2 sec, WIN2 = 52.9 ± 15.0 sec, WIN1 = 64.1 ± 17.7 sec).

CONCLUSIONS: The heart rate, blood lactate and muscle oxygenation levels of the exercise bouts indicate that all three tests were performed to maximal effort. Given that, the subjects who performed the triple Wingate test with 3.5 minutes of recovery inches between each exercise bout performed at maximal effort, but as the test progressed from WIN1 to WIN3, had a reduced power output and a prolonged muscle oxygen recovery.
Fibromyalgia (FM) is a pain syndrome identified by fatigue, disrupted sleep patterns, and chronic total body pain. It has been shown that women with FM have lower levels of strength and aerobic capacity, and it is widely recognized that exercise is valuable in managing FM symptoms. Although studies exist showing the benefits of structured exercise protocols, currently there are no data to show pedometer-determined daily physical activity levels in this population.

**PURPOSE:** To examine baseline pedometer scores and symptoms in women with FM.

**METHODS:** Twenty-one women diagnosed with FM (48 ± 9 years; mean ± SD) were recruited and instructed to wear a pedometer during all waking hours, except when in water. Participants wore the pedometer for four consecutive weeks and recorded the total number of steps for each day in an activity log. The Fibromyalgia Impact Questionnaire (FIQ) was completed by each subject to assess disease impact, with higher scores signifying greater impact. Pearson correlations were used to evaluate the relationships between variables. Significance was accepted at p < 0.05.

**RESULTS:** BMI and ambulatory activity at baseline were 31.0 ± 6.9 kg/m² and 6159 ± 3477 steps/day, respectively. These step values indicate that these women are classified as “low active,” (accumulating 5000-7499 steps/day) as indicated by the population-based National Health and Nutrition Examination Survey (NHANES). Even though these values may be considered within the range of ambulatory activity, there was no significant correlation between steps/day and BMI. There was a negative correlation between steps/day and FIQ scores, however it failed to reach statistical significance (r = -0.415, p = 0.06).

**CONCLUSIONS:** The results suggest that women with FM are relatively inactive and may benefit from a step-based program to increase overall ambulation, which may be important in reducing symptoms and the comorbidities associated with FM.

**RESULTS:** Vertical Impulse of COD

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SD (Session 1)</th>
<th>Mean ± SD (Session 2)</th>
<th>ICC</th>
<th>CV%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Test Time</td>
<td>0.9 ± 0.2</td>
<td>1.3 ± 0.2</td>
<td>0.71</td>
<td>17.0%</td>
</tr>
<tr>
<td>Horiz. Impulse of COD</td>
<td>2.3 ± 0.3</td>
<td>2.5 ± 0.3</td>
<td>0.61</td>
<td>13.0%</td>
</tr>
<tr>
<td>Vert. Impulse of COD</td>
<td>1.2 ± 0.2</td>
<td>1.2 ± 0.2</td>
<td>0.80</td>
<td>9.3%</td>
</tr>
<tr>
<td>Total Impulse of COD</td>
<td>2.5 ± 0.5</td>
<td>2.7 ± 0.5</td>
<td>0.71</td>
<td>11.6%</td>
</tr>
<tr>
<td>Contact time of COD</td>
<td>6.4 ± 0.1</td>
<td>6.4 ± 0.1</td>
<td>0.40</td>
<td>10.7%</td>
</tr>
</tbody>
</table>
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**CONCLUSIONS:** Similar adaptations to sprint training were generally observed in both S-FIELD and S-LAB with the exception that $W_{s}$ continually increased during S-LAB but plateaued for S-FIELD. The relationship between changes in $W_{s}$ and post sprint Lactate (La) and pH appear to be dependent upon the modality of testing with much greater increases in $W_{s}$ for a given La observed following S-LAB.

**POTTER SESSIONS**

**2694 Board #202 4:00 PM - 5:00 PM**

**Critical Velocity and Anaerobic Capacity Defined as the Time to Exhaustion**

Fúvia Barros Machado, Claudio Alexandre Gobatto, Ricardo Vinícius Ledesma Contartez, Marcelo Papoti, Maria Alice Rostom de Mello, Sao Paulo State University - UNESP, Rio Claro, Brazil.

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Since there are obvious limitations in the investigations with human subjects, animal models became important for a deeper insight into the mechanisms involved in the physiological responses to physical exercises. However, the control of exercise intensity is not easily determined in animals.

**PURPOSE:** The aim of the present study was to describe a non-invasive protocol for determination of aerobic capacity (critical velocity) and anaerobic capacity (anaerobic work capacity) of treadmill running rats.

**METHODS:** For this, the critical power model suggested by Monod & Scherrer (Ergonomics, v.8, p.329-337, 1965) for human evaluation was adapted for running rats. After becoming familiarized with treadmill running (15 days), twelve 100 days old male Winter rats were submitted to four exercise tests, consisting in running at 25, 30, 35 and 40min.1, continuously until exhaustion. The velocity sequence was distributed at random, with a 48 hours interval. For the critical velocity (CV) and anaerobic running capacity (ARC) estimations, the hyperbolic curve (velocity versus time to exhaustion) was linearized to $V_{c}$ = $ARC \cdot CV$, where the CV and ARC were linear and slope coefficients, respectively. To verify if the CV corresponds to the maximal aerobic intensity, the rats were submitted to the maximal lactate steady state test (MLSS) by three 25min. continuous running tests at 15:20 and 25min.1, with blood collection every 5 minutes.

**RESULTS:** The CV was obtained at 22.8 ± 0.7min-1 and the ARC, at 26.8 ± 2.6min-1. The MLSS was observed at 20min.1 intensity, with blood lactate 3.84 ± 0.31mmol.L-1. At the 15min.1-velocity, the blood lactate also stabilized, but at a lower concentration (3.17 ± 0.26mmol.L-1). There was a progressive increase in blood lactate concentration at 25min.1-velocity and some animals reached exhaustion between the 10th and 25th minute of exercise. The CV and MLSS were different but presented high and significant correlation ($r=0.81$).

**CONCLUSIONS:** These results indicate that the non-invasive protocol can be used for aerobic running rats evaluation, with little modification. However the ARC requires further investigation.

Supported by FAPESP (proc nº 04/07070-5), CNPq and CAPES

**2695 Board #203 2:00 PM - 3:00 PM**

**Blood Lactate, pH and Bicarbonate following Sprint Cycling: Effects of Training and Testing Methodology**

Andrew S. Gardiner¹, David T. Martin¹, Jason P. Gulbin², Glenn E. Donely³, Tamринie R. Eber¹, David Jenkins⁴. Cycling Australia/KE, Brisbane, Australia. Australian Institute of Sport, Belconnen, Australia. ¹Australian Coaching Council, Belconnen, Australia. ²University of Queensland, Brisbane, Australia.

Despite the widespread use of lactate monitoring of athletes limited research has addressed how training adaptations in sprint cycling fitness manifest themselves similarly in laboratory and field settings.

**PURPOSE:** To characterize the relationship between average power ($W_{a}$), lactate (La), pH and bicarbonate (HCO₃⁻) following a 30 min laboratory cycle test and a field based 500m time trial (TT) throughout six weeks of training.

**METHODS:** 21 female athletes (Mean±SD 22.14±1.7y, 171.8±6.2 cm, 72.7±8.2 kg) completed 6 wks of sprint cycle training on a velodrome following 1 wk of familiarization. Pre, mid and post training, they performed a maximal 30 s sprint on an air-braked cycle testing in the laboratory (S-LAB) and a maximal 500 m TT on the velodrome (S-FIELD) using a fixed gear bicycle fitted with the same dynamically calibrated SRM crank (8 strain gauge). Capillary blood samples were collected two min following completion of all maximal sprints and assayed for La, pH and HCO₃⁻, using a radiometer. S-FIELD was always performed 2-3 hrs following S-LAB.

**RESULTS:** As power increased for S-FIELD, 500m TT time decreased over the 6 wks: pre: 43.7±1.5 s; mid: 42.0±1.3 s; post: 41.6±1.4 s ($p<0.001$). Similarly, training was associated with increases in S-LAB $W_{a}$ ($p<0.001$). Despite the increases in power output there were no changes in post sprint La, HCO₃⁻ or pH following the final three weeks of sprint training. $W_{a}$ was always higher for S-LAB vs S-FIELD (40-70 W). As expected following S-LAB La was generally higher and HCO₃⁻ and pH were lower compared to S-FIELD.

**Table 1. Dependent variables (Mean ± SD, n=21) following S-LAB and S-FIELD (* = sig difference from S-FIELD, $p<0.05$).**

<table>
<thead>
<tr>
<th></th>
<th>Pre S-LAB</th>
<th>Pre S-FIELD</th>
<th>Mid S-LAB</th>
<th>Mid S-FIELD</th>
<th>Post S-LAB</th>
<th>Post S-FIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>$W_{a}$ (W)</td>
<td>240±33</td>
<td>260±35</td>
<td>252±34</td>
<td>252±34</td>
<td>253±34</td>
<td>253±34</td>
</tr>
<tr>
<td>$W_{s}$ (W)</td>
<td>20±2</td>
<td>21±2</td>
<td>21±2</td>
<td>21±2</td>
<td>21±2</td>
<td>21±2</td>
</tr>
<tr>
<td>La (mM)</td>
<td>16.8±2.5</td>
<td>18.5±1.3</td>
<td>18.4±1.2</td>
<td>20.7±2.2</td>
<td>17.6±1.7</td>
<td>19.6±2.3</td>
</tr>
<tr>
<td>HCO₃⁻ (mM)</td>
<td>12.1±1.2</td>
<td>10.6±1.0</td>
<td>12.0±1.2</td>
<td>10.7±1.2</td>
<td>12.0±1.0</td>
<td>10.6±1.4</td>
</tr>
<tr>
<td>pH</td>
<td>7.1±0.04</td>
<td>7.1±0.04</td>
<td>7.1±0.04</td>
<td>7.1±0.05</td>
<td>7.1±0.00</td>
<td>7.1±0.05</td>
</tr>
</tbody>
</table>

**CONCLUSIONS:** Despite striving to optimal performance.
CoNCLUsIoN:
and the average running speed during the 20.1k TT was no significant difference between predicted time and performance time for both the 10k and 20.1k was r=0.90 (p=0.0001) and r=0.88 (p=0.0001), respectively. There during each time trial were calculated
running velocity as determined by the LT profile, one 10 kilometer (k) and one 20.1k time trial (TT) on a treadmill. Predicted

times for the 10k TT were calculated from the speed determined by the Dmax method. 

RESULTS: The estimated CV was 16.6 ± 0.7 min⁻¹, with significant linear regressions (R²=0.90±0.03). The animals presented maximal lactate steady state at 3.90 ± 0.35M of blood lactate, at the velocity of 20 min⁻¹. At 15 min⁻¹, the blood lactate also stabilized, but in lower concentration (3.05 ± 0.34M). There was a progressive increase in blood lactate concentration at 25 min⁻¹. The CV and MLSS presented significant correlation (r=0.78).

CONCLUSIONS: The results suggest that the non-exhaustive protocol used seems to be valid for the aerobic evaluation in sedentary running rats, but this protocol underestimates the MLSS in 20%. Supported by FAPESP (proc n° 04/07075-0), CNPq and CAPES.

Running Velocity Determined by the Dmax Method Correlates with and Predicts Running Performance
Charlas Papadopoulos¹, James A. Doyle¹, Brian D. LaBudde¹, ¹Central Washington University, Ellensburg, WA. ²Georgia State University, Atlanta, GA. (Sponsor: L.J. Brandon, FACSM)
Email: papadopH@cwu.edu
The lactate threshold (LT) has been used extensively to predict endurance performance, prescribe exercise intensity and to monitor training adaptations. By definition, the LT should occur at a single exercise intensity, power or velocity. So, the question that arises is “how can a single point on the lactate response curve predict performance at different distances?”

PURPOSE: The purpose of this study was to determine if the LT (max definition (the point on the regression curve that yields the maximal distance to the straight line formed by the two end points)) correlates and predicts running performance of two different distances.

METHODS: Fourteen well-trained runners (age: 30.7 ± 2.0 yrs; height: 179.5 ± 1.1 cm; weight: 69.7 ± 1.8 kg; body fat: 8.3 ± 0.9% VO₂max: 65.9 ± 1.2 ml·kg⁻¹·min⁻¹) completed an incremental maximal exercise test to determine their individual lactate profile, one 10 kilometer (k) and one 20 lk time trial (TT) on a treadmill. Predicted times for the 10k TT were calculated from the speed determined by the Dmax method. Predicted times for the 20k TT were calculated from the speed that was 10% slower than the speed determined by the Dmax method (Dmax-10%). Correlation coefficients between predicted time and personal record (PR) times for each of the distances were calculated using Pearson’s correlation coefficient. A dependent t-test was used to determine if the PR times for the 10k TT were significantly different from the predicted times for the 20k TT. Correlation coefficients between the running velocity as determined by the LTₜₗₘₐₓ definition and the average running speed during each time trial were calculated.

RESULTS: The correlation between the predicted time and the subjects’ PR time for the 10k and 20k was r=0.90 (p=0.0081) and r=0.88 (p=0.001), respectively. There was no significant difference between predicted time and performance time for both distances. There was a significant correlation (r=0.84; p=0.002) between the average running velocity at the LTₜₗₘₐₓ and the average running speed during the 10k TT. There was also a significant correlation (r=0.78; p=0.002) between the Dmax-10% velocity and the average running speed during the 20k TT.

CONCLUSION: These results suggest that, for runners, the speed determined by the LTₜₗₘₐₓ method can be used to prescribe and predict 10km performance. Furthermore, these data showed that the velocity that is 10% slower than the velocity determined by the Dmax method is associated with running performance at 20lk.

Accumulated Oxygen Deficit & pH Recovery during Multiple Bouts of Intense Exercise
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PURPOSE: The purpose of this study was to profile the effect of active vs. passive recovery on accumulated oxygen deficit (AOD) and recovery pH during multiple bouts of intense exercise.

METHODS: Ten highly trained male cyclists completed two exercise trials. Each trial consisted of 3 exercise bouts to exhaustion (110% workload max) with either a 12 min active (20% workload max) or passive recovery between bouts. AOD was calculated as presented significant correlation (r=0.78).

CONCLUSIONS: The results suggest that the non-exhaustive protocol used seems to be valid for the aerobic evaluation in sedentary running rats, but this protocol underestimates the MLSS in 20%. Supported by FAPESP (proc n° 04/07075-0), CNPq and CAPES.

The lactate threshold (LT) has been used extensively to predict endurance performance, prescribe exercise intensity and to monitor training adaptations. By definition, the LT should occur at a single exercise intensity, power or velocity. So, the question that arises is “how can a single point on the lactate response curve predict performance at different distances?”

PURPOSE: The purpose of this study was to determine if the LT (max definition (the point on the regression curve that yields the maximal distance to the straight line formed by the two end points)) correlates and predicts running performance of two different distances.

METHODS: Fourteen well-trained runners (age: 30.7 ± 2.0 yrs; height: 179.5 ± 1.1 cm; weight: 69.7 ± 1.8 kg; body fat: 8.3 ± 0.9% VO₂max: 65.9 ± 1.2 ml·kg⁻¹·min⁻¹) completed an incremental maximal exercise test to determine their individual lactate profile, one 10 kilometer (k) and one 20 lk time trial (TT) on a treadmill. Predicted times for the 10k TT were calculated from the speed determined by the Dmax method. Predicted times for the 20k TT were calculated from the speed that was 10% slower than the speed determined by the Dmax method (Dmax-10%). Correlation coefficients between predicted time and personal record (PR) times for each of the distances were calculated using Pearson’s correlation coefficient. A dependent t-test was used to determine if the PR times for the 10k TT were significantly different from the predicted times for the 20k TT. Correlation coefficients between the running velocity as determined by the LTₜₗₘₐₓ definition and the average running speed during each time trial were calculated.

RESULTS: The correlation between the predicted time and the subjects’ PR time for the 10k and 20k was r=0.90 (p=0.0081) and r=0.88 (p=0.001), respectively. There was no significant difference between predicted time and performance time for both distances. There was a significant correlation (r=0.84; p=0.002) between the average running velocity at the LTₜₗₘₐₓ and the average running speed during the 10k TT. There was also a significant correlation (r=0.78; p=0.002) between the Dmax-10% velocity and the average running speed during the 20k TT.

CONCLUSION: These results suggest that, for runners, the speed determined by the LTₜₗₘₐₓ method can be used to prescribe and predict 10km performance. Furthermore, these data showed that the velocity that is 10% slower than the velocity determined by the Dmax method is associated with running performance at 20lk.

Coronary Risk Status of Police Officers Compared to Age-Matched Males
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Police work is a sedentary occupation with an occasional need to respond to high physical demands. An adequate level of fitness is a hiring requirement for new police personnel. However, few departments mandate minimal fitness standards after initial employment despite heart disease being the most common cause of death for police officers.

PURPOSE: The purpose of this study was to compare the coronary risk profile scores of police officers (PO) to age matched males (AM) from the general population. Coronary risk profile was assessed using criteria developed by the Cooper Clinic in Dallas, TX. Male police officers were compared to age-matched males in our Cardiovascular Risk Assessment Program database.

RESULTS: Subjects were grouped in 10 year age increments (20-29, 30-39, 40-49, 50-59). After age 20-29 there was a higher coronary risk score in police officers compared to age matched males.

CONCLUSION: The risk of developing coronary artery disease is higher in police officers when compared to age-matched males in the general population. Based on these data it appears that officers would benefit from mandated fitness programs designed to improve cardiovascular risk status.

The Role of Core Stabilization Muscles in Lactate Clearance Following High Intensity Exercise
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Exercise above the anaerobic threshold results in the accumulation of lactic acid. An active recovery involving large muscle groups is known to significantly reduce lactate values following exercise. The core stabilization group are postural muscles that may lead to improved performance if properly trained. Stabilization training involves little joint motion and is primarily designed to improve intrinsic stabilization of the muscle complex. It is unknown whether activation of the core musculature through these exercises have the ability to decrease lactic acid following intense exercise.
**Preliminary Examination on the Effects of Pacing on Metabolism in Overweight and Obese College Students**

Meir Magal¹, Ron T. Smith¹, Jay R. Hoffman, FACSM.

**Purpose:** In the United States, overweight and obesity affects approximately 65% of the adult population. Regular exercise might reduce the risk of overweight and obesity through an increase of daily energy expenditure and fat oxidation. However, there is limited knowledge regarding pacing techniques in this population. The purpose of this study was to compare the effects of two different pacing modes on fuel utilization and energy expenditure in overweight and obese college students.

**Methods:** Four females and one male (mean ± SD, age: 22 ± 1, body mass index: 32.0 ± 5.6 kg/m², body fat: 36.0 ± 1.1%, VO₂peak: 32.3 ± 6.1 ml/kg/min) volunteered to participate in the study. Subjects performed a graded exercise test (GXT) on a treadmill using the Bruce Protocol to determine peak oxygen uptake (VO₂peak). On separate days, subjects performed two 30-minute submaximal bouts of exercise that utilized two different pacing strategies. During one exercise session (ML), subjects began the exercise at a moderate intensity (15 minutes at 65% VO₂peak) and then lowered exercise intensity (45% VO₂peak) for the final 15 minutes. During the second exercise session (LM) the order of pacing was reversed. During both exercise sessions the average exercise intensity was 55% VO₂peak. The order of the trials was randomly assigned.

Energy expenditure and fuel utilization was calculated from gas exchange data and was presented as totals for the entire session. Dependent T-Tests were used to analyze the data.

**Results:** The study yielded the following results:

### Variable | ML trial | LM trial
---|---|---
Percent VO₂ (%) | 69.2 ± 10.0 | 59.6 ± 10.8
Energy expenditure (kJ) | 1031 ± 131 | 840 ± 170
Fat oxidation (kJ) | 328 ± 133 | 241 ± 130
CHO oxidation (kJ) | 797 ± 233* | 880 ± 242
RER | 0.90 ± 0.1* | 0.92 ± 0.1

Values are means ± SD *P< 0.05

### Conclusions:

The results were summarized in Table 1. Although energy expenditure was the same during both trials, fat oxidation was significantly greater and CHO oxidation and RER were significantly lower during the ML trial.

**Conclusion:** Preliminary results suggest that in overweight and obese college students pacing strategies may affect substrate oxidation during submaximal exercise, but not the total energy expenditure.

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**CoNCLUsIoNs:**

**Preliminary findings supported the findings of Martin and Buoncristiani (1995), who found significant correlations between reaction time and final time performance in sprint running. These results were consistently higher in men (r = 0.250, P < 0.05, n = 73, men r = 0.369, P < 0.01, n = 57) than in women. Different reaction time could provide an advantage in the performance in sprint running. However, it is not clear whether RPY is affected by cadence in a similar magnitude.

**Conclusion:** To investigate whether RPY is regulated by the availability of pyruvate indicated by BLC irrespectively of cycling cadence.

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**Effects of Cycling Cadence on Pyruvate Combustion**

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The relative rates of substrate utilization, in terms of carbohydrate and fatty acids, are highly affected by exercise intensity. The breakdown of carbohydrates via glycolysis results in pyruvate. Pyruvate is aerobically combusted or converted to lactate. The relative rate of aerobic pyruvate combustion (RPY) is determined by the availability of pyruvate whilst the ratio between lactate and pyruvate is regulated by the lactate dehydrogenase, which is a near equilibrium enzyme. Consequently, the RPY can be described as a function of the blood lactate concentration (BLC). At given workloads and/or exercise intensities the BLC increases as cycling cadence increases. However, it is not clear whether RPY is affected by cadence in a similar magnitude.

**Conclusion:** To investigate whether RPY is regulated by the availability of pyruvate indicated by BLC irrespectively of cycling cadence.
treadmill walking with (KAATSU-walk) and without KAATSU (Control-walk) on the same day. The exercise consisted of walking at 50 m/min for five 2-min bouts, with a 1-min rest between bouts (total time 14 min). A specially designed elastic belt (50 mm wide) was placed around the most proximal portion of each leg during KAATSU-walk exercise. The belt contrained a pneumatic bag along its inner surface that was connected to an electronic air pressure control system that monitored the restriction stimulus (Kaatsu-Master, Tokyo). The belt air pressure was set at 200 mmHg for the restriction stimulus during KAATSU-walk test. A near-infrared continuous-wave spectrophotometric (NIRS) was used to measure the peripheral muscle oxygenation in the vastus lateralis (VL), and gastrocnemius medialis (GM) muscles. Pulse oximetry (SpO2) was monitored in both the hands and feet. Oxygen uptake during KAATSU-walk and Control-walk was measured on separate days.

RESULTS: Mean heart rate was higher (P<0.05) at the latter half of the walking session in the KAATSU-walk than in the Control-walk. Mean oxygen uptake was higher (P<0.01) in the KAATSU-walk (687 ml/min) than in the Control-walk (612 ml/min). There was no difference in SpO2 (both hand and foot) during KAATSU-walk than during Control-walk (97-99%). On the other hand, muscle oxygenation level was lower (-16.4%; P<0.01) in the VL (54.4±4.6% versus 65.1±5.2%) and was lower (-17.1%; P<0.01) in the MG (51.0±7.5% versus 61.5±3.2%) during KAATSU-walk than during Control-walk, respectively.

CONCLUSION: The lower muscle oxygenation level during KAATSU-walk may be one of the key factors for the muscular hypertrophy. The decrease in muscle oxygenation was, however, likely due to the pooling of venous blood in the working KAATSU muscle. Further study is needed to determine whether muscle is hypoxic during KAATSU-walk exercise.

2707 Board #215
2:00 PM - 3:00 PM
STEPmax Represents the Most Important Predictor of VO2peak on SIP
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PURPOSE: Determine the power of the variables analyzed during SIP (knee elevation height, absolute and relative number of steps, heart rate, and oxygen uptake) to predict the VO2peak.

METHODS: The sample was constituted by 28 clinically healthy elderly women from 60 to 82 years of age (66.7±5.8 yrs). In SIP, volunteers were oriented to perform, in place, as many steps as possible within 2 minutes in a knee elevation height (KEH) established at the midway point between the patella and the iliac crest. The absolute (STEPabs) and relative (STEPrel) numbers of steps, heart rate (HR), percentage of age-predict maximum heart rate (%HMRabs), and rate of perceived exertion (RPE), were measured at every 30-second interval. The uptake oxygen (VO2) was directly measured through breath gas analysis in every 30 seconds with the Quinton QMC 000350 equipment, that was calibrated at each test. VO2peak was considered as the value achieved on the 120s period.

RESULTS: The STEP represented the main predictor of the VO2peak on SIP. The level of association (r2) between STEP and VO2peak was: 36.0 (21.4%), 66.0 (41.7%), 96.0 (61.7%), 37.0 (P<0.001), and 126.0 (52.2%), P<0.001. The regression analysis permitted to develop the follows models: 1) VO2 (β: 0.070; P<0.660) and KEH (β: 0.113; P<0.957; r2 adjusted 0.021); 2) VO2 (β: 2.382; P<0.584) and STEP (β: 0.114; P<0.006; r2 adjusted 0.240); 3) VO2 (β: 4.750; P<0.502) and HR (β: 0.078; P<0.01; r2 adjusted 0.049); 4) VO2 (β: -9.346; P<0.461); KEH (β: 0.197; P<0.401); STEP (β: 0.124; P<0.015); and HR (β: -0.150; P<0.832) (r2 adjusted 0.299); 5) VO2 (β: -8.534; P<0.474); KEH (β: 0.136; P<0.328); STEP (β: 0.118; P<0.005) (r2 adjusted 0.240); 6) VO2 (β: 0.129; P<0.974); STEP (β: 0.105; P<0.018); HR (β: 0.027; P<0.605) (r2 adjusted 0.240).

CONCLUSION: The results permit to conclude that the odds 2, 5 and 6 represented the best predictive models to estimate the VO2peak, as well the regression analysis models better predict the VO2peak in the SIP when STEPmax is included.

2708 Board #216
3:00 PM - 4:00 PM
Muscle Oxygenation and Pulse Oxygen Saturation during Walking Combined with Restriction of Leg Muscle Blood Flow
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We reported that chronic walk training combined with restriction of leg muscle blood flow (KAATSU) increases thigh muscle size and strength. A variety of factors are thought to influence the KAATSU walk-induced muscle hypertrophy, such as enhanced endocrine responses and muscle oxygenation status. Although the precise mechanism is not fully understood, oxygenation status of working muscle seems to play an important role in stimulation of KAATSU-induced muscle hypertrophy.

PURPOSE: To investigate the response of leg muscle oxygenation and pulse oxygen saturation during KAATSU walk.

METHODS: Seven young men [mean (SD): 22.1 (2.9) yrs] performed acute
In vivo Assessment of Intracellular Oxygenation during Fatiguing Isometric Contractions of the Ankle Dorsiflexors

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During fatiguing muscle contractions, a mismatch between oxygen delivery to the muscle and usage by the mitochondria may contribute to muscle fatigue. Such a mismatch will be reflected by a progressive deoxygenation of the cell’s myoglobin pool. The rise in deoxyhemoglobin (dMb) can be measured continuously and non-invasively using 1H magnetic resonance spectroscopy.

PURPOSE: The purpose of this study was to study fatigue and dMb in 8 healthy subjects during 16min of incremental isometric ankle dorsiflexor contractions.

METHODS: Subjects performed 2 contraction protocols in a 4T whole-body superconducting magnet, one with a slow contraction/relaxation cycle (4s contract/6s relax, “slow rhythmic”) that would maximize the role of muscle strength and blood flow occlusion, and one with a rapid contraction/relaxation cycle (1.2s contract, 1.8s relax, “rapid rhythmic”) that would minimize the role of muscle strength and maximize the role of metabolic vasodilation. Each protocol began at 10% MVC and increased by 10% every 2 min. An MVC was performed at the beginning of each stage and after the final contraction to assess fatigue. dMb was measured throughout the contraction protocols and a subsequent 10-min bout of isochronous (220 mmHg) used to obtain 100% desaturation. dMb was measured during the contractions was peaked to dMb obtained during ischemia.

RESULTS: During each protocol, dMb increased linearly with the time-tension integral (TTI; r = 0.78 for slow rhythmic and 0.77 for rapid rhythmic), and this relationship was similar across protocols (p = 0.90 for r and 0.13 for slope of individual regressions). Likewise, fatigue was associated with dMb in a similar fashion during both protocols. Although there was a substantial increase in dMb during both protocols, it is plausible that the “mismatch” between oxygen delivery and usage (indicated by Mb desaturation) was achieved differently in each protocol. With the slow rhythmic protocol providing a transient limitation in oxygen delivery during the 4-s contractions, and the rapid rhythmic protocol providing a greater mitochondrial oxygen need due to the high metabolic demand of this task. This scenario is supported by the presence of a relationship between pre-exercise muscle strength and peak dMb during the slow rhythmic (r = 0.58) but not the rapid rhythmic (r = 0.08) protocol.

CONCLUSIONS: Overall, these data suggest that dMb was proportional to TTI, regardless of the way in which TTI was achieved. The possibility that the mismatch in intracellular oxygen supply and usage (reflected by increased dMb) may be achieved by a variety of mechanisms bears further investigation in studies of skeletal muscle fatigue.

Supported by grants: NATO LST.CLG 979220, Wellcome Trust (UK) 064898.
PURPOSE: To compare the magnitude changes in EMG activity during low-intensity exercise with and without KAATSU and ischemic conditions.

METHODS: Seven male volunteers [mean (SD) age: 24.9 (3.3) years] performed two modes (3 sets of 10 reps with 30 sec rest between sets and 30 consecutive reps) of single arm curl exercise (20% of a predetermined 1-RM) during three different conditions (Control, KAATSU and Ischemia). In the KAATSU condition, a specially designed elastic cuff belt (30 mm wide) was placed at the most proximal position of the upper arm and inflated to a pressure of 30% higher than their systolic blood pressure. During the ischemic condition, blood flow was occluded by over 300 mmHg of occlusive pressure via occlusion cuff. Surface EMG was recorded from muscle belly of the biceps brachii muscle, and mean integrated EMG (iEMG) was analyzed.

RESULTS: During 3 sets of 10 reps exercise, a gradual increase (P<0.01) in iEMG was observed in Ischemia but not in both KAATSU and Control. The magnitude increase in iEMG was higher (P<0.01) in Ischemia (101% higher at end of 3 sets) compared with KAATSU (52%) and Control (23%). On the other hand, there was similar increase in iEMG between Ischemia (92%) and KAATSU (78%) during 30 consecutive reps of exercise, and both conditions were higher (P<0.05) than that of Control (40%). After 30 consecutive reps of exercise, both KAATSU and Control conditions performed additional sets of exercise (3 sets of 15 reps with 30 sec rest between sets). At the end of 3 sets of 15 reps, the increase in iEMG was 244% for KAATSU and 86% for Control. The increase in iEMG was larger (P<0.01) in KAATSU compared with Control.

CONCLUSION: Increase in iEMG during KAATSU may be an important factor for KAATSU training-induced muscle hypertrophy and strength gain.

2715 Board #223 4:00 PM - 5:00 PM

The Effects of Acute Hypoxia on Electrical and Mechanical Activity during Submaximal Isometric Contractions


Prior studies reported acute and chronic effects on electrical and mechanical activity during maximum voluntary contraction (MVC) and motor unit activation strategy by using the surface electromyogram (EMG)-torque and mechanomyogram (MMG)-torque relationships (Orizio et al. 1994) and performance during sustained MVC (Esposito et al. 2003). There are a few studies on acute effects of muscle performance, electrical and mechanical activity during submaximal voluntary contractions under hypoxic condition.

PURPOSE: To examine the influence of acute hypoxia on the EMG-torque and MMG-torque relationships, and muscle performance, electrical and mechanical activity during submaximal isometric contraction of elbow flexor.

METHODS: Eight male subjects (23±4 years) volunteered to participate in the present study. The MVC of the left elbow flexor muscle was measured following normoxic or acute (20 min) normobaric hypoxic (FiO2 0.12) conditions at separate times. The purpose of these MVCs was to ensure an accurate assessment of maximal torque for the calculation of submaximal loads for the EMG-torque and MMG-torque relationships. Subjects were asked to match this target torque as closely as possible during an approximately 4 s contraction. The submaximal loads employed were 20, 40, 60, 80%; these loads were performed in a random order and used the EMG and MMG signals of left biceps brachii muscles were recorded under normoxic and hypoxic conditions. The endurance time, and EMG and MMG signals during submaximal voluntary contractions (80% 20% of MVC) was measured in subsequent tests.

RESULTS: The MVC was not significantly different between normoxic and hypoxic conditions (50.7±15.3 and 50.7±14.0 Nm, respectively). The EMG signals were significantly increased with increased torque. The MMG increased from 20% to 60% of MVC but not to 80% of MVC. There were no significant differences between normoxic and hypoxic conditions in the EMG-torque and MMG-torque relationships. The endurance time, and EMG and MMG signals during submaximal voluntary contraction were also not significantly different between both conditions, although the endurance time at 20% of MVC was shorter in the hypoxic condition (386±166 s) than in the normoxic condition (420±108 s) (but non significant).

CONCLUSIONS: In the elbow flexor muscle, exposure to acute normobaric hypoxia seems to have little effect on the motor unit activation strategy as well as on muscle performance, and electrical and mechanical activity during sustained submaximal isometric contractions. Supported by a Grant-in-Aid for Scientific Research from National Institute of Fitness and Sports in 2004.

2716 Board #224 2:00 PM - 3:00 PM

Difflent Ischaetic Affict on Atrophy Attenuation and Muscle Function Following ULLS

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INTRODUCTION & PURPOSE: A recent report suggests that periodic bouts of blood flow occlusion to skeletal muscle during surgically-induced bed rest results in atrophy attenuation (Takarada et al., 2000). To our knowledge this observation has not be re-investigated, nor is it known how applied ischemia (AI) affects other facets of muscle function. Therefore, the purpose of this study was to investigate the effect of AI on skeletal muscle function following 4-weeks of unilateral lower limb suspension (ULLS; an experimental model of disease).

METHODS: Measurements of voluntary and stimulated forces, the compound muscle fiber action potential (CMAP) and muscle cross-sectional area (CSA, via MRI) were collected before and after a 4-week control period and 4-weeks of ULLS in healthy adults (n=18; 19-28 years). A subset of these subjects (n=6) received AI 3 days per week (3-sets; 5-minutes duration) during the ULLS period.

RESULTS: In subjects not receiving AI, the loss in muscle mass and strength was as expected (~9% and 14%). We observed a 30% slowing in the duration of the CMAP, a 15% decrease in the twitch-to-doublet ratio, and a 26% increase in the twitch (P<0.05). In the subjects receiving the AI, no mitigation was observed in muscle strength, nor did it alter the evoked force properties. We did, however, observe a preferential maintenance of the lateral gastrocnemius CSA in subjects using AI (control and AI atrophy: 10.2% vs. 4.7%, respectively) with no effect of AI on the soleus, and a trend towards atrophy attenuation in the medial gastrocnemius. Additionally, AI abolished the unweighting-induced slowing in the CMAP.

CONCLUSION: These findings suggest that AI impacts the sarcolemma and preferentially affects the type II muscle fibers, but does not influence the force generating capacity of the muscle.

This work was supported in part by the following: NASA Training Grant (NIGT-50446), the 2004 and 2005 NASA Space Physiology Research Grant through the American College of Sport Medicine (ACSM) Foundation, and the 2003 ACSM Mid-Atlantic Regional Chapter Research Award.

2717 Board #225 3:00 PM - 4:00 PM

In Vivo Skeletal Muscle Oxidative and Glycolytic ATP Synthesis in Young and Older Adults

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We have recently demonstrated that older adults rely more on oxidative production of adenosine triphosphate (ATP) during maximal intensity muscle contractions in comparison to young adults, who rely more on glycolytic ATP production. It is unclear whether glycolytic ATP synthesis is impaired with age or whether older adults are simply able to adequately meet the energetic demands of muscular work via oxidative phosphorylation.

PURPOSE: To compare the sources of ATP supply in young vs. older adults during free-flow and ischemic muscle contractions, in order to assess whether older adults can effectively increase glycolytic ATP production under conditions in which oxidative ATP synthesis is restricted.

METHODS: 10 young (21±4 yr, mean±SD, 5M, 5F) and 5 older (75±6 yr; 3M, 2F) healthy adults performed isometric ankle dorsiflexion under free-flow (FF) and ischemic (ISC) conditions while intracellular phosphorous metabolites were measured using magnetic resonance spectroscopy. Protocol: six 12s maximal voluntary isometric contractions (MVC) with 12s rest periods between each contraction. The protocol was repeated on the contralateral leg with ischemia maintained continuously via thigh cuff inflated to 220 torr. The rates of ATP synthesis from net phosphocreatine hydrolysis, oxidative phosphorylation, and anaerobic glycolysis were calculated from changes in phosphorous metabolites and pH.

RESULTS: During FF, there were trends for higher rates of oxidative phosphorylation (P =0.11) and lower glycolytic flux (P =0.10) in older compared to young. During ISC, oxidative phosphorylation was suppressed to a similar level in young and older subjects (P=0.27) and glycolytic rates increased in both age groups. The trend for lower glycolytic flux in older during FF was eliminated in ISC (P=0.91).

CONCLUSIONS: These data suggest that the apparent reliance of older adults on oxidative phosphorylation, which can be observed during intermittent MVCs in which blood flow is not externally restricted, does not appear to be due to impairment in glycolytic ATP production.

2003 Board #226 1:00 PM - 2:00 PM

Effects of Electrical Stimulation on Muscle Strength and Mass During Spaceflight (ULLS)

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INTRODUCTION: The effects of bed rest and microgravity on muscle strength and mass remain to be elucidated. We recently reported (Gainor et al., 2002) that skeletal muscle strength and mass were reduced in men during 4 weeks of bed rest (BUR) and 4 weeks of microgravity (ULLS). This study was designed to test the hypothesis that electrical muscle stimulation (EMS) could mitigate the loss in muscle strength and mass during BUR and ULLS.

METHODS: Eight male subjects (23±4 years) were studied during BUR and ULLS. Subjects were randomly allocated to two conditions: 1) BUR (control), and 2) BUR+EMS. Subjects were randomized to perform 4 weeks of bed rest, then 4 weeks of spaceflight. In the BUR+EMS condition, EMS (20 sec on, 20 sec off, with 5 min rest between sets) was performed 3 times per week for 4 weeks during BUR and ULLS. Prior to and after BUR and ULLS, strength and mass were evaluated.

RESULTS: After BUR, there were no changes in strength or mass in either condition. During ULLS, there were no changes in mass for either condition. Strength in the control condition was reduced below pre-flight levels, while strength in the EMS condition was maintained. EMS produced a 40% decrease in the loss of mass and a 40% decrease in the loss of strength to control.

CONCLUSIONS: EMS may provide a viable approach to mitigate the loss of muscle strength and mass during BUR and ULLS. However, further studies are needed to optimize EMS conditions.
4:00 PM - 5:00 PM

Effects of Antioxidant Supplementation and Repetitive Loading on Biomarkers of Oxidative Stress in Aged Rats
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PURPOSE: The purpose of this study was to characterize the effects of two different dietary antioxidant supplements and chronic repetitive loading exercise on biomarkers of oxidative stress in aged rats.

METHODS: Aged Fischer 344 Brown Norway rats (30 months) were randomly assigned to either a diet supplemented with Vitamin C (2% by weight) and Vitamin E (30,000 I. U.) (N = 4), curcumin (1% by weight) (N = 5) or normal (unsupplemented) rat chow (N=4). The dorsiflexors of one limb in all animals was loaded 3 times per week for 4.5 weeks. The contralateral limb served as the intra-animal control. Additional control aged (30 months, N=4) and young adult rats (6 weeks of age, N=6) underwent the training protocol, but received the non-supplemented diet. The tibialis anterior muscle (TA) was removed and assayed for biomarkers of oxidative stress that included: the ratio of reduced glutathione to oxidized glutathione (GSH/GSSG), which is a measure of redox status, malondialdehyde (MDA) which is a biomarker for lipid peroxidation, 8-hydroxy-2′-deoxyguanosine (8-OHdG), which is a marker of oxidative damage to DNA, catalase concentration, and cytosolic hydrogen peroxide (H2O2) levels.

RESULTS: The data indicate that compared to control muscles, repetitive loading significantly increased catalase activity and lowered MDA levels in the TA. Non-supplemented chronic exercise significantly increased cytosolic H2O2 levels in the TA of old rats, but decreased the cytosolic H2O2 levels in the TA of young adult rats. Supplementation with Vitamin E & C significantly increased the GSH/GSSG ratio and decreased cytosolic H2O2 levels in muscles of old rats. Supplementation with either Vitamin E & C or curcumin attenuated the increase in H2O2 levels in the exercised TA muscle of old rats. Supplementation had no effect on catalase concentration.

CONCLUSION: The results suggest that both antioxidant supplementation and repetitive loading exercise can improve the pro-oxidant status in muscles of old rats, but that they may work via different mechanisms. Supported by NIH/NIA: R01AG021530.

2:00 PM - 3:00 PM

Age-Related Functional and Morphological Changes in the Rat Phrenic Motoneuron
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PURPOSE: There is a general correspondence between the sizes of motoneurons, motor units, and muscle fibers that has particular functional importance in motor control. This study aimed to investigate age-related morphological changes of phrenic motoneurons including dendritic architecture in the rat.

METHODS: By using an intracellular recording technique, the electrophysiological membrane properties of the motoneurons were measured in young adult (less than 1-year) and old (2-year) rats. Under anesthesia and artificially conditions, the recorded motoneurons were divided into recruited (spike discharge) and non-recruited (depolarization only) types. Electrophysiological membrane properties and mean interval of spike discharge were measured in the motoneurons. In another set of animals (5 rats from each age group), the phrenic motoneurons were retrogradely labeled with cholera toxin subunit B (CTB), and then the spinal cord was processed with immunohistochemical staining (1st antibody to CTB and 2nd antibody with Cy3) and observed by confocal imaging techniques to examine dendrites architecture.

RESULTS: In the recruited motoneurons of the old rat, the intervals of action potentials were markedly irregular, and the mean interval of the discharge was significantly longer than the values in the young adult rat (79 ms vs 112 ms). Compared to the young adult rat, there were significant decreases in the somal volume significantly longer than the values in the young adult rat (79 ms vs 112 ms). Potentials were markedly irregular, and the mean interval of the discharge was.

CONCLUSION: Motoneuron excitability is determined by both intrinsic electrophysiological properties and extrinsic factors such as synaptic input. For a given somal surface area and synaptic input density, a smaller dendritic surface area would imply lesser excitability due to lower input. The smaller primary dendrite might be a reason for unstable firing frequency observed in the old phrenic motoneuron.
Sensory neuron evokes a synchronous Ia afferent discharge (spatial summation).

In addition, spatial discharge of the afferent terminals produces less presynaptic inhibition when testing at 25% Hmax and Hmax, respectively.

CONCLUSION: There appears to be more mechanically than electrically stimulated H-reflex depression when testing at 25% Hmax and 50% Hmax. Furthermore, it appears there is no added depression between 25% and 50% Hmax under the mechanically stimulated condition. These results demonstrate the influence of Ia discharge properties on H-reflex depression, and may suggest differences in the affinity of Ia terminals to intrinsic presynaptic inhibition at different stimulus intensities.

Methods: In a randomized within-subjects design, 10 young healthy subjects (age 27 ± 4.8) participated in this study. Subjects were tested in the prone position with their right ankle secured to an isokinetic dynamometer. The soleus H-reflex was tested at three different stimulus intensities (25%Hmax, 50%Hmax, and Hmax) and peak to peak amplitudes were recorded after either a MS or ES conditioning stimulus. For the ES condition, the ankle was held at 90 degrees, whereas the MS condition utilized a 10 degree passive dorsiflexion at 15 degrees/sec back to the 90 degree position. Both conditions were followed by six electrical stimulations at a frequency of 1 Hz. This was repeated in blocks of seven. All H-reflex measurements were recorded with the ankle at 90 degrees.

RESULTS: A 3 x 2 (stimulus intensity x condition) repeated measures ANOVA indicated significant main effects for stimulus intensity (F1,18 = 16.23; p < .003) and condition (F2,36 = 24.48; p < .001), as well as an interaction (F2,36 = 6.59; p = .008). Simple main effects identified significantly (p < .05) more H-reflex depression for MS (94%, 91%, and 44%) compared to ES (65%, 55%, and 19%) at 25%Hmax, 50%Hmax, and Hmax, respectively.

CONCLUSION: The results of the present investigation suggest that resting serum BDNF levels are not elevated in response to chronic exercise training in young healthy humans.

2723 Board #237 3:00 PM - 4:00 PM The Effects of Activity-Wheel Running After β-Adrenergoreceptor Blockade on Copulatory Behavior and Galanin mRNA in the Medial Preoptic Area and Locus Coeruleus in Male Rats
Nathaniel J. Thom, Rod K. Dishman, FACSIM, Philip Holmes, Jenny Reiss, Sarah Eisenstein. University of Georgia, Athens, GA.

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Copulatory performance of male rats is facilitated by acute injection of noradrenaline, and inhibited by β-adrenergoreceptor blockade, in the medial preoptic area (MPOA). Studies in our laboratory have shown that chronic activity-wheel running is modulated by the neuropeptide galanin (GAL). The purpose of this experiment was to investigate whether three weeks of activity-wheel running would increase male copulatory performance and GAL mRNA in the MPOA and locus coeruleus (LC) after β-adrenergoreceptor blockade with propanolol. MATERIALS AND METHODS: Long-Evans rats (N=48) were assigned in a 2x2x2 drug treatment (propanolol vs. saline) x treatment (prolonged vs. saline) x homoeurine control group (n=7). Animals were chronically administered saline or propanolol in saline vehicle (6µm/day) via an osmotic mini-pump connected to a cannula implanted into the third ventricle. After three weeks of activity-wheel running, rats underwent copulatory testing. 24 hours later, after rapid decapitation, rat brains were analyzed utilizing in-situ hybridization histochemistry for GAL mRNA in the MPOA and LC. RESULTS: There was a main effect of drug treatment on GAL mRNA in the MPOA (p < .05) but not other main effects or interactions between drug treatment and wheel running. Contrary to expectations, animals treated with saline had lower GAL mRNA in the MPOA compared with the propanolol and home cage groups, which did not differ. Similarly, wheel running was lower by week 3 in animals treated with saline compared to propanolol (p < .05). Despite abnormally low rates of copulation in the saline groups, the percentage of wheel runners treated with propanolol that achieved an ejaculation (50%) was higher compared to other experimental groups (7%; Z = 2.81, p < .05).

CONCLUSION: Propanolol treatment appeared to normalize expression of the gene that encodes prepro-galanin in the MPOA after chronic activity-wheel running. There is evidence that anxiety does not account for the reduction in the H-reflex after exercise. Another possible explanation for the reduction in the H-reflex is that it represents an anti-spastic effect of acute physical activity.

2725 Board #237 2:00 PM - 3:00 PM Effect of Acute Exercise on the H-reflex: Implications for Anti-spasticity?

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More than 10 studies have examined the effect of acute exercise on the H-reflex. All of those studies reported that acute exercise reduced the amplitude of the H-reflex. There is evidence that anxiety does not account for the reduction in the H-reflex after exercise. Another possible explanation for the reduction in the H-reflex is that it represents an anti-spastic effect of acute physical activity.

METHODS: Participants (N = 15) were individuals with multiple sclerosis (MS) who had spasticity of the leg muscles, but were not currently taking anti-spastic medications. The participants underwent assessments of the modified Ashworth and the H-reflex in the soleus muscle before and 10, 30, and 60 minutes after 20-minute sessions of quiet rest and unloaded cycling exercise. RESULTS: Results of a 2 (condition) by 4 (time) repeated measures ANOVA identified statistically significant interactions on modified Ashworth scores [F(3,42) = 3.19, p = .03,Eta-squared = .19] and the H-reflex [F(3, 42) = 10.02, p < .001, Eta-squared = .42]. The unloaded cycling exercise resulted in reductions in modified Ashworth scores and the H-reflex, and the reductions lasted for 60 minutes. The reductions of the modified Ashworth were small in magnitude, whereas the reductions of the H-reflex were moderate in magnitude. There were no changes in modified Ashworth scores and the H-reflex with the quiet rest session.

CONCLUSION: The post-exercise decrease in the H-reflex coincides with reductions in the modified Ashworth scale, and might represent an anti-spastic effect of acute exercise.

2726 Board #234 3:00 PM - 4:00 PM The Effects of Motor Imagery on the Hoffmann Reflex and Presynaptic Inhibition
Brendon Hale, John S. Raglin, FACSIM, Dave M. Koceja. Indiana University, Bloomington, IN.

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Mental imagery of a motor task may influence the amplitude of the Hoffmann reflex (H-reflex) (Hale et al. 2003, Oishi et al. 1995), but these investigations have not examined the potential influence that presynaptic inhibition might have on the H-reflex during mental imagery of a motor task.

PURPOSE: The purpose of this project was to investigate the effects of mental imagery of a motor task on the H-reflex and on presynaptic inhibition of the H-reflex.

METHODS: In this study 25 adult participants (M=22.8 years, SD=5.4; 15 Females, 10 Males) were examined on one day of testing. The participants mentally imagined a simple plantar flexion movement of the right foot at two intensities: 20 and 60% of maximum voluntary contraction after completing a series of practice trials of the ES actual contractions at these intensities. Five participants served as control subjects who completed the entire testing protocol but did not perform mental imagery. The dependent measures were peak-to-peak amplitude of the H-reflex and the peak to peak amplitude of the conditioned H-reflex. Data analysis was conducted using a 2X2 ANOVA to determine if any changes in H-reflex amplitude occurred from rest and imagery percentage. Additionally, a One-way ANOVA was conducted to determine if
The Effects of Nightly Normobaric Hypoxia on Running Economy and Hemoglobin Mass

Mitsuo Neya, TakaTetsu Neya, Taketuru Maegawa, Taisuke Enoki, Ken-ichi Iwasaki, Miharu Miyamura, Takateru Maegawa

PURPOSE: To investigate the effects of nightly intermittent hypoxia on the total hemoglobin mass (THB) maximum oxygen consumption (VO2max) and running economy.

METHODS: Sixteen college-level long- and middle-distance runners (mean ± SD age, height, mass, VO2max = 22 ± 2 yrs, 169 ± 5 cm, 58 ± 6 kg, 60 ± 7.5 ml/kg/min) were assigned to a hypoxic group (HYP, n=10) who rested and slept in hypoxic accomodation (O2 concentration = 14.5%; = 3000 m) - 12 h night and trained at sea level, or to a control group (CON, n=6) who slept and trained at sea level. The hypoxic period was 29 nights and VO2max and THB were measured before and 5-7 days after.

RESULTS: THB was measured using the carbon monoxide method twice during the 10 days before the intervention and our typical error was 2.4%. Submaximal running economy (RE) was measured on a motorized treadmill at 12, 14, 16 and 18 km/h with 4 min at each speed. The classic Douglass bag method was used to measure VO2.

RESULTS: Twenty-nine consecutive nights of "live simulated high, train sea level" did not increase the THB (HYP-pre 807±64 vs post 798±73 g; CON-pre 872±34 vs post 877±24 g) nor was there a corresponding change in VO2max (HYP-pre 61.7±3.2 vs post 59.1±6.4 ml/kg/min; CON-pre 59.8±7.1 vs post 56.8±4.5 ml/kg/min). These results indicate that this duration of intermittent exposure to hypoxia was insufficient stimulate increased red blood cell production. Only the HYP group had a 5.0% improved RE at 18 km/h (p<0.01). There were no significant changes in submaximal blood lactate concentration (BLA) and ventilation (VE). For instance at 18 km/h BLA was pre (HYP 6.2±3.2; CON 6.0±2.6 mmol/L) and post (HYP 6.1±2.4; CON 4.9±1.7 mmol/L) and VE was pre (HYP 89.3±13.2; CON 81.6±8.2 L/min) and post (HYP 85.1±10.5; CON 80.5±8.7 L/min).

These two results exclude the possibility that greater carbohydrate utilization or reduced energy requirement of respiratory muscle were induced by the exposure to hypoxia.

CONCLUSIONS: Although this hypoxic protocol did not cause changes in THB and VO2max, the improved economy at submaximal running speed implies that sleeping in hypoxia for 29 nights can enhance athletic performance.

9:00 AM - 10:00 AM

Economy and Hemoglobin Mass

Mitsuo Neya, TakaTetsu Neya, Taketuru Maegawa, Taisuke Enoki, Ken-ichi Iwasaki, Miharu Miyamura, Takateru Maegawa

PURPOSE: To determine if a greater reduction in LBM due to severe energy intake deficit will eliminate the performance improvement despite maintenance of a high carbohydrate (CHO) diet.

METHODS: Two groups of men (mean ± SE: 22 ± 1 yrs) were matched at SL on cycle peak oxygen uptake (VO2peak), cycle endurance performance (50% of VO2peak for 50 min followed by 70% of VO2peak to exhaustion), and circulating energy from CHO (%CHO). At ALT, the deficit group (DEF, n = 10) consumed 1340 kcal/day (~40%) below BW maintenance requirements and the adequately fed group (ADQ, n = 7) ingested enough energy to maintain BW. Both groups ingested similar %CHO (~64 to 71%) and >347 g of CHO/day at SL and ALT. Endurance performance was again assessed at ALT on days 1 and 18 using the identical absolute power outputs that were used at SL for 50% (149 ± 4 watts) and 70% (218 ± 6 watts) VO2peak.

RESULTS: From SL to day 18 at ALT, BW was reduced for DEF (80.4 ± 12 to 74.3 ± 3 kg; p<0.01) but not ADQ (74.2 ± 3 to 73.3 ± 3 kg; p=0.1). Similarly, LBM (estimated from circumference measures) was reduced for DEF (71.0 ± 10 to 66.4 ± 7 kg; p<0.01) but not ADQ (66.3 ± 5 to 64.9 ± 5 kg; p=0.1). On either day at ALT, there was no difference between groups in endurance time. For both groups, endurance performance at ALT was 6 ± 2% greater on day 18 (57 ± 2 min) than on day 1 (54 ± 1 min; p<0.01).

CONCLUSION: During the first three weeks of ALT acclimatization, a 6% loss in LBM due to underfeeding did not adversely affect the improvement in endurance performance. The lack of effect on performance during severe energy deficit may have been due to the maintenance of muscle glycogen stores or a lower rate of muscle glycogen utilization for the same amount of work.

8:00 AM - 9:00 AM

Mitsuo Neya

Economy and Hemoglobin Mass

Mitsuo Neya, TakaTetsu Neya, Taketuru Maegawa, Taisuke Enoki, Ken-ichi Iwasaki, Miharu Miyamura, Takateru Maegawa

PURPOSE: To investigate the effects of nightly intermittent hypoxia on the total hemoglobin mass (THB) maximum oxygen consumption (VO2max) and running economy.

METHODS: Sixteen college-level long- and middle-distance runners (mean ± SD age, height, mass, VO2max = 22 ± 2 yrs, 169 ± 5 cm, 58 ± 6 kg, 60 ± 7.5 ml/kg/min) were assigned to a hypoxic group (HYP, n=10) who rested and slept in hypoxic accomodation (O2 concentration = 14.5%; = 3000 m) - 12 h night and trained at sea level, or to a control group (CON, n=6) who slept and trained at sea level. The hypoxic period was 29 nights and VO2max and THB were measured before and 5-7 days after.
increase in ventilation correlated to the change in HVR. However, it is unclear whether or not intermittent hypoxia at rest induces a chronic effect in ventilation at moderate altitude that is accompanied by an increase in hypoxic chemosensitivity.

**METHODS:** Ten subjects performed single-blinded random assignment to one of three groups: hypoxia-altitude (n=9), normoxia-altitude (n=6), and normoxia-sea level (n=7). The hypoxia-altitude group experienced 9-13 sessions of intermittent hypoxic exposure over 15 days, then repeated the performance tests within 12 hours of traveling to an altitude of 1650 m. The normoxia-altitude group experienced placebo exposures by breathing room air before performing the tests at altitude, whereas the normoxia-sea level group experienced placebo exposures before performing the tests at sea level. Hypoxic exposure sessions consisted of moderately breathing through a handheld face mask 6 min hypoxic gas and 4 min ambient air for 1 hour at rest. Oxygen in the gas was reduced progressively (Day 1, 13%; Day 15, 9%). Ambient air replaced hypoxic gas for the placebo exposures. Performance measures gathered at each testing session were oxygen consumption speed, submaximum heart-rate speed and submaximum lactate speed during a 20-m incremental running test, mean time in six 70-m sprints, various mean measures from seven 5.5-min circuits of a rugby simulation, and mean time in a second set of sprints.

**RESULTS:** At altitude there were clear impairments in maximum and heart rate-speed, definitive sprint time, and sprint power (2% to 16%), and a clear improvement in 30 m sprint time (-4%). Relative to the normoxia-altitude group, the hypoxia-altitude group experienced a clear improvement in heart-rate speed (10%; 90% confidence limits ±1% to ±2%) and an unclear improvement in lactate speed (2%; ±4%); effects on all other performance variables were trivial (±1.5%) and in most cases unclear (±3% to ±14%).

**CONCLUSIONS:** Altitude of 1650 m had a positive effect on some sprints but a detrimental effect on 20-m running performance and sprint power. Intermittent hypoxic exposure improved some physiological measures of performance but otherwise had little effect in preparing rugby players for performance at altitude. Supported by New Zealand Rugby Union.

**POSTER SESSIONS**
day of mountaineering (altitude from 2000-3900 meters). All subjects performed approximately 8 hours of altitude hiking daily at the same pace.

RESULTS: Glucose and insulin levels were lowered in the High DHEA group (139.0±8.10 mmol/L vs. 99.6±6.54 mmol/L; 32.6±1.55 μU/ml vs. 11.69±2.24 μU/ml; p<0.05). Haematocrit and hemoglobin levels were significantly elevated on the 25th day only in the High DHEA group (40.2±1.0% vs. 15.4±0.1%; 14.4±1.05 g/dL vs. 15.4±0.17 g/dL; p<0.05). Resting HR mean hiking HR, and EPO were significantly greater in the Low DHEA-S group than those of the High DHEA group (p<0.05). Serum DHEA-S level was significantly reduced below basal on the 3rd day at altitude only in the High DHEA group (40.2±1.0% vs. 15.4±0.1%; 14.4±1.05 g/dL vs. 15.4±0.17 g/dL; p<0.05). Resting HR mean hiking HR, and EPO were significantly greater in the Low DHEA-S group than those of the High DHEA group (p<0.05).

CONCLUSIONS: The effects of mountaineering on glucose tolerance and insulin sensitivity only occurred in the High DHEA-S subjects. An inverse relationship between DHEA-S and EPO levels was observed during altitude stress.

2735 Board #9 10:00 AM - 11:00 AM
Acute Mountain Sickness and SaO2 in Moderate Altitude Versus Sea-level Residents Ascending to 4300 m
Stephen R. Muza, Charles S. Fulco, Anne Friedlander, Mike Zupan, Paul B. Rock, Beth A. Beidleman, Kevin A. Jacobs, Janet Staab, Allen Cymerman, US Army Research Institute of Environmental Medicine, Natick, MA; “U.S. Air Force Academy, Colorado Springs, CO; Oklahoma State University, Tulsa, OK; University of Miami, Coral Gables, FL; (Sponsor: Michael N. Sawka, FACSM)

Email: stephen.muza@us.army.mil

When sea-level residents (SLR) rapidly ascend to ~4300 m, arterial oxygen saturation (SaO2) is low, and the incidence and severity of acute mountain sickness (AMS) is typically high, especially following heavy exertion in the early hours of altitude exposure. In this study, moderate-altitude residents (MAR) have a lower initial SaO2 upon arrival at 4300 m (Muza 2004) compared to SLR, but it is unknown whether they also exhibit a lower incidence and severity of AMS.

PURPOSE: To determine if MAR, compared to SLR, whether ventilatory acclimatization, obtained during residence at 1800-2200 m (21±3 mo, ±SD), reduces the incidence and severity of AMS for up to 72 h to 4300 m with heavy exertion in the early hours of altitude exposure.

METHODS: Sixteen MAR (9 men, 7 women; 30±3 yr, 69±9 kg) and eighteen male SLR (25±5 yr, 78±9 kg;) completed an Environmental Symptoms Questionnaire (ESQ) and resting SaO2 upon arrival at 4300 m (Muza 2004) compared to SLR, but it is unknown whether they also exhibit a lower incidence and severity of AMS.

RESULTS: The incidence of AMS was lower (P<0.05) in MAR compared to SLR, respectively, at PP10 (13% vs. 72%), PP24 (0% vs. 61%), PP48 (0% vs. 56%), and PP72 (0% vs. 44%). The severity of AMS was also lower (P<0.05) in MAR compared to SLR, respectively, at PP10 (0.4±0.2 vs. 1.5±1.3), PP24 (0.2±0.2 vs. 1.4±1.2), PP48 (0.1±0.2 vs. 1.4±1.5), and PP72 (0.1±0.1 vs. 0.7±0.7). The PP3 exercise SaO2 was higher (P<0.01) in MAR compared to SLR (80.3±% vs. 74±6%). Resting SaO2 was similar in MAR and SLR at PP24 (86±2% vs. 88±4%), but higher (P<0.05) in MAR at PP48 (89±3% vs. 83±6%) and PP72 (89±3% vs. 84±4%), respectively.

CONCLUSION: These results show that compared to altitude residence at sea level, residents at moderate altitude are very effective in decreasing the incidence and severity of AMS upon exposure to a higher altitude (4300 m) due, in part, to a greater degree of ventilatory acclimatization.

2736 Board #10 8:00 AM - 9:00 AM
Exercise SaO2 in the Early Hours of Exposure to 4300 m Altitude is Correlated with Subsequent Development of AMS
J E. Staab, 1 C. Fulco, 1 S. R. Muza, 1 M. Zupan, 1 P. B. Rock, 1 B. A. Beidleman, 1 A. Cymerman, 1 U.S. Army Research Institute of Environmental Medicine, Natick, MA; 2 U.S. Air Force Academy, Colorado Springs, CO; 3 Oklahoma State University, Tulsa, OK; 4 VA Palo Alto Health Care System, Palo Alto, CA; (Sponsor: Michael N. Sawka, FACSM)

Email: janet.staab@us.army.mil

Previous research has demonstrated that exercise arterial oxygen saturation (SaO2) during the first 6-10 h of a 10-hour exposure to 4700 m altitude is closely related to the development of acute mountain sickness (AMS) during 10-h of exposure (Reoch, 2000).

PURPOSE: To determine whether exercise SaO2, measured during the first 5 hours of a 72-hour exposure to 4300 m, is related to the subsequent development of AMS during the 72-hour exposure.

METHODS: Thirty four sea-level (50 m) and moderate-altitude residents (1800 to 2200 m) (27 men, 7 women; 28±5 yr, 74±9 kg; ±SD) completed an Environmental Symptoms Questionnaire (ESQ) and resting SaO2, (pulse oximeter) measurement in the morning at their residence altitude and after ~1, 24, 48, and 72 h residence on Pikes Peak (PP, 4300 m, 458 mmHg). AMS was assessed using the validated “AMS-Cerebral” (AMS-C) factor score (>0.7) calculated from the ESQ. Exercise SaO2 was collected during a 2.4 h cycle exercise bout (50%-60% VO2max) within the first 5 h of residence on PP (PP5).

RESULTS: Resting SaO2 at PP1 (range: 76% to 95%) and PP24 (range: 72% to 94%) was significantly correlated with AMS-C at PP24 (r=0.0 to 4.1), PP48 (range: 0.0 to 5.0), and PP72 (range: 2.0 to 2.1). However, exercise SaO2 at PP5 (range: 64% to 83%) was significantly correlated with AMS-C at PP24 (r=-0.40±0.02), PP48 (r=-0.37±0.06), and PP72 (r=-3.4±0.05). The desaturation from rest to exercise at PP5 (range: 2% to 24%) was also significantly correlated with AMS-C at PP24 (r=-0.40±0.02).

CONCLUSION: These results demonstrate that the degree of hypoxemia during the early hours of altitude exposure is correlated with the subsequent development of AMS for up to 72 h of exposure to 4300 m altitude.
RESULTS: All four subjects lost weight using the "Altitude" tents for sleeping. Subject 1 lost weight during "sea level" exposure but not during "altitude" exposure. Subjects 2, 3 & 4 lost weight during "altitude" exposure (average of 0.87 kg (1.9 lb) /wk) but not during "sea level" exposure. Phase II (abrupt "altitude" exposure) tended to produce more weight loss than "gradual" exposure.

CONCLUSION: Sleeping in simulated tents may act to jump-start a weight loss program. Furthermore, understanding mechanisms of appetite suppression with altitude exposure, may prove useful for maintenance program design.

2739 Board #13 8:00 AM - 9:00 AM Maximal Aerobic Performance of Prepubertal Children upon Fast Ascent to High Altitude

Susi Kriemler1, Monica Zehnder1, Malcom Kohler1, Hanspeter Brunner1, Urs Bottiullier2, Exercise Physiology, University of Zürich, Zürich, Switzerland. 3Cardiology, University Hospital Basel, Zürich, Switzerland. Email: kriemler@access.unizh.ch

Aerobic performance is decreased in adults at high altitude compared to low altitude. It is not known, however, if prepubertal children show the same pattern as adults. Therefore, we performed a spiroergometry in 20 father-child pairs at low altitude (LA, 460m) and following fast ascent to high altitude (HA, 3450m). 20 prepubertal children (11±1y) and their fathers (44±4y) were studied at LA and after 5 h of altitude exposure upon fast ascent (30 h) by train. A maximal aerobic exercise test to exhaustion was performed on a stationary bike. Exhaled gases and ventilatory variables were assessed using a metabolic cart. S\text{O}_2 was measured by front pulse oximetry, HR was measured by heart rate monitor. VO\text{max}, work rate, VE\text{max}, HR\text{max}, RO\text{max} were analyzed for group and altitude differences.

RESULTS:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Phase</th>
<th>Altitude (m)</th>
<th>HR (cm)</th>
<th>Wt (kg)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>Net loss/gain</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>I</td>
<td>LA</td>
<td>190</td>
<td>118.1</td>
<td>115.7</td>
<td>114.4</td>
<td>114.4</td>
<td>3.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>II</td>
<td>LA</td>
<td>85</td>
<td>154.4</td>
<td>154.4</td>
<td>115.6</td>
<td>115.6</td>
<td>10.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>II</td>
<td>LA</td>
<td>85</td>
<td>192.2</td>
<td>169.9</td>
<td>118.9</td>
<td>114.4</td>
<td>4.3</td>
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</tr>
<tr>
<td>5</td>
<td>I</td>
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<td>96</td>
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<td>175.2</td>
<td>172.8</td>
<td>172.8</td>
<td>0.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
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<td>LA</td>
<td>116</td>
<td>175.0</td>
<td>172.8</td>
<td>172.8</td>
<td>172.8</td>
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</tr>
<tr>
<td>7</td>
<td>I</td>
<td>HA</td>
<td>118.1</td>
<td>175.0</td>
<td>172.8</td>
<td>172.8</td>
<td>172.8</td>
<td>2.1</td>
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</tr>
</tbody>
</table>

LA-HA: p<0.05, p<0.005, p<0.0005; fathers-children: p<0.05, p<0.005, p<0.0005; delta[LA-HA]: p<0.005

Aerobic exercise performance and S\text{O}_2 were similarly reduced at HA in children and adults. The only difference of short-term adaptation to HA between children and adults was HR\text{max}, which did not change from LA to HA in children, while it decreased in adults.

2740 Board #14 9:00 AM - 10:00 AM The Acute Exhaled Nitric Oxide Response and 5km Performance in Normobaric Hypoxia in Highly Trained Athletes

Charles R. Pedlar1, John Dickinson1, Ken van Sonmeren2, Gregory P. Whyte, FACSM1, Richard J. Godfrey, FACSM1. 1English Institute of Sport, St Mary's College, Twickenham, United Kingdom. 2Brunel University, Uxbridge, United Kingdom. Email: charles.pedlar@eis2win.co.uk

Nitric oxide produced in the lung is an important modulator of pulmonary vascular resistance, and may therefore be influenced by hypoxia or hypoxemia, where pulmonary hypertension or ventilation/perfusion mismatching may occur. Little is known about the effect of exercising in acute normobaric hypoxia upon exhaled nitric oxide (eNO) in athletes, or the relationship between eNO changes and performance in acute hypoxia.

PURPOSE: To characterise the acute effect of heavy exercise in normobaric hypoxia upon eNO, and the relationship with 5km running performance.

METHODS: Twelve highly trained runners and triathletes volunteered to participate in the study (n=12, height:178±9cm, weight: 76±10kg, age:30±6yrs) eNO was measured using an online analyser (Sievers NOA-280i, Analytix Ltd, UK) according to American Thoracic Society guidelines, 10 minutes pre- and 10 minutes post-exercise. Treadmill exercise consisted of three, 4-minute sub-maximal exercise bouts, followed by a 5km time trial, completed under controlled hypoxia (F\text{O}_2=0.150) or sham (F\text{O}_2=0.209) conditions. A randomised, single blind research design was used. Pre- and post-exercise eNO were compared between conditions using repeated measures ANOVA. The relationship between 5km time trial performance and changes in eNO was analysed using a Pearson product-moment correlation.

RESULTS: Exercise in normoxia and hypoxia caused a significantly (P<0.05) reduced eNO (from 44.4±32.4ppb to 35.3±24.7ppb and from 45.2±40.7ppb to 38.5±30.3ppb respectively, with no differences between conditions (P>0.05). 5km performance was significantly improved in hypoxia (by 189±59 seconds); however, there was no relationship between this performance decrement and alterations in eNO (r=0.081; P>0.05).

CONCLUSIONS: In agreement with previous research, these findings do not support the hypothesis that exercise in hypoxia leads to an increased eNO, although further research is needed to further understand the relationship between eNO and performance in hypoxia.

2741 Board #15 10:00 AM - 11:00 AM Hypoxic Induced Changes in Muscle Oxygenation and Lactate Threshold

Kent A. Lorenz, Clifford Hom, Jon Lopez, Robert S. Pozos, Michael J. Buono, FACSM, Fred W. Kolkhorst, FACSM, San Diego State University, San Diego, CA. Email: kentlorenz5@yahoo.co.uk

PURPOSE: Studies have shown that the lactate threshold (LT) and the point of inflection for muscle oxygenation (S\text{O}_\text{2}\text{p}) are strongly correlated and occur at similar workloads. Exercising under hypoxic conditions is known to decrease the lactate threshold. Thus, the purpose of this study was to determine whether the S\text{O}_\text{2}\text{p} point of inflection during incremental exercise during hypoxia remains strongly correlated with LT.

METHODS: Five subjects performed two trials of incremental exercise (20 W·min\text{−1}) to volitional exhaustion on a cycle ergometer under normoxic (~21% O\text{2}) or hypoxic (~14% O\text{2}) conditions. Trials were separated by a minimum of 48 h. Local tissue oxygenation of the vastus lateralis was measured using near infrared spectroscopy (NIRS) with a 25-mm probe located 10-12 cm superior to the patella. Ateuralized blood was sampled for lactate concentration every minute via finger stick. The LT and S\text{O}_\text{2}\text{p} points of inflection were determined using the least-squares method and compared between conditions with paired-sample t-tests. Bivariate correlations were performed to analyze the relationship between S\text{O}_\text{2}\text{p} and LT.

RESULTS: In the hypoxic trial, LT decreased from 168 ± 52 W to 124 ± 33 W (P < 0.01) and the S\text{O}_\text{2}\text{p} point of inflection decreased from 156 ± 56 W to 120 ± 42 W (P < 0.005). Correlations of the LT and S\text{O}_\text{2}\text{p} point of inflection were strong in both trials (R = 0.98 for normoxia and 0.93 for hypoxia). These results agree with Grassi et al. (1999) who reported a similar relationship between LT and the S\text{O}_\text{2}\text{p} point of inflection under normoxic conditions.

CONCLUSION: The concurrent shift in LT and S\text{O}_\text{2}\text{p} point of inflection under hypoxia suggests a cause and effect relationship between these two variables.
Board #17 9:00 AM - 10:00 AM
Prior Disruption of Blood-Brain Barrier Integrity Compounds Hypoxic Headache; Exercise, Heat and Free Radicals as “Vasogenic Primers”

Dianmar M. Bailey1, Philip N. Ainslie2, Kevin A. Evans1, David A. Hullin1, Peter Bartels1. 1University of Glamorgan, Pontypridd, United Kingdom. 2University of Ottawa, Ottawa, Canada.

PURPOSE: Using a combination of exercise and heat stress, the present study examined whether prior disruption of blood-brain barrier (BBB) integrity in normoxia would alter individual susceptibility to neurovascular headache initiated during subsequent exposure to inspiratory hypoxia.

METHODS: Eleven males aged 24 ± 2 (mean ± SD) years were randomly assigned to complete two trials separated by 4 weeks recovery. During the experimental trial (EXP), subjects rested in normoxia (PRE-N) before being immersed supine in water (35°C) for 20 min followed by 45 min of cycling (35°C) at 60% of their previously determined peak oxygen uptake (PRIMER-N). Subjects were then exposed to normobaric hypoxia (12% O2, 25°C) where they rested for 6 h (POST-H). The control trial (CON) incorporated the hypoxic exposure without prior immersion or exercise. Headache scores were assessed using a clinically-validated visual analogue scale. Venous blood samples were mixed ex vivo with 1,4-butanediol (PBN) prior to X-band electron paramagnetic resonance spectroscopy. Additional samples were assayed for S100β, NSE and myoglobin and corrected for plasma volume shifts.

RESULTS: Exercise-heat stress increased the serum concentration of S100β and PBN-adducts (Table 1) whereas no changes were observed in NSE or myoglobin. These increases were compounded during subsequent exposure to hypoxia and were associated with a marked increase in the severity and incidence of hypoxic headache (HH).

CONCLUSION: Exercise-heat stress increased BBB permeability and free radical generation independent of neuronal or sarcolemmal membrane damage. The increased susceptibility to HH suggests that this condition may have a vasogenic basis.

Table 1. Neuro-metabolic responses to hypoxia following prior exposure to heat and exercise

<table>
<thead>
<tr>
<th>Trial</th>
<th>CON (n = 11)</th>
<th>EXP (n = 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>PRE-N</td>
<td>PRIMER-N</td>
</tr>
<tr>
<td>Headache score (mm)</td>
<td>0.1 ± 0.1</td>
<td>0.1 ± 0.1</td>
</tr>
<tr>
<td>S100β (mg/L)</td>
<td>1.04 ± 0.05</td>
<td>1.03 ± 0.04</td>
</tr>
<tr>
<td>PBN-adducts</td>
<td>0.04 ± 0.09</td>
<td>0.08 ± 0.17</td>
</tr>
</tbody>
</table>

*Main effects for trial and stage (P < 0.05, two-factor repeated measures ANOVA); †different between PRE-N for a given trial (P < 0.05, Bonferroni corrected Wilcoxon Matched Pairs Signed Ranks Test); ‡different between trial for a given stage (P < 0.05, Mann-Whitney U Test).

Board #18 10:00 AM - 11:00 AM
The Relationship between Odds Ratios and Relative Risks

Ian Shirier, FACSM, Russell Steele. McGill University, Montreal, PQ, Canada.

PURPOSE: Many articles provide only odds ratios (OR) and not relative risks (RR) as the effect estimate. For a variety of important reasons, multiple logistic regression used to adjust for confounders routinely provides only the adjusted OR (ORadj). However, from the clinician’s perspective, the ORadj is only easily interpretable when it approximates the adjusted RR (RRadj). In general, the relationship between the OR and RR (adjusted or non-adjusted) is dependent on prevalence of disease in the control group (Po) and has always been presented as non-linear. Therefore, it is difficult for the clinician to convert the OR to RR when reading published data. A formula was proposed by Zhang and Yu, but the relationship remains non-linear. Therefore, the objective of this project is to develop a simple formula that can convert OR to RR without the use of computer.

METHODS: Algebraic manipulation.

RESULTS: Through algebraic manipulation, we show that although the OR and RR relationship is non-linear over the range Po, the ratio OR/RR has a linear relationship with Po with a slope of “OR-1”. OR/RR = (OR-1)*Po + 1. Previous problems with confidence intervals noted with the old version of the formula remain (i.e. they are too narrow under some conditions) and the result should be interpreted with this limitation. Relationships between ORadj and RR adj or difference or number needed to treat remain curvilinear but some overall approximations can be made.

CONCLUSIONS: A simple relationship exists that allows readers to easily convert ORadj to RRadj. Limitations of the approach remain but appear to be less restrictive than the limitations of not converting ORadj to RRadj.

Board #19 8:00 AM - 9:00 AM
Will Women Ever Run (or Walk) Faster than Men in Long-Distance Endurance Events?

Alan M. Nevill1, Gregory Whyte, FACSM. 1University of Wolverhampton, Walsall, United Kingdom. English Institute of Sport, Bishopston, United Kingdom. (Sponsor: Dr. Gregory Whyte, FACSM)

Email: a.m.nevill@wlv.ac.uk

Based on linear regression models, previous researchers have predicted that women will eventually run faster than men. In a recent issue of MSSE, the present authors have reported that these linear models were inappropriate when predicting men's middle- and long-distance (800m, 1500m, mile, 5000m, 10000m and marathon) and women's middle-distance (800m and 1500m) world records. The authors demonstrate a more biologically sound, flattened “S-shaped” logistic curve logistic curve provides a better fit to the data.

PURPOSE: To assess whether the same flattened S-shaped logistic curve would provide a better and more interpretable fit to women’s long-distance running (5,000m, 10,000m and marathon) and walking (10,000m, 20,000m) world records.

METHODS: Men and women's long-distance running and walking world record speeds recorded during the past century were modeled using the flattened S-shaped logistic curve.

RESULTS: The logistic curves produced significantly better fits to the world records than linear models (assessed by separating/partitioning the explained variance from the logistic and linear models using ANOVA). The models identify a slow rise in world-record speeds during the early years of the century, followed by a period of “acceleration” in the middle of the century (due to the professionalization of sport and advances in technology and science), and a subsequent peak in world-record performances towards the end of the century. The predicted peak (asymptotic) world-record times (mins:s) were (men vs women): 5.000 (12:12 vs 14:30), 10.000m (26:11 vs 29:28), marathon (123:38 vs 138:35), 20,000m walk (71:22 vs 81:00).

CONCLUSIONS: Many of the established men and women’s long-distance endurance running and walking world records are nearing their limits and, consequently, women’s long-distance world records are unlikely to ever reach those achieved by men.

Board #20 9:00 AM - 10:00 AM
Sample Sizes for Magnitude-Based Inferences about Clinical, Practical or Mechanistic Significance

Will G. Hopkins, FACSM. AUT University, Auckland, New Zealand.

Email: will@clear.net.nz

PURPOSE: The traditional method of sample-size estimation based on statistical significance is not appropriate for a study designed to make an inference about real-world significance, which requires interpretation of magnitude of an outcome. I present here two new methods for estimating sample size for such studies, based on (a) acceptable error rates for a clinical or practical decision arising from the study and (b) adequate precision for a mechanism-related inference.

METHODS: For (a) I devised two new types of error: deciding to use an effect that is actually harmful (a Type 1 clinical error), and deciding not to use an effect that is actually beneficial (a Type 2 clinical error). I then constructed a spreadsheet to...
calculate sample sizes for chosen values of Type 1 and 2 errors, for chosen smallest beneficial and harmful values of various outcome statistics and designs (changes or differences in means in controlled trials or cross-sectional studies, correlations in cross-sectional studies, relative risks in cohort studies, and odds ratios in case-control studies). For these reasons it was decided that precision is adequate when the uncertainty in the estimate of an outcome statistic (represented by its confidence interval) does not extend into values that are substantial in both a positive and a negative sense when the sample size of the statistic is zero or null. Sample sizes are then derived from the spreadsheet by choosing equal Type 1 and 2 clinical errors (e.g., 5% for a 90% confidence interval). The sample size for both methods can be compared with those based on the traditional method, included in the spreadsheet. Also included are confidence limits and quantitative and qualitative characteristics of benefit and harm for the “decision value” and any other values of the outcome statistic.

RESULTS: Sample sizes for Type 1 and 2 clinical errors of 1% and 20% are ~10% smaller than those for adequate precision with a 90% confidence interval, which in turn are only one-third of traditional sample sizes (for Type I and II statistical errors of 5% and 20%). Confidence limits and clinical chances provided by the spreadsheet are fully consistent with Type 1 and 2 clinical errors.

CONCLUSION. Researchers can now justify and use sample sizes for studies aimed at making inferences about magnitudes. The sample sizes can be much smaller than those based on traditional significance.

Intraclass correlation (ICC) is commonly used in kinesiology research in assessing the reliability of dependent measures. There are different forms of intraclass correlation coefficients available. However, in empirical research, the procedure of choosing an appropriate ICC was often ignored or wished away and inappropriate ICC was used with disastrous consequences.

PURPOSE: This study was to provide guidelines with SPSS for selecting, calculating and interpreting ICC based on (1) one-way and two-way effect models, (2) random and fixed effects, (3) single or average measures, and (4) consistency and agreement of the dependent measures. One practical example was presented with detailed procedures of using statistical package SPSS.

METHODS: The participants were 58 elementary school students. They were measured in steps/min using a pedometer (an indicator of the intensity of physical activity) over three school days. The data measured using the pedometer were obtained from both the left and right sides of the body. Ten different forms of ICC were calculated using SPSS based on the different hypothesized consistency or agreement of the research designs.

RESULTS: The ICCs ranged from 0.60 to 0.85 depending on either one-way or two-way models were chosen and whether consistency or agreement was the concern. The interpretations were also different depending on either random or fixed effect of the subject and dependent measures.

CONCLUSION: Choosing different forms of ICC would bring about different ICC values. It may substantially affect the results of assessing the reliability in empirical research. Therefore, choosing an appropriate ICC is very important in assessing the reliability of dependent measures. Following the four steps shown bellow in calculating ICC would help to avoid the miscalculation and interpretation of reliability of the kinesiology measures: (1) one-way or two-way effect model, (2) random or fixed effect of the dependent measures, (3) single or average measures, and (4) consistency or agreement. The details of running SPSS reliability function were provided.

Purpose: To assess the reporting of power and effect size in publications of MSSE® and to present methods of calculating sample size using an example from respiratory physiology.

METHODS: 173 physiology articles published in MSSE® (Oct 04-Sept 05) were surveyed for their statistical methods reported. Respiratory data was then collected from 11 physically active individuals (VO2 peak = 44.8±9.9 ml/kg/min). Peak power output (pp) was determined using a ramp protocol to volitional exhaustion (6W/15sec, electromagnetically braked cycle ergo). Two further visits were made: test 1= submaximal incremental test (4 x 3min @ 20, 30, 40, 50% pp.), a 15min rest was then followed by a test to the limit of tolerance (Tlim) @ 70% pp. Test 1=test 2. PFTs, b x b metabolic and ventilatory data (Sensormedics, Vmax) were collected at rest and during exercise. Maximal inspiratory capacity was measured during the last 30 s of each stage during the sub-max test and each min during the Tlim test, values were subtracted from FVC to obtain EELV. TV was averaged (10-20 breaths) at each stage of the sub-max test and each min during Tlim. Sample size estimates were calculated using Zar (1996).
sample sizes based upon previous literature. The reporting of an actual F-ratio (10% of ANOVA) and t-value (2% of t-tests) is also low. The F- & t-values are important when an effect size is not stated; as they allow effect size (ω²) to be calculated (to obtain sample sizes). Estimated sample sizes differ depending on the physiologic variable and exercise intensity, thus estimates should be based upon the largest sample size required to detect differences.

CONCLUSION: Despite the importance of power being emphasized by MSSE 8, the reporting of effect size and sample size is low.

G-12 Free Communication/Poster – Bone and Physical Activity/Disuse

SATURDAY, JUNE 3, 2006 8:00 AM - 11:00 AM
ROOM: Hall B

2750 Board #24 10:00 AM - 11:00 AM
Influences of Aerobic Capacity, Isometric Strength, and Body Composition on Bone Mineral Content and Density in Men
Lee M. Pierson1, Larry E. Miller2, William G. Herbert, FACSM3, Mary E. Pierson1, Gary M. Kiebzak4, Joseph W. Cook1. 1University of North Carolina School of Medicine, Chapel Hill, NC. 2Virginia Tech, Blacksburg, VA. 3Carolina Medical Center, Charlotte, NC. 4St. Luke's Episcopal Hospital, Houston, TX.

Email: Lee_Pierson@med.unc.edu

PURPOSE: To assess the influences of aerobic capacity, isometric strength, and body composition on bone mineral content and density in men.

METHODS: Eighty-one men aged 45-79 years, underwent isometric grip and elbow flexor strength tests, dual-energy x-ray absorptiometry, and a maximal exercise treadmill test with respiratory gas exchange. Relationships among variables were assessed with zero-order and partial correlations, and stepwise multiple regression. Group differences were determined with analysis of variance.

RESULTS: Fat-free mass (FFM) related to BMD (r = 0.37 - 0.64) and BMC (r = 0.31 - 0.70) at all sites. Body weight correlated with bone mineral at most sites, although slightly less than FFM. Fat mass showed a moderate significant (p < 0.001) correlation with BMC of the total body (r = 0.40), arm (r = 0.41), and pelvis (r = 0.45), but not the leg (r = 0.22). Moderate correlations were observed between fat mass and BMC of the total body (r = 0.47) and leg (r = 0.50), but not the arm. Regional BMD related to regional FFM more than FM. All bone mineral density and content measures were slightly less than FFM. Fat mass showed a moderate significant (p < 0.001) correlation and weight controlled (p = 0.05). Regression analysis also showed no significant association between PA and spine BMD when regional BMD related to regional BMC and total proximal-femur BMD. Two-way analysis of variance revealed a significant interaction (time by intervention) in total-body BMC and total proximal-femur BMC.

CONCLUSIONS: These results suggest that aerobic exercise could prevent regional BMD reduction (especially in loading regions), but total-body bone mass may not be maintained during weight loss.

Supported partly by the 21st century COE program, and Tsukuba Advanced Research Alliance (TARA).

2751 Board #25 8:00 AM - 9:00 AM
Physical Activity Volume is Predictive of Hip Bone Mineral Density in Middle-Aged Women
John E. Strong1, Lee M. Pierson2, Carl M. Maresh3, Rachel K. Evans4, Rachel L. Hatfield5, William J. Kraemer, FACSM. 1University of Connecticut, Dept. of Kinesiology, Storrs, CT. 2University of North Carolina, Chapel Hill. 3St. Anthony's Hospital, Longmont, CO. 4University of Missouri, Columbia. 5Texas Tech University Health Sciences Center, Lubbock, TX.

PURPOSE: To determine if anthropometric measurements, parameters of bone composition, which are thought to influence bone geometry. Peripheral quantitative computed tomography (pQCT) allows direct measurement of bone geometry including the Strength Index (SII), an index of bone strength.

METHODS: 69 healthy college women (age 21.5 ± 1.9 years) were measured for height, weight, body mass index, calf circumference, and tibial length of their non-dominant leg. Subsequently, all subjects underwent DXA and pQCT scans of the non-dominant tibia at ROI 38% and 66% proximal to the tibial endplate. SII was calculated at each site. Correlation coefficients were calculated to evaluate the association of anthropometric and DXA data with SII measurements at these sites. Parameters demonstrating a Pearson’s r ≥ 0.50 were subsequently used in linear and stepwise regression analyses to determine the best-fit regression line.

RESULTS: Bone mineral content (BMC) and bone area (BA) measured by DXA were the only parameters that met the criteria to be included in the regression analyses. Anthropometric variables and DXA derived bone mineral density (BMD) failed to correlate strongly enough with SII to be included in these analyses. Regression equations are included in the table.
It has been shown recently that low intensity (20% 1-RM) resistance exercise in conjunction with vascular restriction, known as KAATSU Training, accelerates muscle hypertrophy. The effect of such training on bone metabolism is not clear.

**PURPOSE:** To investigate the effects of acute (1 bout) KAATSU Training for knee extensors and flexors on serum bone biomarkers in young men, 18-30 years of age.

**METHODS:** Nine males performed two test sessions, KAATSU (vascular restriction + low intensity resistance exercise) and control (low intensity resistance exercise only) 48 hours apart in random order. The exercise protocol consisted of 1 set of 30 reps followed by 3 sets of 15 reps with 30 seconds rest between sets at 20% 1-RM for both muscle groups. On both days, fasting blood draws were obtained immediately prior to exercise (7 am), immediately post exercise and 30 minutes post exercise for the measurement of bone formation (bone-specific alkaline phosphatase, BAP) and bone resorption (cross-linked N-telopeptide of type I collagen, NTx) markers. Hematocrits were measured at each sample time to estimate plasma volume changes. Serum samples were aliquoted and frozen at -70°C until the BAP (Metra® BAP EIA kit, Quidel Corporation) and NTx (Osteomark® NTx Serum, Wampole Laboratories) assays were performed.

**RESULTS:** KAATSU training resulted in greater plasma volume decreases (p<.05) immediately post exercise compared to the control session. There was a significant (p<.05) training x time effect for NTx levels. 30 minute post exercise NTx levels (21.4 ± 3.4 nM BCE) significantly (p<.05) decreased from baseline (24.9 ± 4.3 nM BCE) after KAATSU training but not in response to the control training. After correcting for plasma volume shifts, decreases in serum NTx were observed for both KAATSU post exercise samples. There were no significant (p>.05) training or time effects for BAP.

**CONCLUSION:** A single bout of KAATSU training resulted in decreases in the bone resorption marker (NTx) but had no effect on the bone formation marker (BAP). The NTx response to KAATSU training was not mediated by shifts in plasma volume. Supported by a Japan KAATSU Training Society grant

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**Board #28 8:00 AM - 9:00 AM**

**Effects of a Single Bout of Low Intensity KAATSU Resistance Training on Markers of Bone Turnover in Men**

Debra Bemben, FACSM, Ian Palmer,1 Takeshi Abe,1 Yoshiaki Sato,2 Joel Cramer,1 Michael Bemben, FACSM.1 University of Oklahoma, Norman, OK. 1Tokyo Metropolitan University, Tokyo, Japan. 2The University of Tokyo, Tokyo, Japan. Email: dbemben@ou.edu

**Board #30 10:00 AM - 11:00 AM**

**Regional Bone Mineral Density of the Tibia in Female Soldiers Following 16-Weeks of Recruit Training**

Daniel E. Catrano1, Rachel K. Evans1, Erin Israel1, Ran Yanovitch2, Daniel S. Moran, FACSM.1 US Army Research Institute of Environmental Medicine, Natick, MA. 2Heller Institute of Medical Research, Tel Hashomer, Israel.

The bone adaptation response to exercise is specific to the site being loaded, and may differ between regions of trabecular and cortical bone. It has been suggested that strenuous physical training may result in decreased bone mineral density (BMD) at regions susceptible to stress fracture. Additionally, individuals may respond uniquely to comparable exercise programs.

**PURPOSE:** 1) To determine if regional BMD of the tibia decreases following 16 weeks of recruit training, and 2) to assess whether a change in tibia BMD is related to onset of lower extremity stress fracture.

**METHODS:** 105 women (18.9 ± 0.5 yr) underwent DXA scanning before and after a 16-wk recruit training program in the Israeli Defense Forces. 57 women participated in a physically rigorous combat training program and did not sustain a stress fracture (no stress fracture), 10 participated in rigorous training and were diagnosed with a stress fracture (stress fracture), and 38 completed an academic program with light physical activity requirements (control). BMD was assessed at 5 regions of interest (ROI) at points 4, 33, 56, 66, and 95% from the distal end plate of the tibia. The 4 and 95% regions reflect predominantly trabecular bone; the 33, 56, and 66% sites reflect cortical bone. The 33 and 95% sites are the most frequent site of stress fracture. A total tibia BMD value was calculated as the mean of the five ROIs. Data were analyzed using a repeated measures ANOVA and Tukey post hoc testing.

**RESULTS:** Stress fracture incidence was 14.9% in the combat training group, whereas there were no stress fractures in the control group. The following table presents tibial BMD (g/cm²) compared across groups for each ROI (means±SD):

**Board #29 9:00 AM - 10:00 AM**

**Does Bone Exhibit a Dose-Response to Jumps of Increasing Height and Repetitions?**

Kara A. Witzke1, Kerri M. Winters-Stone2,1 California State University, San Marcos, San Marcos, CA. 1Oregon Health and Science University, Portland, OR.

Jump exercise has been shown to be an effective mode of training for increasing bone density in adult women, but little is known about the optimal combination of jump height (magnitude) and jump repetitions to improve bone health.

**PURPOSE:** We conducted a 6-month pilot study to evaluate the effect of jump height and jump repetitions on hip and lumbar spine bone mineral density (BMD) in premenopausal women.

**METHODS:** Ninety premenopausal women participated in this study (mean age: 31.3±9.4 yrs; mean BMI: 23.3±2.9); mean hip t-score: +0.7±0.6). Women were randomly assigned to one of nine jump groups (n=10 per group) comprised of the 9 combinations of jump height (4", 8" or 12" box height) and number of jump repetitions (30, 60, or 90 jumps per session). Boxes were constructed and provided to women to be used for jump training at home. Women were instructed to wear athletic shoes and to step up onto their box and then jump off onto a hard, stable surface, for their specified repetitions three times per week for six months. BMD at the proximal hip and lumbar spine was measured by dual energy x-ray absorptiometry (Hologic QDR-1000W@) at QDR-1000W@ and 6 months. Baseline BMI, energy and calcium intake, minutes of physical activity and BMD were similar between groups. The effect of jump height and repetitions on BMD was evaluated using a 3 x 3 x 2 repeated measures ANOVA, with time as the repeated factor. Of interest were both 3-way (height x repetitions x time) and 2-way (height x time and repetitions x time) interactions.

**RESULTS:** Seventy-three women (81%) returned for post-testing. Compliance to the 6-month, home-based jump training program averaged 60% among the 55 subjects who returned training logs. There were no significant 3-way interactions at any bone site. However, the interaction term for repetitions x time approached significance at the greater trochanter (p=0.16). Graphical inspection of this 2-way interaction revealed a dose-response effect of jump repetitions such that the greater trochanter bone response improved with increasing jump repetitions. This effect was not apparent for different jump heights, nor was there any effect at the lumbar spine.

**CONCLUSIONS:** Data from this pilot study suggest that the number of jump repetitions may influence the magnitude of the bone response to jump training, in a dose-dependent, fashion, independent of jump height. However, these data are limited by low sample sizes per group, short study duration and modest compliance to training. A larger, longer, and perhaps supervised program is warranted in order to better examine the dose-response of bone to jump exercise.
METHODS: The participants included 51 college-aged women (24.5±0.4 years; 60.6±1.4 kg) currently participating in moderate to high levels of aerobic activity, both with and without participation in resistance exercise. BMD was measured at the hip, lumbar spine and whole body by DXA (Hologic QDR 1500). Physical activity (pre-, post-menarche and current levels), menstrual history, bone health history, and calcium intake were assessed by questionnaire. Subjects were grouped by pre-menarche activity status (sedentary vs. active) and impact of profiles of activities (based on GRFs) pre-menarche, post-menarche (menarche to age 20) and current. Activity group differences in BMD were determined by multiple analysis of covariance (MANCOVA) with tobacco use, alcohol use, lean body mass, age at menarche, age, and use of oral contraceptives (N=21) as the covariates.

RESULTS: The sedentary (SED) vs. active (ACT) comparisons for participation in activity prior to menarche (Pre-Men) are presented below as ±SD. The significantly different from SED group at p<0.05 level is bolded.

- **Lumbar spine (L1-L4) (g/cm²)**
  - SED: 0.99±0.15
  - ACT: 1.20±0.15

- **Whole body (g/cm²)**
  - SED: 1.01±0.09
  - ACT: 1.02±0.09

Additionally, care participation in supervised resistance training in addition to aerobic activity did not contribute to an enhanced BMD.

CONCLUSION: Women who participated in physical activity prior to menarche had higher BMD than women who were sedentary before menarche. Participation in physical activity prior to menarche appears important to the optimization of peak bone mass.

**2758 Board #32**

9:00 AM - 10:00 AM

**Prediction of Bone Mineral Density from Calcaneal Ultrasound in Adolescents: The Fels Longitudinal Study**

Valerie J. Spees, Stefan A. Czerwinski, Dana L. Duren, Derek W. Reed, W. Vernon Chalmers, Miryung Lee, Shamelie S. Sun, Bradford Towne, Richard J. Sherwood, Ellen W. Demerath, Roger M. Shievogl, FACSM. *Wright State University, Dayton, OH.*

**Purpose:** To develop prediction equations for total body (TB), femoral neck (FN) and lumbar spine (LU) BMD in children using QUS estimated BMD values and general descriptive characteristics.

**Methods:** DXA is the optimal method to assess bone mineral density (BMD), but it is often unavailable in clinical practice due to inaccessibility and prohibitive cost. Instead, many physicians prefer to evaluate BMD via quantitative ultrasound (QUS). QUS measurements have been shown to predict future fractures as accurately as central measurements of the spine or femur in postmenopausal women, but little research has demonstrated the efficacy of these measurements in children. QUS may prove to be a useful radiation free method for studying bone density accrual in children.

**Results:** DXA is the optimal method to assess bone mineral density (BMD), but it is often unavailable in clinical practice due to inaccessibility and prohibitive cost. Instead, many physicians prefer to evaluate BMD via quantitative ultrasound (QUS). QUS measurements have been shown to predict future fractures as accurately as central measurements of the spine or femur in postmenopausal women, but little research has demonstrated the efficacy of these measurements in children. QUS may prove to be a useful radiation free method for studying bone density accrual in children.

**Conclusion:** While fat mass, (FM), lean mass (LM), and muscular strength (MS) have been related to bone mineral density (BMD) in females, these relationships have not been as well studied in males.
RESULTS: As expected, CA had a lower body mass index compared to other groups [BMI: 18.8±0.9 vs. 19.4±1.8 (SOC), 20.0±1.0 (SW) and 20.1±1.3 (CON) kg/m², p<0.05]. The relation between LS-LAT and LS-Pa was strong in SOC and SW (r=0.84 and r=0.86 respectively; p<0.01), moderately strong in CA (r=0.61, p=0.05) but not significant in CON (r=0.52; p=0.10). As expected, LS-Pa was greater than LS-LAT in all groups (p<0.001). LS-Pa BMD was 13% greater in SOC than in CA (p=0.006) and not different from SW and CON; however, after controlling for BMI, SOC had greater BMD than all groups (p<0.05). SOC had greater LS-LAT BMD than all groups (14±12% CA, 12±14% SOC, all p<0.02); however after controlling for BMI, only a trend existed for CA (p=0.07) but SW and CON differences remained (both p<0.02). SOC also had significantly greater LFP and RPF BMD than SW and CON (18.5±2.5% SW, 12.5±2.5% CON). No significant differences were apparent between LFP and RPF in any group. As anticipated, SW had similar BMD across all sites as compared to CON.

CONCLUSIONS: Effects of differential bone loading patterns on BMD are detectable using the new DXA images. The result was more accurate, cross country, and swimming sports. Strain pattern does not appear to impact BMD of the left and right proximal femur, possibly due to the non-side dominance of the investigated sports. Increased BMD demonstrated in SOC may have implications for bone health in females participating in impact sports.
were placed in a cage fitted to the animal hyperbaric chamber; HU was maintained during HBO treatments given for 90 min, 6 d/wk (1×d), totaling 24 treatments. After 28 d of HU, animals were sacrificed under isoflurane anesthesia, and the femurs removed for analysis. Cortical and cancellous BMD was determined using peripheral quantitative computed tomography. Markers for bone resorption and formation were evaluated using commercially available assays to assess urinary content of deoxypyridinoline (DPD) and serum content of osteocalcin (OC), respectively. Mechanical testing of the femur was determined using a three-point bending test. Load-displacement curves were constructed to determine UF and FF.

RESULTS: MANOVA results indicated that HU and HBO did not significantly affect (p > 0.01) cortical or cancellous BMD at the mid-diaphysis of the femur following the 28-day experimental period. It appeared that HU added to weight bearing resulted in a slight increase in cortical BMD (AC = 1430.82±12.55 mg/cm^2, AC-HBO = 1437.07±16.70 mg/cm^2). Adding HBO to HU resulted in a slight increase in cortical BMD over HU alone (HU = 1419.70±14.67 mg/cm^2, HU-HBO = 1427.12±14.03 mg/cm^2). Neither HU and HBO had a significant effect (p > 0.01) on biochemical bone markers or mechanical strength.

CONCLUSION: Under these conditions HBO was not an effective intervention to offset effects of microgravity on bone. Increasing treatment effect by altering the HBO treatment frequency and duration, increased sample size, and the addition of hyperoxia and pressure control groups should be considered in future investigations.

2764 Board #40 8:00 AM - 9:00 AM
Reduced Mechanical Loading Does Not Diminish the Anabolic Response of Bone to Intermittent PTH
Joshua M. Swift, Mati Nilsom, Kyungwha Baek, Susan Bloomfield, FACSM. Texas A&M University, College Station, TX.

PURPOSE: Skeletally mature rats subjected to 28 days of hindlimb unloading (HU) experience a significant loss of proximal tibia bone mineral density (BMD) and plantar flexor muscle strength. Although muscle strength recovers within 14 days of reambulation, there is no sign of BMD recovery through 28 days. Our previous work demonstrated that daily administration of parathyroid hormone (PTH), a stimulator of osteoblast activity, effectively accelerated recovery of bone parameters during recovery from HU. We have now tested PTH administration in normally weight-bearing (WB) rats of the same age, gender and strain in order to test the hypothesis that previous disuse will dampen the anabolic response of bone to PTH.

METHODS: Six-month-old male Sprague Dawley rats were randomized into 2 groups, WB+ VEH (n=9) and WB+PTH (n=10), and given daily IP injections of saline VEH or PTH (1.34, 80 µg/kg/day), respectively, for 28 following 28 d of single housed cage activity. In vivo peripheral quantitative computed tomography (pQCT) scans of the proximal tibia metaphysis, providing BMD for cortical and cancellous compartments, as well as total BMD, were obtained at baseline, after 28 days of WB and after 28 "recovery days". In vivo peak isometric torque (ISO) and mass of plantar flexor muscles were obtained at sacrifice. All results were analyzed by 3-way ANOVA with repeated measures.

RESULTS: PTH treatment had no detectable effects on gain of body mass in WB rats nor on muscle weights and peak torque, but resulted in significant gains in total (+17%) and cancellous BMD (+24 at the proximal tibia). No significant effects were noted in cortical shell BMD. Interestingly, the gain in total BMD in WB rats was significantly less than that observed (+22%) in our previous studies with rats previously exposed to HU. We have now tested PTH administration in normally weightbearing (WB) rats of the same age, gender and strain in order to test the hypothesis that previous disuse will dampen the anabolic response of bone to PTH, and may even enhance the responsiveness of bone as judged by the greater gain in total BMD in rats previously exposed to HU at a bone site sensitive to alterations in mechanical loading.

2767 Board #41 9:00 AM - 10:00 AM
Effect of Femoral Rotation Flaws on Measured Hip Bone Mineral Density
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Dual-energy X-ray absorptiometry (DXA) is considered the standard for measuring bone mineral density (BMD) for the purpose of evaluating bone health. Since DXA measures areal BMD, the lowest femoral neck BMD is assumed to occur at a bone site sensitive to alterations in mechanical loading. In this study, underrotation of the femur did not affect the BMD of the femoral neck or the total hip; however, the BMD of the trochanter was increased. Therefore, the assumption that deviations from the standardized position would alter BMD of the hip was only supported for the trochanter region. Further study is warranted on the importance of a standardized hip position for yielding the lowest BMD at the hip.

2769 Board #43 8:00 AM - 9:00 AM
Resistance Training Effects on Inflammatory Markers in Multiple Sclerosis
Darpin I. Patel, Vanessa Castellano, Rebecca Larson, Sean C. McCoy, Lesley J. White, FACSM. University of Florida, Gainesville, FL.

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Multiple sclerosis (MS) is an autoimmune inflammatory disease associated with reduced physical fitness. While studies have reported the salutary effects of resistance training on muscle strength, few have addressed the effect of resistance exercise on inflammatory markers in MS.

PURPOSE: To evaluate the acute response of pro-inflammatory (IL-2, IL-6, INF-y) and anti-inflammatory (IL-6, IL-10, TNF-α) cytokines to resistance exercise in individuals with MS (disability score ≥ 4.4 ± 1.510).

METHODS: Seven ambulatory MS subjects (49.8 ± 6.5 yrs) and three healthy matched controls (42.1 ± 9.6 yrs) participated in a single bout of resistance exercise consisting of spinal flexion/extension, knee flexion/extension, and plantarflexion. Exercise consisted of one set of 12-15 repetitions at 70% of estimated 1RM. Blinded
samples were acquired prior to and immediately following exercise and were subsequently analyzed for cytokine concentrations using a multiplex immunosassay utilizing fluorescently labeled microsphere beads and laser based fluorescent detection in duplicate (Lincos Research Inc., St. Charles, MO).

RESULTS: Significant increases in IL-2 (Pre: 14.6±10.5; Post: 23.3±14.7 pg/ml; 61%; p<0.05) and IFN-γ (Pre: 25.3±16.9; Post: 47.1±31.3 pg/ml; 86%; p<0.05) were observed following exercise in MS with a trend for IL-10 (Pre: 15.6±7.5; Post: 23.3±14.7 pg/ml; 50%; p<0.06) to increase. A similar response to exercise was observed in control subjects. Other cytokines remained unchanged from pre to post exercise intervention.

CONCLUSION: Our results suggest that resistance exercise may alter inflammatory markers in MS. Based on the literature and our limited number of controls, the cytokine response observed in MS is similar to healthy individuals. Further research is needed to clarify the clinical significance of exercise-related changes in inflammatory markers in MS is warranted.

2770 Board #44 9:00 AM - 10:00 AM Effects of a Short-term Lifestyle Intervention on Myocardial Function in Patients with Type 2 Diabetes

Matthew D. Hordern, Louise M. Smith, Xiaohong Zhang, Elaine M. Beller, Johannes B. Prins, Thomas H. Marwick, Jeff S. Coombers. The University of Queensland, Brisbane, Australia.

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Long-term lifestyle interventions improve insulin sensitivity and cardiovascular disease risk factors in patients with type 2 diabetes. Furthermore, pharmaceutical interventions targeting insulin sensitivity have shown improvements in myocardial function in these patients.

PURPOSE: To investigate the effects of a short-term (4-week) lifestyle intervention on myocardial function in patients with type 2 diabetes.

METHODS: Patients with type 2 diabetes were randomised into a control group (n = 85) or a lifestyle intervention group (n = 84). The lifestyle intervention consisted of two one-hour supervised exercise training sessions/week and a session with a dietician. The training sessions contained cardiorespiratory and resistance exercises individualised for each patient. Insulin sensitivity (QUICKI), glycemic control (HbA1c), VO2 max and myocardial function (left ventricular tissue velocity, strain and strain rate) were assessed before and after the intervention.

RESULTS: There was a significant (p = 0.05) improvement in VO2 max from pre-post baseline on the control group and in the intervention group (5.9±1.45 vs 6.2±1.56 ml · kg · min⁻¹, p = 0.01), diastolic ventricular tissue velocity (r = 0.282, p = 0.015) and treatment group (r = 0.188, p = 0.046). Changes in QUICKI positively correlated with changes in VO2 max (r = 0.298, p = 0.011) and negatively correlated with changes in BMI (r = -0.482, p = 0.001). Multiple regression analysis showed lifestyle intervention was an independent predictor of myocardial strain (β = 0.455, p = 0.008) and accounts for 20% of improvement in this myocardial function measure.

CONCLUSIONS: A four-week lifestyle intervention improved exercise capacity and preserved myocardial function and insulin sensitivity in patients with type 2 diabetes. Improvements in myocardial function were associated with improvements in glycemic control and treatment groups. Improvements in insulin sensitivity were correlated with improvements in body composition and exercise capacity. Furthermore, the short-term improvements in myocardial function were independently predicted by lifestyle intervention.

2771 Board #45 10:00 AM - 11:00 AM Protective Effect of Exercise Training plus Vitamin C supplementation on Endothelial Dysfunction in Diabetic Rats

Daronwan Chakrapanit1, Pattarin Siridulayakul2, Bandit Thipakorn1, Srichatta Bunnag1, Virginia H. Huxley1, Suthath Patumraj1, 1School of Sports Science, Chulalongkorn University, Bangkok, Thailand. 2Dept. of Physiology, Siriraj Medical Faculty, Bangkok, Thailand.

PURPOSE: To determine the protective effects of exercise training plus vitamin C supplementation on endothelial dysfunction in diabetic rats.

METHODS: Male Sprague-Dawley rats (n=20) were divided into four groups; control (Con), diabetes (DM), diabetes with exercise training (DM+Ex) and diabetes with exercise training plus supplemented vitamin C (DM+Ex+Vit.C). Diabetes was induced by intravenous injection of streptozotocin (STZ,50 mg/kgBW). The exercise intervention protocol consisted of treadmill running 5 times/week with velocity 13-15 m/min for 30 min. Vitamin C was given in drinking water with the concentration of 1 g/L. To examine ED, leukocyte adhering in mesenteric venules and vascular response to the endothelial cell-dependent vasodilator, Ach in mesenteric arterioles were monitored using intravital fluorescence microscopy. Muscle malondialdehyde level (MDA) and activity of superoxide dismutase (SOD) as well as endothelial nitric oxide synthase protein level (eNOS) in heart was also measured.

RESULTS: At 24-wk, the diabetic state enhanced leukocyte adhesion (5.57±0.97 vs 11.36±8.66 cells/100µm) and impaired vasorelaxation (12.59±1.45 vs 3.24±1.51 %). The increase of leukocyte adherence was attenuated in both DM+Ex (15.3±1.70 cells/100 µm, p<0.001) and DM+Ex+Vit.C (15.4±1.67 cells/100 µm, p<0.001). However, the impaired vasorelaxation was found to be decreased in only DM+Ex+Vit.C (15±0.21 ±66 cells/100 µm, p<0.005). MDA of DM (2147±241.55 nmole/g wet wt.) and DM+Ex+Vit.C (1947±38±143.57 nmole/g wet wt.) were significantly lower (p<0.01) than those of DM (2843±368±142.6 mg/g wet wt.). DM had significantly lower in SOD (p<0.05) but DM+Ex+Vit.C (4.35±0.40 mg/g wet wt.) compared with DM (1.45±0.66 mg/g Protein).

CONCLUSION: Regular exercise training combined with vitamin C supplementation is an effective therapeutic modality to prevent diabetic endothelial dysfunction by ameliorating the diabetic-induced imbalance of oxidants/antioxidants.

Supported by Graduate School, Chulalongkorn University and Ministry of University Affairs, Thailand.

2772 Board #46 8:00 AM - 9:00 AM Hyperoxia during High Intensity Aerobic Training and Testing in Patients with Chronic Obstructive Pulmonary Disease

Siri Bjaøren1, Jan Helgerud, Vigitids Schnell Husbxy, Sigurd Steinshamn1, Jan Hoff.5 1Norwegian University of Science and Technology, Trondheim, Norway. 2NRU University Hospital, Norwegian University of Science and Thechnology, Faculty of medicine, Trondheim, Norway.

Endurance intolerance in COPD patients has been coupled with reduced muscle metabolism that might be a result of O2 supply limitation from the disease. PURPOSE: 1) Does supplemental O2 increase peak oxygen uptake (VO2peak) and peak workload (Wpeak) compared to ambient O2 air during one leg high intensity endurance training? 2) Are COPD patients exercise limited by O2 supply from the cardiovascular system or by O2 demand from the locomotor muscles? METHODS: 7 COPD patients completed 8 wks of one leg endurance interval training (breathing 100% O2) 3 times a week, training 4x4 min intervals cycling with each of both legs at a high aerobic intensity of 85% of Wpeak achieved during a one leg incremental exercise test. The patients work economy and VO2peak was measured pre- and post the training intervention. Each test was carried out on an ergometer cycle using first one- then two legs. Each patient performed two tests, one in normoxia and one in hyperoxia (65% O2) in a randomized order. 5 COPD patients who carried out a similar training regime breathing ambient air (ATG) acted as controls for the normoxia tests.

RESULTS: VO2peak increased in the OTG and the ATG in one leg cycling in normoxia, by 19.7% (17.1±3.7 to 20.3±3.3 ml · kg⁻¹ · min⁻¹) and 16.8% (17.8±2.4 to 20.7±3.9 ml · kg⁻¹ · min⁻¹) respectively, whereas Wpeak increased by 34.4% (64±12 to 86±14 W) and 36.4% (55±8 to 73±13 W) respectively. Also two legs VO2peak improved in the OTG and the ATG from the training with one leg at a time by 13.8% (20.1±3.2 to 22.9±3.1 ml · kg⁻¹ · min⁻¹) and 11.3% (20.7±3.8 to 23.0±3.2 ml · kg⁻¹ · min⁻¹) respectively, whereas Wpeak increased by 21.8% (101±20 to 123±24 W) and 23.3% (90±18 to 111±26 W) respectively. No difference was found between the groups in VO2peak or Wpeak in the OTG, whereas Wpeak in the ATG was different between hyperoxia and normoxia in one leg post test. Wpeak was higher in hyperoxia compared to normoxia both at pre- and post test in two legs cycling Conclusions: Training each of both legs increase VO2peak and Wpeak similar to two legs training. Supplemental O2 both during training and testing did not increase VO2peak from ambient air, indicating that the patients also after the training have their aerobic endurance limitations linked to the locomotor muscle capacity for utilizing O2.

2773 Board #47 9:00 AM - 10:00 AM Blood Glucose Responses to Resistance Exercise Above and Below Lactate Threshold for Type 2 Diabetics


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PURPOSE: To investigate the effects of resistance exercise performed below and above the lactate threshold (LT) on blood glucose (Gluc) responses during exercise for individuals under hypoglycemic agents and diet therapy.

METHODS: Nine type-2 diabetics (12.4±3.4 age 57±10 yrs, 87±20.0 kg; 174±9.5 cm and ambulatory blood glucose of 179±62.0 mg/dL) performed the following tests on different days: Session 1 - a one maximal repetition for strength assessment (IRM); Session 2 - an incremental test (IT) on bench press (BP) and leg press (LP) to identify the lactate threshold (LT) through polynomial acceleration/deceleration/workload relationship. The IT imitated at 10% IRM with increments of 10%IRM at
each 1-min stage and 30 repetitions per stage. Sessions 3 and 4 - circuit of resistance exercises performed below LT (session 1 - 30 rep x 23% 1RM) and above the LT (session 2 - 16 rep x 43% 1RM). The session 3 and 4 consisted of 3 laps on a 6 exercises that resulted in the same total workload. Session 5 - control without exercise. Blood lactate and Gluc were measured (YSI 2100 S) during each 2-min recovery between stages for LT and after each 6-exercises lap during the resistance exercise circuits (23% and 43%1RM) as well as at the corresponding moment of the control session.

RESULTS: The LT was observed at 36.7±5.6 and 31.8±6.7 % 1RM respectively for LP and BP. ANOVA evidenced a significant reduction in Gluc during the 23%1RM and 43%1RM sessions in relation to control (p<0.01). The Gluc at resting / 1st circuit / 2nd circuit and 3rd circuit were respectively 120.8±35.8 / 90.2±23.6 / 84.9±29.5 and 79.6±30.0 mg.dL-1 for 23%1RM; 128.5±33.2 / 97.8±34.9 / 93.5±23.9 and 90.8±22.5 mg.dL-1 for 43%1RM, and 130.0±36.6 / 72.6±23.5 / 50.7±22.7 and 113.7±32.5 mg.dL-1 for corresponding moments of control condition, with a significant difference in relation to resting both for the 23%1RM and 43%1RM sessions (p<0.001).

CONCLUSIONS: A single resistance exercise session performed at intensities of 23%1RM and 43% 1RM respectively below and above LT contributed significantly for an acute blood glucose reduction on type-2 diabetes.

Board #48
0:10 AM - 11:00 AM
Lower Muscle Strength Gains in Older Men with Newly Diagnosed NIDDM After a Resistance Training
Javier Ibáñez Santos1, Esteban M. Gorostiaga1, Alicia M. Alonso1, Luis Forges1, Hadio Argüelles2, José L. Larrín3, Mikael Iqzquierdo1.
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Purpose: To determine if a twice-weekly whole body supervised-supervised resistance training (PRT) program is effective in neuromuscular (maximal strength and power output) and endurance adaptations in newly diagnosed older men with NIDDM, as it has been shown in healthy ones.

Methods: Eleven healthy and ten newly diagnosed NIDDM subjects completed 2 times per week a 16-week period of supervised PRT at intensities of 50–80% of one repetition concentric maximum (1-RM). Lower and upper body maximal strength and muscle power output were assessed using 1-RM action and a 30% of their respective 1-RM in a half-squat and in a bench-press position, respectively. Resting serum total testosterone (T), free testosterone (fT) and cortisol (C) were determined by radioimmunoassays.

Results: Baseline maximal voluntary arm and leg strength was not significantly different between healthy and NIDDM groups (47.8 ± 12.4 vs. 45.9 ± 6.5 Kg; and 103.1 ± 25.9 vs. 106.3 ± 8.3 Kg, respectively). After training, the increase in arm and leg strength was significantly larger in healthy subjects (24.2 ± 4.1% and 26.0 ± 3.8%, respectively) vs. NMD (0.1% and 1.1%, respectively). Significant linear correlations were observed in a combined group of healthy plus older men with NIDDM between the mean level of individual serum total T and C concentrations (averaged for the entire training period) and the individual changes in 1-RM of the leg (r = 0.85 and 0.51; P < 0.05, respectively) and arm muscles (r = 0.63 and 0.70; P < 0.05, respectively).

Conclusions: In NIDDM, PRT leads to a similar muscle power increase but to a smaller strength gains than in healthy older men. Collectively, these observations suggest that the partial androgen deficiency should play a key role in strength gains in these patients.

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Board #51 10:00 AM - 11:00 AM
Metabolic Syndrome: The Effect of Low and Moderate Altitude on Blood Pressure and Heart Rate
Serge P. von Duvillard, FACSFM, Robert Berent1, Dietmar Fries1, Markus Mittermayr1, Stephen F. Crouse, FACSFM, Egon Humpeler1, Sven Greie1, Anton Klinger1, Wolfgang Schoberberger1, Reinhard Spiessberger1, Rochus Pokan, FACSFM, Peter Hofmann1, Michael Wonisch1.1 Texas A&M University-Commerce, Commerce, TX. 2Center for Cardiovascular Rehabilitation, Bad Schallerbach, Austria. 3University Clinic for Anesthesia and Intensive Care Medicine, Innsbruck, Austria. 4Texas A&M University, College Station, TX. 5HHS Research Institute for Leisure and Travel Medicine, Bregenz, Austria. 6Pribitine University of Health Sciences, Institute for Leisure, Travel and Alpine Medicine, Innsbruck, Austria. 7Department of General and Transplant Surgery, University of Innsbruck, Innsbruck, Austria. 8Institute of Sport Science, University of Vienna, Vienna, Austria. 9Institute of Sport, University of Graz, Graz, Austria. 10Department of Internal Medicine, Div. of Cardiology, Medical University of Graz, Graz, Austria.

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The metabolic syndrome is a multiplex risk factor for cardiovascular disease. One of the components of risk reduction is the treatment of hypotension.

PURPOSE: The aim of the study was to investigate the effect of a 3 week habituation at moderate vs. low altitude on blood pressure and heart rate in patients with the metabolic syndrome in a randomized controlled trial.

METHODS: Seventy-one male volunteers with a metabolic syndrome were randomly assigned into a moderate altitude (MA) (1,700 m) group with 38 participants (age 54.31 ± 7.55; BMI 31.22 ± 2.86) and a low altitude (SL) (540 m) group with 33 participants (age 55.29 ± 5.51; BMI 32.18 ± 2.16) in Austria. The 3 week habituation at MA and SL resulted in a reduction in blood pressure and heart rate in both groups. No clinically relevant differences could be documented in both groups. However, these differences were not statistically significant between the two groups.

CONCLUSION: The 3 week habituation at MA and SL resulted in a reduction in blood pressure and heart rate in both groups. No clinically relevant differences could be determined. Therefore, habituation of several weeks at moderate altitude appears to be safe and can be recommended for patients with a metabolic syndrome.

Board #52 8:00 AM - 9:00 AM
Metabolic and Cardiovascular Responses to Body Weight Supported Treadmill Walking
Julia E. Gamble, Ronald W. Dietrick, FACSFM, Danielle M. Fischer, Michael J. Welikonich, The University of Scranton, Scranton, PA.

Body weight supported (BWS) treadmill exercise is a therapeutic modality used for gait training and neurological impairments. While a number of studies have investigated its effect on gait patterns, there is limited information regarding the energy costs and cardiovascular effects of BWS.

PURPOSE: To examine the metabolic and cardiovascular responses of motorized treadmill walking with and without partial BWS at varying speeds in males and females.

METHODS: Twenty (males = 10 and females = 10) college-aged (20.2 ± 1.7 yrs; 5% fat via Bod Pod = 16.14 ± 3.4 and 27.3 ± 7.8, males; females) above average aerobically fit (VO2max: males = 54.8 ± 4.3 and 48.2 ± 12.8 ml kg/min; females) without neurological or functional impairment performed a maximal aerobic power walking test on a motorized treadmill (3.0, 3.5, and 4.0 mph) in random order without uniformized harness system (BAS) and at 30% reduced body weight (BWS). Body weight was measured by Tanita scale prior to each visit and after being placed in the uneven weighted harness system to ensure the 30% reduction. Heart rate was measured by Polar monitor while oxygen uptake was determined by ECG monitoring. Blood pressure and heart rate in both groups. No clinically relevant differences could be documented in both groups. However, these differences were not statistically significant between the two groups.

CONCLUSION: The 3 week habituation at MA and SL resulted in a reduction in blood pressure and heart rate in both groups. No clinically relevant differences could be determined. Therefore, habituation of several weeks at moderate altitude appears to be safe and can be recommended for patients with a metabolic syndrome.

Board #53 9:00 AM - 10:00 AM
Blood Pressure Reduction in Prehypertension: Accumulation of Physical Activity vs. a Single Continuous Session
Saejong Park1, Jason R. Scherzinger1, Lauren C. Bollinger1, Lamia O. Nuseibeh2, Lawrence D. Rink, FACSFM, Janet P. Wallace, FACSFM, 1Indiana University, Bloomington, IN. 2Internal Medicine Associates, Bloomington, IN. Email: saepark@indiana.edu

Despite limited evidence, the accumulation of physical activity (PA accum) instead of continuous exercise has recently been recommended for the treatment of prehypertension.

PURPOSE: 1) to compare the duration and magnitude of blood pressure (BP) reduction following the PA accum vs. a single continuous session (PA cont) in prehypertensive adults, and 2) to investigate sympathetic modulation as a possible mechanism for BP reduction. It was hypothesized that: 1) the duration and magnitude of BP reduction following the PA accum would not be different from the reduction following the PA cont in prehypertensive adults; and 2) the reduction in BP would be associated with the change in sympathetic modulation following each physical activity treatment.

METHODS: Twenty prehypertensive adults participated in a randomized cross-over design: 1) ambulatory BP and 2) heart rate variability (HRV; Holter monitoring) were measured for 12 hrs following: a) the PA accum (four 10-min walk 50-min apart at 50% of VO2peak), b) the PA cont (40-min walk at 50% of VO2peak), and c) the control. Sympathetic (S), diastolic (D), BP, and HRV were averaged hourly following each treatment. The 95% confidence limits for the slope of each activity treatment of the BP reduction was used to determine the duration of BP reduction; which was used for the period to average the magnitude of BP reduction. Normalized low (LF) and high (HF) frequency LF:HF ratio were averaged for the duration of the BP reduction. Paired t-tests were used to test the magnitude of BP reduction between each activity treatment vs. the control, and to compare the area of BP reduction between PA accum and PA cont. Pearson correlations were used to investigate the association between the reduction in BP and the change in sympathetic modulation following each PA.

RESULTS: The PA accum reduced SBP 5.4±1.70 mm Hg for 11 hrs (P<.005) and DBP 3.4±1.34 mm Hg for 10 hrs (P=.022) while the PA cont reduced SBP 5.6±1.56 mm Hg for 7 hrs (P=.002) and DBP 3.1±0.22 mm Hg for 7 hrs (P=.020). Area of SBP reduction was greater (P=.004) for the PA accum than the PA cont (32.8±11.34 mm Hg/hr). In the PA accum, the differences in LF (r=.517, P=.028) and HF (r=.503, P=.033) were correlated with SBP reduction and the differences in LF (r=.745, P<.001), HF (r=.738, P<.001), and LF:HF ratio (r=.756, P<.001) were correlated with DBP reduction in the PA accum only the difference in LF:HF ratio (r=.543, P=.020) was correlated with DBP reduction.

CONCLUSION: The accumulation of PA is more efficacious than a single continuous session in the management of prehypertension. Sympathetic modulation was associated with the BP reduction.

Board #54 10:00 AM - 11:00 AM
The Exercise-Induced Insulin Response and Postexercise Hypotension
Brian J. Griffiths1, Andileeb Shabahat1, Bruce E. Blanchard1, Paul D. Thompson, FACSFM, Jaek L. Van Heest1, Carl M. Marek2, FACSFM, Nancy Rodriguez, FACSFM, Linda S. Pescatello, FACSFM, 1University of Connecticut, Storrs, CT. 2Hartford Hospital, Hartford, CT. (Sponsor: Dr. Linda Pescatello, FACSFM)

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PURPOSE: The acute effects of exercise on insulin and blood pressure (systolic and diastolic, BP; i.e. postexercise hypotension (PEH), are well documented. Yet, the influence of insulin on PEH has not been studied. Thus, we investigated the relationship between the insulin response during exercise and PEH.

METHODS: Subjects were 50 overweight (29.4 ± 0.7 kg/m2) men (43.8 ± 1.3 yr) with systolic BP (158 ± 4.3/91 ± 3.0 Hg). Subjects consumed a standard meal 2 hr prior to performing three randomized experiments: a non-exercise control and two cycle bouts at 40% (LITE) and 60% (MOD) maximal oxygen consumption (VO2max). Insulin was measured at baseline, 30 min during, and 45 min after the experiments. Subjects left the laboratory wearing an ambulatory BP Ho and insulin and BP differed among experimental conditions and over time. Simple linear and multiple variable regression analyses examined the relationship between insulin and BP.

RESULTS: Insulin decreased during and after exercise and control in the laboratory conditions (BAS and BWS) were significantly (p<.05) different at higher speeds for VO2 and RPE (VO2: 13.5 ± 3.4 mph; RPE: 19.5 ± 17.2 vs 20.2 ± 17.2 ml O2/kg/min; RPE: 16.1 ± 18 vs 18.7; females vs males).

CONCLUSIONS: The findings suggest that at 30% BWS, physiological responses are not affected at slower clinically-related walking speeds and are similar to walking without BWS; however, these same physiological responses are significantly altered at faster fitness-related walking speeds. Gender differences at faster walking speeds should also be considered in using BWS for fitness purposes.

#1368-1849-WEDNESDAY, MAY 31 #1850-2288-THURSDAY, JUNE 1 #2269-2726-FRIDAY, JUNE 2 #2727-2915 - SATURDAY, JUNE 3

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The relationship between the insulin response during MOD and average BP remained in the presence of age, adiposity, and VO2 max. However, the influence of insulin on BP was eliminated when baseline BP was entered into the statistical models with the exception of systolic BP. While most studies have found that active children generally had supportive families, the present study suggested that successful interventions geared toward childhood behavioral changes must target parents first. Once mothers internalize and accept an active health philosophy for both themselves and their children, they will provide the support and encouragement necessary for their children to follow.

CONCLUSIONS: This study revealed the importance that physically active mothers placed in affecting their children’s activity choices. Physically active mothers believed that they exerted a significant influence on their children’s participation in physical activity. In light of the current childhood obesity epidemic, the present study suggested that successful interventions geared toward childhood behavioral changes must target parents first. Once mothers internalize and accept an active health philosophy for both themselves and their children, they will provide the support and encouragement necessary for their children to follow.

RESULTS: Five general trends emerged. All participants believed that they exerted a significant influence on their children’s physical activity patterns by providing a supportive environment and demonstrating activity to be an essential life skill. Mothers indicated that they reaped the benefits of activity by spending time with their children. They also acknowledged how their goals have changed by having children and that the computer posed a significant challenge to motivating their children to be active.

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2784 Board #58 8:00 AM - 9:00 AM
Supported Physical Activity Patterns and Plans for Future Physical Activity in University Students

Robert Weathers, Evan Bylmana, Lustyk Kathly. Seattle Pacific University, Seattle, WA. Email: weathers@spu.edu

Physical activity recommendations for health include muscular conditioning exercises and regular moderate-to vigorous-intensity activities of an aerobic nature. However, it is unclear how times spent in these activities differ from each other and track over time.

PURPOSE: The purpose of this study was to investigate the differences among past, current and projected future physical activity patterns in undergraduate students at a private university in the Pacific Northwest.

METHODS: Volunteers (77 females and 42 males aged 19.9±3.3 y and registered in non-majors biology courses), anonymously reported typical weekly minutes of moderate-intensity, vigorous-intensity, and muscular fitness activities in the 6 months previously, during the past month, and projected 6 months in the future.

RESULTS: To determine if activity reports varied from past, present, and future projections; a series of within subject ANOVAs were performed for each intensity level. The multivariate analyses for moderate-intensity indicated a significant effect of time, Wilks’ A = 0.93, F (2, 117) = 4.50, p < .013, multivariate n2 = .071.

From the results above it was found that the mean number of minutes spent in moderate-intensity activity decreased from the past to present to future (p < .001), multivariate n2 = .16) accounted for by the difference between current and future activity reports (4.118) = 4.38, p < .05, passive error was controlled for at the 0.02 level. Similar results were observed with vigorous-intensity activity reports (Wilks’ A = .84; F (2, 117) = 11.03, p < .001, multivariate n2 = .16) accounted for by the difference between current and future activity reports (4.118) = 4.38, p < .05, passive error was controlled for.

CONCLUSION: In this sample, we found that students were more likely to report being active in the past than at present. Furthermore, for each measure of activity assessed, students give their highest time endorsement to future activity — there hopes for the future being greater than either current realities or recollections of the past.

2785 Board #59 9:00 AM - 10:00 AM
Pedometer-Determined Physical Activity Indices of Pregnant Women at 20 and 32 Weeks Gestation

Danielle Symons Downs, Guy C. LeMasurier. Pennsylvania State University, University Park, PA. Email: dds11@psu.edu

Pregnant women (N = 32; M age = 31.0 years; 87% Caucasian) wore a Yamax pedometer for three consecutive days at 20 and 32 weeks of gestation. Inclusion in the study required women to provide all three days of data (Tudor-Locke et al., 2005). Pedometer data were also screened for outliers based on criteria proposed by Rowe et al. (2004). Extreme day-to-day step count variability (e.g., lack of compliance in the monitoring period), resulted in the removal of four participants. Thus, data from 28 participants were included in the final analyses. The mean step/day variable at 20 and 32 weeks was based on the average steps/day from the three days.

RESULTS: Mean steps/day at 20 and 32 weeks were 7,524±3,260 and 5,215±2,756, respectively. The proportion of participants classified as sedentary (<5,000 steps/day), somewhat active (5,000-7,499 steps/day), low active (7,500-8,999 steps/day), and active (>10,000 steps/day) at 20 weeks were 14%, 18%, 39%, and 11%, respectively. At 32 weeks, the proportions were 54%, 18%, 25%, and 4%, respectively. From 20 to 32 weeks, 32% of the participants maintained their activity category, 57% decreased their PA, and 11% increased their PA.

CONCLUSION: Consistent with the hypothesis, our preliminary findings illustrate the participants were sedentary and low active during pregnancy. These data provide initial pedometer-determined PA levels of pregnant women at 20 and 32 weeks. The pedometer-determined PA indices proposed by Tudor-Locke and Bassett (2004) demonstrate validity with this population. Also, the categories were sensitive to PA declines in the gestational period. Future research is needed to determine the utility of an optimal step goal to motivate women to meet PA recommendations during pregnancy.

Grant funded by College of Health and Human Development Grant and General Clinical Research Center NIH M01RR10732.

2786 Board #60 10:00 AM - 11:00 AM
The Effectiveness of a Web-Based Tailored Message Intervention on the Exercise Behavior of Taiwanese Female Youths

Shue-jen Huang1, Wen-Chi Hung1, Tien-yu Yang2, Yi-Jyun Lin1, Maiga Chang1. 1National Taiwan Normal University, Taipei, Taiwan Republic of China; 2Oxford University, Oxford, United Kingdom. 3Project Office of National Science and Technology Program for e-Learning in Taiwan, JungLi City, Taiwan Republic of China. Email: huangsj@ntnu.edu.tw

PURPOSE: This study aims to investigate the usefulness of educational intervention on the exercise behavior of female youths.

METHODS: The strategies included: (1) the messages tailored to the needs of the subjects. The measures were based on psychosocial factors of the process of change of the Transtheoretical Model. (2) The social support provided through interpersonal contacts, on-line e-mail and chatting room and simultaneous talk line on the Internet. The contents of the tailored messages were displayed on a website, which includes knowledge of exercise and prevention of injuries of exercise.

The subjects of the designated groups could enter the pages, which contained the appropriate educational materials based on her stages of readiness of adopting exercise behavior. Regarding the social support, the students were grouped into 8 teams; also, chatting room and simultaneously talk line in the Internet were constructed. The subjects were recruited from the female freshmen of two universities. The subjects from one university were assigned as the experimental groups and one served as the control group. The first college used both the tailored message and the social support approaches as a controlled group. The second one served as a controlled group. This kind of design helped with the detection of contamination within the same college. The data were analyzed by ANOVA.

RESULTS: It was found that the subjects of the controlled group who did not receive any treatment exercised least among their counterparts in the other groups. The group with both tailored message and social support exercised most.

CONCLUSIONS: We concluded that the website served as an useful intervention tool which increased the amount of physical activity effectively, and helped with the subjects move toward the next stage of behavior change of exercise. Findings for the development of interventions to improve young female’s exercise levels are discussed.

2787 Board #61 8:00 AM - 9:00 AM
Perceptions of Neighborhood Safety and Pedometer-Determined Physical Activity Among Low-Income Housing Residents

Gary G. Bennett1, Kathleen Y. Wolin2, Elaine Palen3, Karen M. Emmons4. 1Harvard School of Public Health / Dana Farber Cancer Institute, Boston, MA; 2Northwestern University, Chicago, IL; 3University of Massachusetts, Boston, MA.

While many have hypothesized an inverse association between the perception of unsafe surroundings and physical activity, empirical support for the association has been inconsistent. Concerns about neighborhood safety, particularly in urban settings, may influence willingness to engage in outdoor activity and may promote utilization of non-ambulatory transportation options (i.e. use of buses, subways, automobiles).

PURPOSE: To evaluate the association between perceptions of neighborhood safety and pedometer-determined physical activity among predominantly racial/ethnic minority, low-income housing residents.

METHODS: Sex-stratified mixed models were used to analyze the association between perceptions of neighborhood safety (during the day and at night) and pedometer-determined steps per day (steps/d) among 438 adults. Participants self-reported whether they felt “safe, a little unsafe or not at all safe” in their neighborhood during the day and at night. Multivariable models adjusted for age, race/ethnicity, education, employment status, and body mass index.

RESULTS: Most participants (82%) perceived their neighborhood as safe during the day. Fewer (31%) perceived their neighborhood as unsafe at night. While only 3% of participants reported their neighborhood as unsafe during the day, 31% found it unsafe at night. In multivariable analyses, perceptions of neighborhood safety were not associated with accumulated steps/d among men. Among women, perceptions of neighborhood safety during the day were not associated with steps/d. However, women who perceived their neighborhood as unsafe had more than 1500 fewer mean steps/d than women who perceived their neighborhood as safe (1546 steps/d, 95% CI -2725, 659 steps/d).
cigarettes/day; SD = 10.7). The majority of the women were minorities (58.1%), unmarried (64.5%), had a high school education or less (77.4%), were unemployed (61.3%), and had a household income under $20,000 (67.7%). Physical Activity Stage of Change was as follows: 3.2% Precontemplation, 32.3% Contemplation, 29.0% Preparation, 12.9% Action, and 22.6% Maintenance. The most commonly reported activity in the past week was walking (61.3%), followed by dancing (45.2%), and biking (22.6%). When asked which activities they would choose if they were to start exercising or become more active, dancing was endorsed most frequently (87.1%), followed by walking and swimming (both 60.6%), hiking (58.1%), and aerobics (51.6%). Barriers to exercise included weather (54.8%), not enjoying exercise (35.5%) and not having enough time (32.3%). Nineteen percent of the sample reported that safety would be a barrier to exercising in their neighborhood.

CONCLUSION: The data suggest that within this group of diverse women, approximately 70% were not meeting ACSM guidelines for moderate intensity activity. The women were surprisingly open to different types of activities including swimming and biking. These data were used to create new examples of physical activity and to address populationspecific physical activity barriers such as safety and weather in the smoking cessation and physical activity promotion intervention.

2790 Board #64 8:00 AM - 9:00 AM Barriers and Motivations to Exercise in Older African-American and Caucasian Women Petra B. Schauer1, Jane L.P. Roy2, Debra Vinc1, Steve Philp1, Gary R. Hunter, FACSM1. 1University of West Florida, Pensacola, FL. 2University of Alabama, Birmingham, AL. Email: pchule@uwf.edu

It is estimated that as many as 48.6% of African-American women compared to 32.9% of Caucasian women are overweight or obese. Differences in socioeconomic status (SES) resulting in a lack of access to time and exercise and leisure activities (Sobal & Stunkard, 1989) have been suggested to explain these differences.

PURPOSE: To determine ethnic differences in older women’s motivations and barriers to exercise and exercise participation.

METHODS: 204 older female volunteers (89 Caucasian; 115 African-American) ranging in age from 55 to 86 years (72±9) completed a pencil and paper questionnaire. The survey was composed of 2 parts: general information (age, height, weight, race, level of education, annual household income [SES]) and questions regarding exercise. Volunteers were asked whether they participated in regular exercise (yes/no) and, depending on their answer, to check “all that applied” from a list of 10 barriers or 6 possible motivations. Frequencies were calculated for each barrier/motivation; ethnic differences were assessed using the Mann-Whitney non-parametric test. A one-way ANOVA was used to test for ethnic differences in anthropometric and demographic variables.

RESULTS: The majority of participants reported to exercise regularly (n=125); no ethnic differences in the frequency of exercise participation were found. African-American women were significantly heavier (F1,200=27.72; p<.01) and had significantly lower levels of education (F1,200=17.72; p<.01) and income (F1,200=14.97; p<.01). Significantly more Caucasian women (Z=1.97; p<.05) perceived ‘expense’ as a barrier to exercise and significantly more African-American women (Z=3.13; p<.01) reported to exercise because their doctors’ told them to (see table below).

Conclusions: The findings of this study do not support the theory proposed by Sobal and Stunkard (1989). Differences in socioeconomic status did not result in a lack of access and time to exercise and therefore did not explain ethnic differences in the prevalence of obesity in the present sample of older women.

2791 Board #65 9:00 AM - 10:00 AM Worksites Health Promotion Programs: Barriers and Incentives Judy Kruger, Michelle Yore, Harold W Kohl III, FACSM, CDC, Atlanta, GA. Email: jkruger@cdc.gov

Employees health promotion programs are becoming more prevalent and offer the potential to promote activity even among the inactive population. Worksites offering services with high perceived value and fewer perceived barriers are more likely to have higher utilization rates.
PURPOSE: To assess attitudes towards likely use of worksite health promotion services, perceptions of incentives and barriers to participation in worksite health programs and determine if physical activity (PA) level influences potential use of these programs.

METHODS: Data from 2004 HealthStyles, a volunteer mail survey, were used to examine barriers and incentives, and potential use of worksite health promotion programs among full or part-time employed adults outside the home (n = 2,337). PA levels were grouped as active (≥ 30 minutes of moderate-intensity activity on ≥ 5 days a week or ≥ 20 minutes of vigorous-intensity activity on ≥ 3 days per week), irregularly active (some activity but not enough to meet active definition), and inactive (no moderate or vigorous intensity activity). Data were stratified by gender, BMI, and PA level, and weighted to be representative of the U.S. population.

RESULTS: Respondents were 72.7% white, 52.1% women, 38.5% college educated, 34.9% regularly active, and 35% had BMI < 25. The most common barriers to use of worksite services were no time during work day (42.5%) and no time before or after work (39.4%). Incentives reported by over 65% of employees were a convenient time, convenient location, and employer gave paid time off during the work day to participate in a free worksite wellness program. Respondents were most likely to use health promotion services such as fitness centers (80.6%), health screening tests (86.2%) weight loss programs (67.1%), and on-site exercise classes (55.2%). Policy practices of paid time to exercise at work, and healthy vending or cafeteria food choices were preferred by almost 90% of employees. Active respondents had a significantly higher odds of joining sports leagues (unadjusted odds ratio: OR: 2.2, 95% CI: 1.6-2.9) and using online tools for tracking food and exercise (OR: 1.8, 95% CI: 1.3-2.4) compared to inactive respondents.

CONCLUSIONS: Because adults spend considerable time at work, worksites are considered an ideal location for offering health promotion services. The most common barriers to use of worksite services are no time before or after work, or no time at work, and the greatest incentive is paid time off at work. Data on such programs are useful to increase awareness among employers developing health-plans.

2793 Board #67 8:00 AM - 9:00 AM Associations between Self-Reported and Objective Physical Activity, Inactivity, and Physical Function in Older Women
Katherine S. Morris, Edward McAuley. University of Illinois, Urbana, IL. (Sponsor: E.M. Evans, FACSM)
Email: kmorris1@uiuc.edu

Although literature exists demonstrating the association between physical activity (PA) and physical function, there is limited information available as to the nature of this relationship across modes of assessment and the characteristics of the activity that are most salient.

PURPOSE: The purpose of this study was to examine the associations between physical function and PA across activity levels using self-report and objective measures when controlling for other psychosocial factors.

METHODS: Participants (N = 135, M age = 69.6 yrs) completed measures of physical support, self-efficacy, social function, and physical function, and PA. Characteristics of the physical environment were assessed using Geographical Information Systems (GIS).

Time spent in sedentary/light and moderate PA was objectively measured using the Actigraph accelerometer for a period of 7 days and also through self-report using the Physical Activity Scale for the Elderly (PASE; Washburn, Smith, Jette, & Janney, 1993). Regression analyses examined the associations between self-efficacy, social support, and physical function, and functional limitations separately for self-reported and objectively-measured PA.

RESULTS: Using the Actigraph, only time spent in moderate PA emerged as a significant correlate of functional limitations (β = –.28, p < 0.05). Only time spent in sedentary/light activity demonstrated significant associations when assessed through self-report (β = –0.17, p < 0.05). Self-efficacy demonstrated the strongest associations with functional limitations in both the Actigraph (β = –0.28, p < 0.01) and self-report models (β = –0.35, p < 0.001).

CONCLUSIONS: These results suggest that the associations between PA and functional limitations differ across activity levels and measurement techniques. Time spent in moderate PA was associated with fewer functional limitations only when measured with the Actigraph. Conversely, time spent in sedentary/light activity was associated with greater functional limitations only when measured through self-report.

Interestingly, regardless of activity intensity and method of assessment, self-efficacy was the strongest correlate of functional limitations. Future investigation into the mechanisms of these relationships is warranted, particularly as the variables identified as significant in this study represent modifiable constructs, and thus have implications for future activity program development.

Funded by a grant from the National Institute on Aging (AG20118).
During puberty, there are significant changes in high-density lipoprotein-cholesterol (HDL-C), triglycerides (TG) and adiposity in males. More specifically, HDL-C declines and TG and truncal fat increases. We have previously shown that despite high levels of physical activity and maximal oxygen consumption (Vo\textsubscript{max}) and low adiposity, adolescent distance runners demonstrate a decline in HDL-C and increase in TG during puberty that is relatively similar to boys in the general population. Furthermore, adverse levels of HDL-C and TG were observed.

**PURPOSE:** The purpose of the present analysis was to determine the occurrence of the conjoint trait of high TG and low HDL-C in a sample of pubertal male distance runners, and to examine if there were differences in familial factors, birthweight, Vo\textsubscript{max}, and skinfolds between those with and without the conjoint trait.

**METHODS:** 43 male distance runners, aged 14 to 19 years were included in the data analysis. HDL-C and TG were measured in the fasting state. Low HDL-C was considered as < 45 mg/dl and high TG was considered as >90 mg/dl. Familial factors (maternal and paternal body mass index (BMI) and family history of coronary heart disease (CHD)) and birthweight were reported on a medical history questionnaire. Vo\textsubscript{max} and skinfold thickness were measured by standard laboratory procedures.

**RESULTS:** Approximately 21% (10 of 47) of the sample possessed the conjoint trait. There were no significant differences in body size/composition or Vo\textsubscript{max} (65.4 ± 4.0 v. 66.1 ± 6.2 mg/kg/min, respectively) between those with and without the conjoint trait. Subjects with the conjoint trait displayed a more adverse lipid profile and higher blood pressures compared to those without the conjoint trait. Although there were no differences in the occurrence of a family history of CHD, subjects with the conjoint trait had a higher birthweight (3820 g, v. 337 v. 3420 g, respectively) and paternal BMI (27.8 ± 2.4 v. 25.8 ± 3.8 kg/m\(^2\)).

**CONCLUSIONS:** The results indicate a relatively high occurrence of the conjoint trait in a sample of highly-trained, lean pubertal boys which is associated with higher birthweight and paternal BMI but not a family history of CHD.

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**CoNCLUsIoN:** In young women, sprint training apparently fails to influence the antioxidative capacity for LDL-oxidation, but leads to a reduction of cholesterol and LDL-cholesterol.

**PURPOSE:** To determine the effect of sprint training on changes in lipoproteins and on the oxidation of LDL in vitro.

**METHODS:** Sprint training was performed by 20 untrained women, aged 23 ys, BMI 21 kg/m\(^2\), and total body fat of 20% and 10 controls with comparable anthropometric data for 8 weeks 3 x/wk for 30 min. Before and after training they underwent a progressive exhaustive spiroergometric treadmill test. Venous blood was taken 30 min before and 3 min after the test. The test was repeated after the training. Cholesterol, triglycerides and lipoproteins were measured as well as the oxidation of LDL in vitro, the products of lipoperoxidation and malondialdehyde.

**RESULTS:** With a compliance of 94%, the running speed was increased by 0.5 km/h, while VO\textsubscript{max} and maximum lactate remained constant. With the triglycerides, HDL and VLDL, unchanged, cholesterol reduced from 191±23 to 178±23mg/dl (p<0.001) and LDL from 126±21 to 117±18mg/dl in the training group. Lp (a) and malondialdehyde remained unchanged in both groups. In the training group, the small increase in lactate from 79 to 87 min was not significant. After treadmill running, HDL increased before and after training, in the control group before the intervention only, and LDL in the training group only. VLDL remained unchanged in both groups.

**CONCLUSION:** In young women, sprint training apparently fails to influence the antioxidative capacity for LDL-oxidation, but leads to a reduction of cholesterol and LDL-cholesterol.
and the transition from one mode to the other is recognized to further increase exercise stress. In training, triathletes often use sessions of alternating work between cycling and running.

PURPOSE: To establish whether an alternating cycle-run session elicits higher concentrations of IGF and higher rates of FFA oxidation during exercise or in recovery compared with cycling or running in isolation.

METHODS: Eight club-level triathletes (age 32.9 ± 4.8 yrs, height 1.83 ± 0.05 m, body mass 80.10 ± 5.20 kg, mean ± SD) provided written informed consent and completed five exercise trials. Two pre-trials consisted of an incremental test to identify lactate threshold (LT); one on a treadmill (T) and the other on a cycle ergometer (C). The three test trials comprised 60-minutes of exercise at LT intensity and were completed independently on C, T or alternating every 10 minutes between cycle ergometer and treadmill (ALT). Sampling occurred every 10 minutes; blood for hGH concentration and expired gas for FFA. Heart rate was measured throughout. Repeated measures ANOVAs and pairwise comparisons were used to examine interaction and differences between exercise mode and sampling time for hGH and FFA. The relationship between IGF and FFA was examined using Pearson product moment correlation.

RESULTS: A significant main effect was identified for mode of exercise, however this could only be observed for IGF in recovery (p<0.05), although FFA oxidation during exercise approached significance (p=0.056). Significant differences (p<0.05) between modalities: T>C and ALT>C suggest that cycling is best for eliciting an exercise-induced growth hormone secretion. FFA oxidation and IGF secretion, in both exercise and recovery in all three modes of exercise, were unrelated (p<0.05).

CONCLUSION: The contention that alternating between C and T in one session would result in higher rates of FFA oxidation and that this would correlate highly with IGF secretion was not supported by current findings. A differential response for IGF secretion and FFA oxidation for C and T suggests that a range of modalities is required to optimise substrate utilisation and hGH secretion.

2800 Board #74 10:00 AM - 11:00 AM Mitochondrial Fatty Acid Binding Protein Content is not Altered in Human Skeletal Muscle during Prolonged Aerobic Exercise Lawrence L. Spriet, FACSM, Graham P. Holloway,1 George J.F. Heigenhauser, FACSM, Jorge Calles-Escandon,2 Ared Benon.1 1University of Guelph, Guelph, ON, Canada. 2McMaster University, Hamilton, ON, Canada. Wade Forest University, Winston-Salem, NC. E-mail: lspriet@uguelph.ca

PURPOSE: The transport of long chain fatty acids (LCFA) across mitochondrial membranes is considered a rate-limiting step in fatty acid oxidation. Traditionally, mitochondrial LCFA transport was believed to be solely regulated by carnitine palmitoyltransferase I (CPTI) activity. Although CPTI activity remains an integral part of mitochondrial LCFA transport, it is becoming increasingly clear that additional proteins influence LCFA transport. Recently, the plasma membrane (PM) proteins fatty acid translocase (FAT/CD36) and fatty acid binding protein (FABP) have been found on skeletal muscle mitochondria. While it has been shown that both PM proteins follow an oxidative hierarchy, are involved in PM LCFA transport and increase following chronic training, only FAT/CD36 has previously been studied in humans with respect to the mitochondrial fraction. It has been shown that FAT/CD36 translocates from an intracellular depot to the mitochondria in exercising skeletal muscles, however the role of FABP with respect to mitochondrial LCFA transport and oxidation in human skeletal muscle during exercise remains unknown. We hypothesized that exercise induced increases in fatty acid oxidation result from an increased mitochondrial FABP content, similar to the translocation of FAT/CD36 that has previously been observed.

METHODS: Participants cycled at ~60% VO2peak for 120 min, and blood and ventilatory data were collected at rest and every 30 minutes during exercise. Percutaneous needle biopsies were taken from the vastus lateralis at rest, 30 min and following 120 min. Mitochondria were immediately isolated, and used to measure the content of mitochondrial FABP through Western blotting (n=12).

RESULTS: Whole body fat oxidation rates increased (P<0.05) during exercise by ~100% (15 min; 10.1 ± 1.2 vs 120 min; 20.5 ± 2.5 KJ/min), associated with the exercise induced increase in whole body fat oxidation was ~200% increase (P<0.05) in plasma free fatty acid concentration (15 min; 0.32 ± 0.03 vs 120 min; 0.91 ± 0.11 mm). However, despite increases in fatty acid oxidation mitochondrial FABP protein content did not change (Rest; 2.62 ± 0.54, 30 min; 2.48 ± 0.49, 120 min; 2.75 ± 0.45 arbitrary units), and as a result did not correlate with whole body fat oxidation rates (r=0.23).

CONCLUSIONS: It is concluded that during 120 min of cycling, the content of FABP on mitochondria does not change, despite large increases in whole body fat oxidation. While it appears that FABP exists on mitochondria, the exact role of this subcellular fraction remains to be elucidated.
S544  Vol. 38  No. 5  Supplement

2803  Board #77  10:00 AM - 11:00 AM  Exercise Induced Energy Deficit Does Not Impact Resting Plasma Fatty Acids and Glycerol
Matthew A. Pikosky, Tracey J. Smith, J Phillip Karl, Ann Grediagn, Ellen L. Glickman, FACS, Mona M. Mathow, Andrew J. Young, FACS, U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Recently, negative energy balance induced by decreased energy intake was reported to cause resting plasma free fatty acid and glycerol concentrations to increase (1). Whether negative energy balance induced by increased energy expenditure affects biomarkers of lipid metabolism similarly is not known.

PURPOSE: To compare effects of energy deficit induced by increased exercise on plasma markers of lipidosis with effects of increased exercise without energy deficit.

METHODS: Fourteen men (23.4±1.3yrs, 74.0±1.8 kg, 14.4±1.4 % body fat, VO2peak 58.2±2.2 mlkgr/min) consumed a diet containing ~55% CHO, 38% fat, and 9.9 g protein/kg for 11 days. Day 1-4 (baseline, BL) energy intake (EI) matched EI and energy expenditure (EE) recorded the week before BL. Volunteers then added exercise at 55%-65% VO2peak to expend an additional 1000 kcal/d for 7 days (EX). Seven volunteers increased EI to maintain energy balance (BAL), while seven maintained BL EI (DEF).

EE was assessed by closed circuit spirometry, and body weight was recorded daily. Fasting plasma was analyzed for free fatty acid (FFA) and glycerol on days 3, 6, and 11.

RESULTS: EI and EE for BAL were 3642±271 and 3659±276 kcal/day during BL and increased to 4594±266 and 4655±274 kcal/day during EX. EI for DEF was 3450±97 kcal/d for BL and EX, while EE increased from 3491±151 to 4477±157 kcal/d for BL and EX respectively. BAL remained stable weight, while DEF lost 2.0±0.21 kg (p=0.05). Resting FFA and glycerol values (mean ±SEM) are shown. * Difference between groups (p<0.05)

<table>
<thead>
<tr>
<th>Group</th>
<th>FFA (mM)</th>
<th>Glycerol (mM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL</td>
<td>0.53±0.08</td>
<td>0.04±0.03</td>
</tr>
<tr>
<td>EX</td>
<td>0.55±0.05</td>
<td>0.05±0.02</td>
</tr>
<tr>
<td>DEF</td>
<td>0.49±0.07</td>
<td>0.04±0.01</td>
</tr>
</tbody>
</table>

CONCLUSION: In contrast to what was observed with a one-day diet-induced energy deficit, a 7-d 1000 kcal/d exercise-induced energy deficit did not affect plasma markers of lipidosis, suggesting differential lipolytic regulation during dietary and exercise-induced energy deficit. References: 1) Horowitz et al., J Appl Physiol. 98:1612-1618, 2005.

2804  Board #78  8:00 AM - 9:00 AM  The Effect of Exercise Training on Protagonists of Lipogenesis and Lipolysis in Rat Tissues
Vassilis Mougios, Anatoli Petridou. University of Thessaloniki, Thessaloniki, Greece.

Exercise is a powerful modifier of the manifestations of the metabolic syndrome in the direction of health enhancement. This is achieved especially through alterations in carbohydrate and lipid metabolism caused by modifications in the activity and/or quantity of specific proteins. However, the mechanisms by which exercise alters lipid metabolism are unclear, as data regarding the effect of exercise training on key proteins involved in lipogenesis and lipolysis are limited and controversial.

PURPOSE: The aim of this study was to examine the effect of exercise training on the concentrations of two enzymes involved in lipogenesis (fatty acid synthase, FAS; and diacylglycerol acyltransferase 1), two proteins involved in lipolysis (hormone-sensitive lipase, HSL; and perilipin), and three transcription factors mediating the induction of genes involved in lipid metabolism (the α, γ, and δ members of the peroxisome proliferator-activated receptor, or PPAR, family) in rat liver, gastrocnemius medialis muscle, epididymal fat, and subcutaneous fat.

METHODS: Twenty rats lived for eight weeks in cages equipped with wheels. The eleven most active of them, having run at least 2 km/d, formed the trained group. Fourteen sedentary counterparts served as controls. The aforementioned proteins were measured through Western blot analysis in the relevant tissues of both groups. Serum leptin, an index of body fat mass, was measured by enzyme immunoassay.

RESULTS: The trained rats ran on average 5.2±1.0 km/d. Serum leptin was 2.4-fold lower in the trained compared to the untrained animals (P<0.05). The trained rats had lower FAS in the liver, higher FAS, HSL, and perilipin in epididymal fat, as well as higher HSL in subcutaneous fat. Additionally, the trained rats had higher total protein concentrations in both fat depots. No significant differences in the liver, muscle or adipose tissue PPAR contents were found between groups.

CONCLUSIONS: Our findings suggest that long-term wheel running decreased lipogenesis in the liver, increased lipolysis in subcutaneous fat, and increased lipid turnover in visceral fat. Because no differences were observed in PPAR content, we propose that the specific type of exercise training affected the expression of target genes of these transcription factors through PPAR activation rather than induction, rendering the regulation of the above processes more economical and flexible.

GRANTS: This study was supported by a grant from the Greek Ministry of Education and the European Union (Heracleus project).

2805  Board #79  9:00 AM - 10:00 AM  The Effects of Intense Acute Exercise on Muscle Function of Long Chain Dehydrogenase Deficient Mice.
Marcos A. Michaelides, David E. Martin, Charles Riggs, FACS, University of Arkansas, Fayetteville, AR.

Email: mmichael@uark.edu

The initial step of mitochondrial fatty acid oxidation (FAO) is the - dehydrogenation of the acyl-CoA esters. The process is catalyzed by one of the four chain-length-specific enzymes that catalyze the same reaction. The long-chain acyl-CoA dehydrogenase (LCAD) enzyme activates the breakdown of acyl-CoA esters that derive from C16-C20 carbon length fatty acids. The effects of LCAD deficiency on skeletal muscle under stress are unclear.

PURPOSE: To determine the effect of acute intense exercise on the skeletal muscle function of LCAD-deficient mice.

METHODS: Thirty-six male (20 LCAD-/- deficient and 14 LCAD +/- non deficient C57BL/129) mice were used for this study. Both groups were randomly divided into an exercise and a non-exercised group. The exercised groups ran to exhaustion, rested for 24 hours and then exercised again to exhaustion using the same protocol. Twenty-four hours later the mice were anesthetized and the gastrocnemius muscles attached to a force displacement transducer using the Achilles tendon. The sciatic nerve was surgically exposed and placed on silver wire electrodes. Contractile properties were measured using a force displacement transducer (Grass Model FT01D).

RESULTS: A two way ANOVA showed that the effect of the enzyme deficiency was significant (p<0.05) for peak tension (P< 1.1 02×10<0023). Taeky’s HSD test showed that LCAD-/- had significantly (p<0.05) lower Pt. In addition, LCAD-/ mice demonstrated significantly (p<0.05) lower tetanic forces at 40 and 60 Hz.

CONCLUSION: LCAD-/- mice demonstrated abnormal signs in response to exercise stress. The cause of these differential responses is unknown but indicates that the severity of the deficiency varies among the animals.

Supported by a grant from the Arkansas Biosciences Institute.

2806  Board #80  10:00 AM - 11:00 AM  Recovery Metabolism Following High Intensity Intermittent Exercise
E Gail Trapp, Sarah L. Dien, Stephen H. Boutcher, FACS, University of NSW, Kensington NSW, Australia.

Email: z11004212@student.unsw.edu.au

Tremblay et al. (1994) have shown that regular short intermittent high intensity exercise results in significantly greater fat loss compared to continuous steady state exercise. A possible mechanism underlying this fat loss may be excess post-exercise oxygen consumption (EPOC).

PURPOSE: The purpose of this study was to determine the effects of intermittent high intensity exercise upon EPOC among untrained college-aged women.

METHODS: Seven females, aged between 19-23 years were required to undergo two cycle ergometer testing sessions; a VO2peak test, and 20 min of short high intermittent intensity exercise (8 s sprint, 12 s recovery). Resting metabolic rate (RMR) was assessed before and after the high intensity exercise bout. A ramped bicycle test was administered to determine VO2peak and lactate threshold. On a separate day, power output was then increased to energy expenditures at an RER of .93 were continued for 20 min in the 8 s sprint condition.

Concomitantly, blood samples were collected from an antecubital vein at rest, every 5 min during exercise, and throughout a 60-min recovery from the high intensity exercise. Ventilatory and heart rate measurements were recorded throughout exercise and during recovery.

RESULTS: Heart rate, RER, glycerol, lactate, and EPOC were significantly elevated (p=0.001) 10 min after exercise. Heart rate, glycerol, and lactate, had returned to baseline levels after 30 min of recovery but EPOC was still significantly elevated and RER was significantly lower than baseline at 60 min (p=0.05). There was a strong positive correlation between resting insulin resistance and RER at 60 min (r=0.94, p = 0.005).

CONCLUSIONS: 20 min of short intermittent high intensity exercise incurred a significant EPOC response, however, women with insulin resistance displayed impaired fat metabolism post exercise.

2807  Board #81  8:00 AM - 9:00 AM  Effect of Dicylglycerol High Fat Diet on Fat Metabolism in Rat Skeletal Muscle
Akira Nakatani1, Megumi Hashimoto1, Kazuhiko Higashida1, Mitsuuru Higuchi, FACSM1,2. 1Nara University of Education, Nara, Japan. 2Waseda University, Tokyo, Japan. (Sponsor: Mitsuuru Higuchi, FACSM)

Email: akira@nara-edu.ac.jp

PURPOSE: Although “fat loading” increases oxidative enzymes in skeletal muscle and improves endurance capacity, it is well-known that a long term high fat diet induces obesity. Dicylglycerol oil has been reported to prevent the accumulation of body fat. The purpose of this study was to determine the effect of dicylglycerol high fat diet on fat metabolism in rat skeletal muscle.

"1"#1362-1849-WEDNESDAY, MAY 31  #1850-2268-THURSDAY, JUNE 1  #2269-2726-FRIDAY, JUNE 2  #2727-2915 - SATURDAY, JUNE 3

MEDICINE & SCIENCE IN SPORTS & EXERCISE®
METHODS: Male Wistar rats, 5 weeks old, were assigned to a low fat (L: n=10) diet (12% calories as fat), triacylglycerol rich high fat (HTG, n=10) diet (60% calories as fat) or diacylglycerol rich high fat (HDG, n=10) diet (60% calories as fat) groups. They ate their diets ad libitum for 5 weeks.

RESULTS: Epidymal fat pad weight was significantly (P<0.05) higher in the HTG diet group than in LF and HDG diet groups. Serum triglyceride level was lower in HDG diet group than in LF diet group. Triglyceride content in tripes muscles was significantly (P<0.05) higher in HTG group than LF and HDG diet groups. CS activity in the red portion of Gastrocnemius muscles is higher in HTG and HDG than LF group (~75%, P<0.01 and ~50%, P=0.001, respectively). 3-HAD activity in red Gastrocnemius muscles was higher in HTG diet group than LF (~33%, ns). CPT-1 activity in red Gastrocnemius muscles were significantly higher in HTG and HDG diet groups than LF diet group (~58%, P<0.05 and ~93%, P=0.001, respectively).

CONCLUSIONS: These results suggest that a long term high diacylglycerol diet may increase fat metabolism in skeletal muscle without fat accumulation and hyperlipemia. Supported by Kao Research Council for the Study of Healthcare Science Grant.

2808	Board #82	9:00 AM - 10:00 AM
Elevated Lipid Oxidation in Men Following Endurance Exercise
Email: henderson@berkeley.edu

Exercise increases metabolic rate and the exercise-induced perturbation in metabolism persists into recovery.

PURPOSE: We sought to confirm findings of elevated lipid oxidation in postabsorptive men for 3 hr following 60-90 min of exercise (day 1) and to test the hypothesis that lipid oxidation would remain elevated above that in the resting control trial on the following morning (day 2).

METHODS: Ten men were studied by indirect calorimetry on 2 different occasions during and for 3 hr after isometric exercise bouts [90 min at 45% VO2Peak (Mod) and ~60 min at 65% VO2Peak (Hard)], and on a third occasion to obtain time of day-matched resting control (Con) data. Subjects rested the day prior to day 1 and received a standardized diet to cover energy needs (IOM, 2002). On day 1 of each trial, participants received individualized diets with the same energy content and macronutrient composition (breakfast 3 hr before exercise; lunch 3 hr after exercise, followed by dinner and snack). On the morning of day two, participants were transported to the laboratory overnight fasted for an indirect calorimetry measurement.

RESULTS: Exercise energy expenditure was elevated above resting by 693 +/- 40 kcal in Mod and 704 +/- 42 kcal in Hard with no significant difference between Mod and Hard. As well, on the morning of day 2, following both Mod and Hard exercise trials, lipid oxidation remained elevated above Con (P < 0.05) with no significant difference between exercise intensities (0.38 +/- 0.08, 0.56 +/- 0.05, and 0.50 +/- 0.04 kcal/min in Con, Mod, and Hard, respectively).

CONCLUSION: Compared to a sedentary control, lipid oxidation remains elevated for at least 20 hr after an endurance exercise bout when energy intake is held constant. Supported by NIH grant AR 42906 to GAB.

2809	Board #83	10:00 AM - 11:00 AM
Metabolic Responses to Acute Exercise at Two Different Exercise Intensities during Rowing and Cycling Ergometry
Brendan Egan, David T. Ashley, Emmet Kennedy, Paul O'Connor, Javier Monceldro, Fiona M. Sarfield, Niall M. Moyua, FACSM, Donald J. O'Gorman. Dublin City University, Dublin 9, Ireland.
Email: brendan.egan8@mail.dcu.ie

The relative contribution of carbohydrate and fat oxidation to whole body energy production during steady state exercise is dependent on exercise intensity and duration i.e. fat oxidation declines with increasing exercise intensity. However, exercise that requires a greater anaerobic muscle mass may also influence substrate utilization in increasing the contribution of fat oxidation at the same relative intensity (%VO2peak).

PURPOSE: The purpose of this study was to determine the impact of whole body (rowing) and lower limb (cycling) exercise on substrate utilization at different exercise intensities.

METHODS: Nine trained rowers [age, 23.3±1.7 yr; body mass, 75.4±1.9 kg; height, 1.81±0.02 m] exercised for 20-min at 50% VO2peak followed by 20-min at 4mL lactate threshold, once each on a rowing (ROW) and cycling (CYC) ergometer. Steady state carbohydrate and fat oxidation rates were determined by indirect calorimetry during the last 60-min of each stage.

RESULTS: Oxygen consumption during exercise at 50% VO2peak was similar between ROW and CYC (2.06±0.12 vs. 2.01±0.10 lmin−1; p=0.555). The steady state rates of carbohydrate oxidation (1.50±0.13 vs. 1.57±0.09 gmin−1; p=0.496) and fat oxidation (0.42±0.04 vs. 0.36±0.04 gmin−1; p=0.409) were also similar for ROW and CYC at this intensity. During exercise at 4mL lactate threshold, oxygen consumption was greater in the ROW trial (3.66±0.21 vs. 3.10±0.16 lmin−1; p=0.014). However, the relative contribution of carbohydrate and fat to whole body energy production was similar between modes (fat contribution: 18.8±2.9% vs. 16.4±2.2%, ROW vs. CYC respectively; p=0.576). There were slightly, but not significantly, higher rates of carbohydrate (3.65±0.31 vs. 3.15±0.44 gmin−1; p=0.139) and fat (0.34±0.06 vs. 0.27±0.05 gmin−1; p=0.359) oxidation during ROW.

CONCLUSION: At both 50% VO2peak and LT, the contribution of carbohydrate and fat oxidation to energy production was similar during rowing and cycling. During steady state exercise, recruiting a greater muscle mass does not appear to alter the contribution of fat oxidation to energy production at the same relative intensity or with a similar level of metabolic stress.

2810	Board #84	8:00 AM - 9:00 AM
The Effects of Prior Resistance Exercise on Lipolysis and Fat Oxidation during Subsequent Endurance Exercise
Kazushige Goto, Naokata Iishi, Shuhei Sugihara, Toshitsugu Yoshikawa, Kaoru Takamura. 1. University of Tokyo, Tokyo, Japan. 2. University of Tsukuba, Tsukuba, Japan. (Sponsor: Robert R Kraemer, FACSM)
Email: gotoh@fitness.taiiku.tsukuba.ac.jp

PURPOSE: This study examined the effects of prior resistance exercise on the lipid metabolism during subsequent endurance exercise.

METHODS: Ten healthy male subjects performed three types of exercise regimen on separate days: 1) endurance exercise only (E), 2) endurance exercise with prior resistance exercise and 20-min rest (RE20), and 3) endurance exercise with prior resistance exercise and 120-min rest (RE120). Resistance exercise consisted of six exercises, with each 3-4 sets at 10 repetition maximum. Endurance exercise was performed on cycle ergometer at approximately 50% of the maximal oxygen uptake for 60 min.

RESULTS: Measurements of blood lactate and hormone concentrations showed that the prior resistance exercise caused marked increases in lactate, norepinephrine (NE) and growth hormone (GH) concentrations. Before the endurance exercise, free fatty acids (FFA) concentration was higher in the RE120 trial than in the RE20 and E trials (P < 0.05), whereas concentrations of NE and GH were higher in the RE20 trial than in the RE120 and E trials (P < 0.05). During 60 min endurance exercise, the FFA and glycerol responses were greater in RE120 and RE20 trials than in the E trial (P < 0.05). Ketone body concentrations increased significantly in all trials (P < 0.05) with no significant difference between trials. In the RE20 trial, the concentration of GH after the resistance exercise showed significant correlations with mean concentrations of FFA (r=0.77, P < 0.01) and glycerol (r=0.92, P < 0.01) during the subsequent endurance exercise. During the endurance exercise, no significant difference was observed between trials when the oxygen uptake for the entire 60-min period of exercise was compared. However, the relative contribution of fat oxidation for energy production (calculated by the respiratory exchange ratio) was larger in the RE120 and RE20 trials than in the E trial (P < 0.05).

CONCLUSION: These results suggest that lipolysis and fat oxidation during endurance exercise are enhanced by prior resistance exercise. Although both trials with long and short rest periods between resistance and endurance exercises caused similar effects, the involvement of different mechanisms is suggested.

Supported by Grant from the Ministry of Education, Science, Sports and Culture of Japan.

2811	Board #85	9:00 AM - 10:00 AM
Effects of Exercise Training on Fat Oxidation in Obese Women
Donna L. Wolf, Sara Fleet, George Grove, John M. Jakicic, FACSM, Bret H. Goodpaster. University of Pittsburgh, Pittsburgh, PA.
Email: wolfd@dom.pitt.edu

Reduced energy expenditure and impaired fat oxidation are critical factors associated with obesity. Although much is known about the effects of exercise training on fat metabolism in normal weight, healthy women, considerably less is known about the potential benefits of exercise on fat metabolism in obesity.

PURPOSE: To determine the effects of aerobic exercise on fat metabolism and body composition in previously sedentary obese women.

METHODS: 13 Obese (BMI > 30 kg/m2) premenopausal women, aged 38 ± 7 years completed a 16- week intervention consisting of moderate exercise (3-4 sessions/week, 30-50 minutes/session, at 60-70 VO2 max). Pre and post intervention, all subjects underwent a DXA scan to determine body composition, graded exercise test to determine maximal oxygen uptake (VO2 max), and indirect calorimetry to measure energy expenditure and fat oxidation at rest and during exercise (treadmill walking at 55% VO2 max).

RESULTS: VO2 max improved on average by 10.1% from 50.9 ± 8.2 to 56.1 ± 8.1 ml/kgFFM/min (p<0.01). There was a slight decrease in fat mass from 38.0 ± 6.9kg to 38.2 ± 6.7 kg (p>0.05). There was an increased rate of fat oxidation during 60 minutes of sub-maximal exercise (0.30 to 0.34 g/min; p<0.05). There was, however, no change in resting metabolic rate (RMR) or resting fat oxidation.
CONCLUSION: In obese premenopausal women, 16 weeks of moderate exercise enhanced fatty acid oxidation during sub-maximal exercise, but did not alter RMR or resting rates of fat oxidation.

Supported by a grant from Experimental and Applied Sciences, Inc.

G-16 Free Communication/Poster – Muscle: Cellular and Molecular Mechanisms II

SATURDAY, JUNE 3, 2006 8:00 AM - 11:00 AM
ROOM: Hall B

Heat shock protein 70 (Hsp70) has been found to play cyto-protective roles in both cardiac and skeletal muscle. To this point, little attention has been paid to the signaling mechanisms involved in expression of Hsp70 in skeletal muscle.

PURPOSE: To characterize the role of protein kinase A (PKA) in regulation of the Hsp70 response to endurance exercise in skeletal muscle.

METHODS: Twenty-eight 12 week-old male Sprague-Dawley rats were divided into sham (5% DMSO; n=14) and PKA-inhibited (0.36 mg/kg H-89 in 5% DMSO; n=14) groups and run on a motor-driven treadmill for 60 min at 30 m/min on a 2% grade. Exercised (EX) animals were subsequently killed at 30 min (Hsp70 mRNA evaluated by RT-PCR; n=7) or 24 h (western blot analysis of Hsp70; n=7) post-exercise and portions of the white vastus (V) and soleus (So), representing muscles with different recruitment patterns and fiber-type profiles, were taken and evaluated compared to appropriate non-exercised controls (CON; n=7 per group).

RESULTS: All data are expressed as means ± SE. Hsp70 protein (% of control standard) increased in sham-injected rats in V (CON: 30.30 ± 4.14; EX: 77.37 ± 11.81) but not So (CON: 152.42 ± 23.62; EX: 134.81 ± 32.23) following exercise. PKA inhibition suppressed this response in V (EX: 25.01 ± 6.26). However, Hsp70 mRNA (corrected to β-Actin mRNA), was significantly increased (P<0.05) in both muscles (CON: 5.69 ± 0.59; EX: 26.43 ± 10.55 for V; CON: 3.22 ± 0.44; EX: 56.87 ± 14.37 for So) following exercise and this increase was unaffected by PKA inhibition.

CONCLUSIONS: Exercise selectively increases the relative content of Hsp70 in a muscle-specific, PKA-dependent manner. In skeletal muscle, the exercise-induced increase in Hsp70 appears to be under both transcriptional and translational control and PKA appears to regulate this process at the level of translation.

Supported by NSERC grant #1870-00 and Ontario Graduate Scholarship funding.

2812 Board #96 10:00 AM - 11:00 AM
Phenotypic-Specific Effect of Protein Kinase A on Skeletal Muscle Induction of Hsp70 Following Exercise

PURPOSE: To characterize the role of protein kinase A (PKA) in regulation of the Hsp70 response to endurance exercise in skeletal muscle.

METHODS: Twenty-eight 12 week-old male Sprague-Dawley rats were divided into sham (5% DMSO; n=14) and PKA-inhibited (0.36 mg/kg H-89 in 5% DMSO; n=14) groups and run on a motor-driven treadmill for 60 min at 30 m/min on a 2% grade. Exercised (EX) animals were subsequently killed at 30 min (Hsp70 mRNA evaluated by RT-PCR; n=7) or 24 h (western blot analysis of Hsp70; n=7) post-exercise and portions of the white vastus (V) and soleus (So), representing muscles with different recruitment patterns and fiber-type profiles, were taken and evaluated compared to appropriate non-exercised controls (CON; n=7 per group).

RESULTS: All data are expressed as means ± SE. Hsp70 protein (% of control standard) increased in sham-injected rats in V (CON: 30.30 ± 4.14; EX: 77.37 ± 11.81) but not So (CON: 152.42 ± 23.62; EX: 134.81 ± 32.23) following exercise. PKA inhibition suppressed this response in V (EX: 25.01 ± 6.26). However, Hsp70 mRNA (corrected to β-Actin mRNA), was significantly increased (P<0.05) in both muscles (CON: 5.69 ± 0.59; EX: 26.43 ± 10.55 for V; CON: 3.22 ± 0.44; EX: 56.87 ± 14.37 for So) following exercise and this increase was unaffected by PKA inhibition.

CONCLUSIONS: Exercise selectively increases the relative content of Hsp70 in a muscle-specific, PKA-dependent manner. In skeletal muscle, the exercise-induced increase in Hsp70 appears to be under both transcriptional and translational control and PKA appears to regulate this process at the level of translation.

Supported by NSERC grant #1870-00 and Ontario Graduate Scholarship funding.

2813 Board #87 8:00 AM - 9:00 AM
Proteolytic mRNA Expression in Response to Acute Resistance Exercise in Human Single Skeletal Muscle Fibers
Yifan Yang, Bozena Jemiolo, Scott Trappe, FACSM. Ball State University, Muncie, IN.

PURPOSE: To characterize changes in mRNA expression of select proteolytic markers in human slow (myosin heavy chain I, MHC I)- and fast (MHC Ia)-switch single skeletal muscle fibers following an acute bout of resistance exercise (RE).

METHODS: Muscle biopsies were obtained from the vastus lateralis of eight young healthy sedentary males (23±3 y, 93±17 kg, 183±6 cm) before, and 4 and 24 h after 3 sets of 10 repetitions of bilateral knee extensions at 60% of 1-RM resistance exercise. (RE). The mRNA level of eight select markers of muscle proteolysis [tumor necrosis factor (TNF)-α, calpains 1 and 2, muscle RING finger 1 (MuRF-1), atrogin-1, cysteine-aspartate dependent protease (caspase)-3, β-cell leukemia lymphoma (Bcl)-2 and Bcl-2-associated X protein (Bax)] were quantified using real-time RT-PCR.

RESULTS: Generally, MHC I fibers had higher (1.6- to 5.0-fold, p < 0.05) mRNA expression for all post-RE. One exception was a higher (1.6- to 3.9-fold, p < 0.05) Bax/Bcl-2 mRNA ratio in MHC Ia fibers pre- and post-RE. RE resulted in a 2.2- to 4.8-fold increase (p < 0.05) in MuRF-1 at 4 h post-RE compared to pre-RE, and a 1.6-fold increase (p < 0.05) in atrogin-1 at 4 h post-RE compared to 24 h post-RE in both fiber types. Caspase-3 mRNA increased (p < 0.05) 1.4- and 1.8-fold at 4 and 24 h post-RE, respectively, in both fiber types. Bax/Bcl-2 mRNA ratio increased (p < 0.05) 2.2-fold at 24 h post-RE only in MHC I fibers. There were no changes in TNF-α, and calpains 1 and 2 mRNA at 4 and 24 h post-RE.

CONCLUSIONS: These results suggest that MHC I fibers have a greater proteolytic activity before and after RE compared to MHC Ia fibers. The mRNA induction of MuRF-1, atrogin-1 and caspase-3 with RE suggest increased proteolytic activities of the ubiquitin/proteasomal and caspase pathways. This altered and specific proteolytic activity among slow- and fast-twitch muscle fibers indicate that these pathways may play an important role in the muscle remodeling process with RE.

Supported by NIH grant AG18409
Skeletal muscle atrophy after spinal cord injury (SCI) has been associated with the development of insulin resistance and an increased risk of developing diabetes mellitus. Recent intervention therapies aimed at increasing skeletal muscle mass and improving glucose tolerance have been successfully implemented. However, to date, the molecular responses associated with these therapies have not been examined.

PURPOSE: The purpose of this study was to implement genome wide expression profiling to define the precise molecular signature associated with 12 weeks of neuromuscular electrical stimulation (NMES)-evoked progressive resistance training (RT) in individuals with SCI.

METHODS: Three men with chronic, complete SCI (CS-T10) trained their quadriceps femoris (QF) muscle groups using NMES-evoked dynamic, loaded knee extensions 2 days/week for 12 weeks. Skeletal muscle biopsies of the m. vastus lateralis, magnetic resonance images (MRI) of the thigh and oral glucose tolerance tests (OGTT) were performed prior to and following 12 weeks of RT.

RESULTS: RT resulted in improvements in muscle size via MRI (29.0 ± 3.8%) and blood glucose concentration at the 60 (23.8%) and 90 (31.3%) minute points of the OGTT. Microarray analysis revealed altered expression of genes associated with protein turnover (atrogen-1/MAFbx, calpastatin, serine/threonine protein kinase, MAPK, cAMP-dependent protein kinase, cathepsin B), cell growth (growth hormone receptor, IGF-1/IGF-2), cytoskeletal integrity (adenosine monophosphate deaminase, four-and-a-half LIM domains, ankyrin G) and energy metabolism (enolase-3, glycogen synthase, phosphoglucomutase) after RT.

CONCLUSIONS: The results of this study suggest that the adaptations to RT are complex and involve a number of molecular pathways that contribute to the regulation of muscle size and glucose homeostasis. It is our hope that this information garnered might lead to the identification of novel therapeutic targets not previously described, thereby facilitating improvements in the efficacy and specificity of rehabilitation interventions targeting recovery of muscle mass and improvements in insulin sensitivity in persons with SCI.
CONCLUSION: These data indicate a differential regulation of pro-oxidant, pro-inflammatory signaling including iNOS, NF-κB, 4-HNE and HSP25 during short-term and long-term reloading following HU in skeletal muscle.

CONCLUSION: This technique appears to be reproducible and adequately sensitive to detect relevant differences in skeletal muscle quality while remaining relatively insensitive to interference from nearby biological tissue. Further, these data indicate age-related differences in skeletal muscle quality, possibly due to intramuscular fat and fibrosis, are detectable with this technique.
Nitric Oxide (NO) produced by neuronal nitric oxide synthase (nNOS) has been shown to induce satellite cell (SC) activation; which in turn contributes to skeletal muscle adaptation to resistance training. This process involves an increase in the expression of skeletal muscle cytoskeletal proteins. We measured effects of age, gender, and mechanical load on transcript levels of alpha 1-syntrophin and nNOS protein levels. Our results showed that there was a significant effect of training status on plasma PAI-1 activity, such that the untrained group had significantly higher levels than the trained group. These findings support the hypothesis that resistance training may improve skeletal muscle function through increased nNOS protein expression.
MetHoDs: GFP-desmin plasmids were introduced into the living tibialis anterior (TA) muscle of desmin-null mice by electroporation. Seven days later, single TA fibers were dissected free, mounted in a chamber, passively stretched in 10% increments, and imaged at each length by confocal microscopy. Fast Fourier Transform combined with cross-correlation functions was used to quantify phase shift variance between Z-lines as a function of sarcomere length, a function of Z-disk alignment. Fibers (n=6/group) were isolated from 1) wild-type, 2) untransfected desmin-null muscles, 3) transfected desmin-null muscles expressing GFP-desmin, and 4) transfected desmin-null fibers not expressing GFP-desmin. 

RESULTS: GFP-desmin fluorescence colocalized with alpha-actinin at the Z-disk suggesting incorporation into the myofibrillar lattice. For each group, phase shift variance increased with sarcomere length (p<0.05). However, the phase shift variance increase was significantly greater for desmin-null fibers (0.017±0.001 Angstrom/200µm) and transfected desmin-null fibers not expressing GFP-desmin (0.019±0.001 Angstrom/200µm), compared to wild-type fibers (0.005±0.001 Angstrom/200µm) and transfected desmin-null fibers expressing GFP-desmin (0.006±0.001 Angstrom/200µm; p<0.001). These results demonstrate that the GFP-desmin chimeric protein integrates into the myofibrillar lattice and reversed the structural alterations induced by the absence of desmin.

CoNCLUsIoN: This study demonstrates that exogenous desmin expression can mechanistically align Z-disks that were disordered due to development in the absence of desmin. A dramatic phenotype appearance of disordered Z-disks results directly from desmin loss and is not a secondary effect of the knockdown process. Future studies are required to determine whether exogenous desmin introduction can also reverse the functional effects of deleting desmin, namely loss of contractile stress and less susceptibility to injury.

Supported by NIH grant AR40050 & Department of VA.

2828 Board #102 8:00 AM - 9:00 AM Effects of Cystoseira Canariensis on C2C12 Cell Behavior In Vitro Jillian Gettel, Brandon Smith, Scott Barriger, Karen L. Ball, Alma College, Alma, MI. Email: 06jgettel@alma.edu

Proliferation of muscle precursor cells is under negative regulation by myostatin, a member of the TGF-beta family of proteins. Several lines of evidence demonstrate that disruption in myostatin content or activity lead to excess muscle growth. Cystoseira canariensis (CC) has recently been marketed as an inhibitor of myostatin activity, increasing muscle mass as a result. While the claims are based upon the ability of the CC, a sulfated polysaccharide, to bind myostatin, an increase in precursor cell proliferation and subsequent myofiber differentiation in the presence of this supplement has yet to be directly tested.

PURPOSE: The objective of this work was to test the hypothesis that CC increases proliferation and differentiation of C2C12 cells in vitro.

METHODS: C2C12 cells were plated in 96 well plates at either 600 or 1000 cells/well and incubated for 24 hours, allowing for attachment. Media was replaced with DMEM/10%FBS containing CC at concentrations between 50ng/mL and 0.5ng/mL. Proliferation was measured 96 hours after supplement addition using Promega Aqueous CellTiter 96 NoRadioactive Proliferation Assay. For differentiation, cells were plated in 50mm plates and allowed to reach confluence, at which time media was changed to DMEM/2% horse serum containing 2,500, 2.5 and 0.0025ug/mL of CC. Plates were assessed for numbers of multinucleated myotubes after 48 hours.

RESULTS: The proliferative response showed a clear dose dependent inhibition. At the highest concentration of CC cellular proliferation was significantly below those measured in control wells (1.038 +/- 0.146 vs 0.440 +/- 0.033, p<0.05). As concentrations decreased, proliferation increased approaching control but never increasing beyond that of the control condition (1.27 +/- 0.168). Data from initial differentiation experiments showed that, like proliferation, differentiation was markedly inhibited at high concentrations and comparable to control at the lowest concentrations.

CoNCLUsIoN: The ability of CC to actually suppress C2C12 proliferation and differentiation suggests that careful in vivo examination of CC bioavailability and action is essential if enhanced muscle growth is desired.

2829 Board #103 9:00 AM - 10:00 AM Transfection of Adult Desmin-Null Muscles with GFP-Desmin Plasmid Restores Normal Sarcomere Z-disk Alignment Michelle G. Palmisano1, Shannon Brenmer2, Sameer B. Shah1, Allen F. Ryan1, Richard L. Lieber, FACS3, 1UCSD Bioengineering Department and VA Medical Center, San Diego, CA; 2VA Medical Center, San Diego, CA. Email: mpalmisano@ucsd.edu

PURPOSE: To transfect desmin-null muscles with a GFP-desmin plasmid to test the hypothesis that the desmin protein is directly responsible for alignment of muscle Z-disks. This experiment is based on the fact that desmin, the muscle-specific intermediate filament protein, provides structural integrity and transmits muscle force throughout the cell. In the absence of desmin, muscle sarcomeres lose their structural scaffolding and cell morphology is characterized by a highly disorganized Z-disk. However, this could be due directly to the loss of desmin or to secondary changes that occur due to development in the absence of desmin.

METHODS: GFP-desmin plasmids were introduced into the living tibialis anterior (TA) muscle of desmin-null mice by electroporation. Seven days later, single TA fibers were dissected free, mounted in a chamber, passively stretched in 10% increments, and imaged at each length by confocal microscopy. Fast Fourier Transform combined with cross-correlation functions was used to quantify phase shift variance between Z-lines as a function of sarcomere length, a function of Z-disk alignment. Fibers (n=6/group) were isolated from 1) wild-type, 2) untransfected desmin-null muscles, 3) transfected desmin-null muscles expressing GFP-desmin, and 4) transfected desmin-null fibers not expressing GFP-desmin.

RESULTS: GFP-desmin fluorescence colocalized with alpha-actinin at the Z-disk distinguishing incorporation into the myofibrillar lattice. For each group, phase shift variance increased with sarcomere length (p<0.05). However, the phase shift variance increase was significantly greater for desmin-null fibers (0.017±0.001 Angstrom/200µm) and transfected desmin-null fibers not expressing GFP-desmin (0.019±0.001 Angstrom/200µm), compared to wild-type fibers (0.005±0.001 Angstrom/200µm) and transfected desmin-null fibers expressing GFP-desmin (0.006±0.001 Angstrom/200µm; p<0.001). These results demonstrate that the GFP-desmin chimeric protein integrates into the myofibrillar lattice and reversed the structural alterations induced by the absence of desmin.

CoNCLUsIoN: This study demonstrates that exogenous desmin expression can mechanistically align Z-disks that were disordered due to development in the absence of desmin. A dramatic phenotype appearance of disordered Z-disks results directly from desmin loss and is not a secondary effect of the knockdown process. Future studies are required to determine whether exogenous desmin introduction can also reverse the functional effects of deleting desmin, namely loss of contractile stress and less susceptibility to injury.

Supported by NIH grant AR40050 & Department of VA.

2830 Board #104 10:00 AM - 11:00 AM Impact of Insulin-Like Growth Factor-I on Type IIb Myosin Heavy Chain Promoter Activity R. Andrew Shanely, Thomas E. Childs, Frank W. Booth, FACS.M. University of Missouri, Columbia, MO. Email: shanelya@missouri.edu

Myosin heavy chain (MyHC) is an important skeletal muscle contractile protein that undergoes a fast-to-slow fiber type shift as a result of aging. Also, a decrease in IGF-I plasma level is a risk factor for mortality triggered by muscle binding of the pro-inflammatory cytokine IL-6. The expression of IGF-I in vivo restores MyHC phenotype to youthful levels in mice, i.e., normal levels of type II MyHC. The mechanism(s) by which IGF-I restores the MyHC phenotype remain unclear.

PURPOSE: We tested the hypothesis that IGF-I stimulates type Ibb MyHC promoter activity and increases Ibb MyHC mRNA levels.

METHODS: 3,000 base pairs of the 5’ flanking region (3 kb-promoter) of the mouse Ibb MyHC gene were cloned from a bacterial artificial chromosome using primers with engineered restriction enzyme sites. The promoter clone was then ligated into a reporter vector driving firefly luciferase expression. 5’ deletion constructs to 3 kb-construct and annealed to the reporter vector. PCR fidelity and promoter orientation were confirmed by automated DNA sequencing. C2C12 mouse myoblasts were transiently transfected with the constructs. The following day, differentiation was initiated by replacing the growth media with low-serum differentiation media (DM) or DM + IGF-I (250ng/mL). All media was replaced daily. Total mRNA was reverse transcribed and Ibb MyHC levels were then determined by real-time PCR. Firefly luciferase activity was assayed using a commercial reagent system.

RESULTS: Ibb MyHC mRNA was detectable after 2 days of differentiation, with no difference between IGF-I treated cells and control cells. After 3 and 4 days of differentiation Ibb MyHC mRNA was 12 and 7 fold greater, respectively, in IGF-I treated cells compared to control cells, p<0.05. During 4 days of differentiation the activity of the 3-kb Ibb MyHC promoter was significantly greater in the IGF-I treated cells compared to the control cells, i.e., Ibb MyHC promoter activity was 3.6 fold greater in IGF-I-treated cells, p<0.05. 5’ deletions made to the 3-kb construct demonstrated that the minimal length of the Ibb MyHC promoter is 2 kb with variable activity between 2-kb and 1-kb. The stimulation of the Ibb MyHC promoter activity was lost on constructs less than 1-kb in length.

CoNCLUsIoN: These data indicate that Ibb MyHC mRNA levels are significantly increased in IGF-I-treated muscle cells. The Ibb MyHC promoter reporter data suggest that increased MyHC ibb promoter activity contributes to the increase in Ibb MyHC mRNA. Sponsored by the National Institutes of Health: SF32AR051640-02 (RAS).
of stressors, and both protein synthesis and degradation rates can be impacted. Orally administered HMB attenuates protein degradation in muscle by preventing induction of a proteolytic pathway as well as at least partially preventing protein synthesis shutdown. The impact on protein degradation involves disruption of a major proteolytic pathway. HMB feeding also prevents tumor-induced shutdown of protein synthesis, apparently through a pathway similar to leucine. Further work is needed to confirm this hypothesis, as well as to assess the impact of HMB on other examples of disruption of muscle protein homeostasis such as intense exercise bouts, cardiovascular and renal disease.

2832 Board #106 9:00 AM - 10:00 AM
Histological and Ultrastructural Features of Skeletal Muscle in Subclinical Hypothyroid Patients
Michael E. Dunn1, James V. Hennessey2, Rebecca Lifchus-Ascher2, Arthur Cosmus1, Thomas G. Manfredi, FACSM, 1 University of Rhode Island, Kingston, RI; 2 Brown University School of Medicine, Providence, RI. University of Connecticut, School of Allied Health, Storrs, CT. Email: mvdunn@uri.edu

Untreated subclinical hypothyroidism presents the serious risk for the development of cardiovascular disease along with the progression to overt hypothyroidism. The lack of outwardly expressed signs and symptoms makes its diagnosis without endocrinological screening a challenge. Inconsistencies exist in the true defined diagnosis of subclinical hypothyroidism using Thyroid Stimulating Hormone (TSH) levels as an indicator. No study to date has examined the ultrastructural and histological changes of skeletal muscle associated with subclinical hypothyroidism.

PURPOSE: To perform histological and ultrastructural analyses of skeletal muscle samples from subjects diagnosed with subclinical hypothyroidism.

METHODS: Skeletal muscle biopsies from the vastus lateralis were obtained from 4 subjects with subclinical hypothyroidism. Samples were fixed, sectioned and stained for electron and light microscopic analysis.

RESULTS: Light microscopic examination revealed an increased accumulation of glycogen and regions of marked fiber size variation, consistently due to fiber atrophy. Inclusions were apparent in a number of fibers and areas where fibers were separated by edema and loose connective tissue were evident. There was no evidence of central nuclear displacement. Fewer satellite cells were observed when compared with euthyroid muscle that may be indicative of a decreased proliferative activity in hypothyroid muscle. Possibly hypothyroidism depresses the ability of satellite cells to differentiate and fuse with existing fibers.

Ultrastructural examination revealed areas of disorganized myofibrils, Z-band streaming and intracytoplasmic inclusions closely associated with lipofuscin in the subsarcomembranous region. Thickening and lamination of the basement membrane, capillary endothelial proliferation, lumen occlusion and capillary degeneration was also apparent. Areas where the perivascular spaces were distended and filled with material of low electron density containing a cell infiltrate consisting of RBC’s and a variety of inflammatory cells were also apparent. Areas where the perivascular spaces were distended and filled with material of low electron density containing a cell infiltrate consisting of RBC’s and a variety of inflammatory cells were also apparent. There was no evidence of central nuclear displacement. Fewer satellite cells were observed when compared with euthyroid muscle that may be indicative of a decreased proliferative activity in hypothyroid muscle. Possibly hypothyroidism depresses the ability of satellite cells to differentiate and fuse with existing fibers.

CONCLUSION: This study indicates that specific alterations in skeletal muscle morphology precede outward symptoms of clinical hypothyroidism.

2833 Board #107 10:00 AM - 11:00 AM
ERK1/2 Phosphorylation in Human Skeletal Muscle of Elite and Recreationally Weighted Trained Men
Christopher A. Moore1, Andrew C. Fry1, Donald B. Thomas1, Aidar R. Gosmanov2, Matthew P. Harber1. 1University of Memphis, Memphis, TN. 2University of Tennessee-Memphis Health Sciences Center, Memphis, TN. 3Ball State University, Muncie, IN. Email: cmoore@cardlink.net

Muscle readily adapts to resistance exercise, but to date, little data is available linking the MAPK signaling pathways to these adaptations.

PURPOSE: This study was designed to quantify the relative activation via phosphorylation of the ERK1/2 MAPK pathway in human skeletal muscle in subjects with varied weight training backgrounds.

METHODS: Subjects were national and international caliber competitive weightlifters (WL, n=6), recreationally trained men (PL, n=5), recreationally trained men with 10 wks of circuit weight training experience (CWT, n=8), or sedentary controls (CON, n=3). All subjects provided muscle biopsies from the vastus lateralis muscle. Samples were lyed and ERK1,2 and phosphorylated ERK (ERK-P) were determined via SDS-PAGE and western blots using infrared markers. Data were analyzed via one-way ANOVA and LSD post-hoc tests.

RESULTS: WL & PL had less total ERK1/2 than CWT or CON (p<0.05; OD [arbitrary units]: WL=1385±202, PL=1957±142, CWT=4401±723, CON=3733±600, X±SE), which was a larger effect size observed compared to CON (Cohen’s D=0.64). Similar patterns were observed for ERK-P (OD).

WL=474±34, PL=1148±89, CWT=2284±372, CON=2228±178). When expressed as % of total ERK1/2 phosphorylated (%ERK-P), no significant differences were observed (%WL=39±3.7%, PL=59±3.4%, CWT=519±3.5%, CON=63±0.10.9%, although a large effect size was apparent for the WL when compared to CON (D=1.25).

CONCLUSIONS: Chronic weight training appears to influence resting levels of ERK1/2 MAPK pathway activity. Total ERK1/2 is modestly increased in recreationally trained individuals, while elite lifters with training histories of >10 yrs exhibit attenuated total ERK1/2. This response pattern suggests increased ERK1/2 as an initial response to resistance exercise, while long-term training experience and elite-level performances may result in either a more efficient ERK1/2 MAPK pathway, or simply reduced activation of this system. The absolute levels of ERK-P appear to simply reflect total ERK1/2 levels, with ERK-P decreasing with total ERK 1/2. In summary, elite lifters exhibit altered activation of the ERK1/2 MAPK pathway primarily by altering total ERK1/2 available. Additionally, elite lifters appear to require less ERK activation, perhaps reflective of a more efficient signal or less stimulus for ERK activation.

Funded by The University of Memphis FedEx Institute of Technology Research Investment Fund and the National Strength and Conditioning Association

2834 Board #108 8:00 AM - 9:00 AM
Influence of Post-Injury Ultrasound Treatments on Muscle Specific Insulin-Like Growth Factor (MGF)
Nicole M. McBreer1, Lawrence J. Drahan2, Mark A. Merrick2, Steven T. Devor, FACSM, 2 The Ohio State University, Columbus, OH. Email: nm1313@psu.edu

Non-thermal ultrasound (US) is commonly used in an attempt to improve skeletal muscle regeneration, although the efficacy of this practice is not firmly established. Researchers have investigated a number of growth factors involved in the activation of satellite cells during the regeneration process, however, muscle specific insulin-like growth factor (MGF) has not been examined in this context.

PURPOSE: To examine the influence of non-thermal ultrasound on markers on MGF following blunt trauma.

METHODS: Male Wistar rats received a bilateral contusion injury to superior aspect of the gastrocnemius (GTN) muscle via a drop mass technique. US administration (0.3 W/cm², continuous duty cycle) commenced 24-hr post-injury and was delivered 5minutes daily on 4 consecutive days. Rats received the US treatment on their left hindlimb, and the contralateral right hindlimb served as a non-US control. Dependent variables included muscle mass (g) and MGF mRNA as measured via real time RT PCR.

RESULTS: Ultrasound had no effect on muscle mass (F₂,28= 2.7, P = 0.11, 1-β = 36, η = 0.09). There was a main effect and post-hoc for ultrasound treatments (F₂,28= 6.61, P = 0.02, 1-β = 70, η = 0.19) and days post-injury (F₂,28= 7.3, P = 0.001, 1-β = 97, η = 0.44). Ultrasound treatments significantly decreased MGF mRNA levels compared with non-treated hind limb on day 1 (3.5 ± 2.7 vs. 5.8 ± 4.6); day 2 (0.9 ± 0.50 vs. 2.6 ± 2.2); and day 3 (0.7 ± 0.3 vs. 1.6 ± 1.4) post-injury. MGF values on day 1 post-injury were statistically greater than the values observed for days 3 and 4 after injury.

CONCLUSIONS: This study is the first to examine the specific effects of non-thermal ultrasound treatments on MGF following blunt trauma.

2835 Board #109 9:00 AM - 10:00 AM
Influence of Ageing on Monocarboxylate Transporter in Human Skeletal Muscle
William Richards, Moustafa Moustafa-Bayouni, Andy Gerken, Timothy E. Kirby, Kenneth W. Hinchcliff, Steven T. Devor, FACSM, The Ohio State University, Columbus, OH. Email: alohavri@hotmail.com

Isomers of the lactate transporter known as monocarboxylate transporter (MCT) are increased in skeletal muscle following vigorous exercise. To date, no studies have investigated how age influences the content of MCT1 and MCT4 in human skeletal muscle.

PURPOSE: To test the hypothesis that, compared with the vastus lateralis (VL) of untrained subjects, the VL of endurance trained athletes would exhibit an increase in the content of MCT1 and MCT4.

METHODS: Healthy male subjects (n=33) were recruited and assigned to one of six groups based on age and training status (young trained (YT), n=6, 23.2 ± 6.8 yr; young untrained (YU), n=6, 22.3 ± 2.9 yr; middle-aged trained (MAT), n=6, 46.3 ± 4.3 yr, middle-aged untrained (MAU), n=5, 44.6 ± 3.9 yr, senior trained (ST) n=6, 58.7 ± 3.4 yr, and senior untrained (SUT), n=5 58.8 ± 3.9 yr). The inclusion criteria required that all trained subjects spend at least 8 hours per week training above 60% of their VO2max, and that all untrained subjects have a self-reported average of less than 3 hours per week of moderate physical activity. Assignment to training status was supported by the completion of a VO2max test, by the wearing of an Actiheart™downloadable heart rate monitor to record daily heart rates, and by completing a physical activity questionnaire. Muscle biopsies of the VL were analyzed Western Blot for MCT1 and MCT4 content.

RESULTS: There were no significant age-related differences in MCT1 or MCT4 content (Y vs. MA vs. S, P > 0.05), and no significant differences in MCT1 or MCT4 content related to training status were observed (T vs. UT, P > 0.05), although a trend
toward decreased content of both isoforms was found in the untrained group when compared with the trained group.

CONCLUSION: The results of this first study investigating an effect of age and training status on monocarboxylate transporters in human skeletal muscle suggest that age does not influence the level of lactate transporter proteins MCT1 and MCT4.

Supported by a grant from The Gatorade Sports Science Institute.

MetHoDs: These bands consisted of dense fibrous connective tissue in which the sparse cells were ITB, together with the adjacent epicondyle were removed and prepared for routine anchoring the tract to the femur, and any bursae were noted. The distal part of the epicondyle as the former ‘rolls over’ the latter during knee movements. The purpose

PURpOSe: Aging and physical inactivity result in reduced fibrilinotic potential in the plasma as characterized by a decrease in IPA activity and/or an increase in PAI-1 activity. However, data examining the expression of these proteins in skeletal muscle is limited. The aim of this study was to determine the effect of age and aerobic training status on IPA and PAI-1 gene expression in skeletal muscle.

METHODS: Skeletal muscle IPA and PAI-1 gene expression was measured in four groups of males; 1) Young Aerobically Trained (YT; n = 7, VO₂ max = 70.1 ± 6.7), 2) Older Aerobically Trained (OT; n = 6, VO₂ max = 51.9 ± 3.7), 3) Young Aerobically Untrained (YU; n = 6, VO₂ max = 58.9 ± 8.4), 4) Older Aerobically untrained (OU; n = 6, VO₂ max = 39.6 ± 6.9). Muscle samples were obtained from the vastus lateralis muscle via a percutaneous muscle biopsy following a 12-hour fast. Total RNA was extracted from the muscle samples, and subject to reverse transcription. Skeletal muscle IPA and PAI-1 gene expression was then assessed by the polymerase chain reaction using gene specific primers.

RESULTS: Untrained males had significantly lower levels of IPA expression (2.7 x 10^-4 ± 0.7 x 10^-4 vs. 3.3 x 10^-4 ± 0.6 x 10^-4 pixels; p = 0.01) in skeletal muscle compared to trained males. A significant age by training status interaction was observed for skeletal muscle IPA expression, whereas, OU had significantly lower levels of skeletal muscle IPA expression (2.4 x 10^-3 ± 0.3 x 10^-3 vs. 3.7 x 10^-4 ± 4.9 x 10^-4 pixels; p = 0.05) when compared with older trained males. No significant differences were observed for either physical activity level or age for PAI-1 expression in skeletal muscle.

CONCLUSIONS: Higher levels of physical activity are associated with a higher level of IPA expression in skeletal muscle. Additionally, aerobic training appears to prevent an age-related decline in skeletal muscle expression of IPA.

CoNCLUsIoNs: Compared with older trained males. No significant differences were observed for either muscle tPA expression, whereas, OU had significantly lower levels of skeletal muscle males. A significant age by training status interaction was observed for skeletal muscle tPA and PAI-1 gene expression in four groups of males; 1) Young Aerobically Trained (YT; n= 7, VO₂ max = 58.9 ± 9.8), 2) Older Aerobically Trained (OT; n= 6, VO₂ max = 51.9 ± 3.7), 3) Young Aerobically Untrained (YU; n= 6, VO₂ max = 58.9 ± 8.4), 4) Older Aerobically untrained (OU; n= 6, VO₂ max = 39.6 ± 6.9). Muscle samples were obtained from the vastus lateralis muscle via a percutaneous muscle biopsy following a 12-hour fast. Total RNA was extracted from the muscle samples, and subject to reverse transcription. Skeletal muscle IPA and PAI-1 gene expression was then assessed by the polymerase chain reaction using gene specific primers.

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CONCLUSIONS: Higher levels of physical activity are associated with a higher level of IPA expression in skeletal muscle. Additionally, aerobic training appears to prevent an age-related decline in skeletal muscle expression of IPA.

G-17 Free Communication/Poster – Orthopedics: Connective and Articular Tissues
SATURDAY, JUNE 3, 2006 8:00 AM - 11:00 AM
ROOM: Hall B

2837 Board #111 8:00 AM - 9:00 AM The Structure of the Iliotibial Band in Relation to Iliotibial Band Friction Syndrome John Fairclough1, Koji Hayashi2, Hechmi H. Touni3, Kathleen Lyons4, Graeme Bydder2, Nicola Phillips2, Thomas M. Best5, FACSM®, Mike Benjamin2, 1UWIC, Cardiff, United Kingdom, 2Cardiff University, Cardiff, United Kingdom, 3University of Wales, Cardiff, United Kingdom, 4University of California, CA, 5Ohio University, Ohio, OH. (Sponsor: Best TM, FACSM®)
Email: fairoak@btopenworld.com

PURPOSE: Iliotibial band (ITB) friction syndrome is an overuse injury well recognised by sports medicine practitioners as a common cause of lateral knee pain. It is thought to result from repetitive friction between the ITB and the lateral femoral epicondyle as the former ‘rolls over’ the latter during knee movements. The purpose of this study was to re-evaluate the clinical anatomy of the region which challenges the common view that the ITB moves in an anterior-posterior direction over the lateral femoral epicondyle and that ITB syndrome is thus a ‘friction syndrome’.

METHODS: Gross anatomical studies were conducted on the region of the lateral epicondyle in fifteen cadavers. The presence of fat deep to the ITB, fibrous connections anchoring the tract to the femur, and any bursae were noted. The distal part of the ITB, together with the adjacent epicondyle were removed and prepared for routine histology. Magnetic resonance imaging of six asymptomatic volunteers and two athletes with clinical signs of ITB syndrome was conducted using a 1.5T scanner at both 30 degrees of flexion and full extension.

RESULTS: No bursa was seen in any MR scans or dissected cadavers. The histological sections showed that the ITB was constantly anchored to the distal femur by fibrous bands, associated with a layer of richly-nerveated and vascularised fat. These bands consisted of dense fibrous connective tissue in which the sparse cells were elongate fibroblasts. The MR scans of the healthy volunteers showed that ITB was compressed against the lateral femoral epicondyle at 30 degrees of knee flexion and moved laterally in full extension. The MR scans of the athletes demonstrated marked signal changes in the fat immediately deep to the ITB, in the region of the fibrous bands.

CONCLUSION: The firm distal anchorage of the ITB in the region associated with its friction syndrome prohibits significant anterior-posterior movement. Thus, we suggest that ITB syndrome may not be the consequence of friction of the tract over the lateral femoral epicondyle but of compression of the tract against a layer of highly innervated fat that intervenes between it and the epicondyle.

CoNCLUsIoN: Running induces anterior knee laxity no matter what was the direction.

2839 Board #114 8:00 AM - 9:00 AM Gender, Bilateral Symmetry, and the Knee Extensor Mechanism Mark D. Tillman1, Jeff T. Wight2, Braden Fichter3, John W. Chow4, FACSM®, Univ. of Florida, Gainesville, FL.
Email: tillmanj@hsp.ufl.edu

Females are substantially more susceptible than males to acute noncontact injury of the anterior cruciate ligament (ACL). Although the cause of disparity in injury rate is not fully understood, numerous extrinsic and intrinsic factors are believed to be associated with ACL injury. We examined knee extensor moment function in male and female athletes to determine the effective moment arm of the quadriceps force, patellar tendon length, patella height, patellar mechanism and patellar tendon angles, and tibiofibial and patellofemoral joint spaces.

RESULTS: Separate three-way ANOVA (gender x side x angle) with repeated measures on the last two factors revealed several main effects (p < 0.05). More specifically, ten of the twelve variables tested varied with knee flexion angle, four variables varied between right and left legs, and 3 varied between males and females. Interestingly, females exhibited decreased patella tendon angles, increased patellofemoral joint space, and increased patella tendon length.

CONCLUSION: Our observations may help explain the increased rate of injury in the athletic female population and provide justification for future studies involving the knee extensor mechanism with continued focus on two dimensional radiograph digitizing methods. The absence of a gender difference in the effective moment
arm may suggest that the greater knee extension strength in males is due to a greater quadriceps strength while a decrease in patella tendon angle will lower the shear component of the patella tenden force and decrease the potential stress on ACL.

CONCLUSIONS: It was concluded that cervical spine BMD values were correlated with BMD values at the spine, hip and total body. Thus, women with osteopenia or osteoporosis at standard regional BMD sites should also be considered to have low cervical BMD. Bone density should be assessed in cervical patients as part of their medical evaluation.

**Significant p<.01.**

REFERENCES:

study in eight European countries. In each of these countries, PA was measured in a random sample of 600 persons, using a combination of a new pre-harmonised set of questions (IPAO) and a historical set of country specific questions. Using the database a demo version of CAT has been developed.

RESULTS: This project showed that all assumptions in RC are explicit. The conversion process takes small steps, is fully repeatable, and leads to verifiable quantitative results. Application of the method helps also to evade some common pitfalls when dealing with cross-cultural comparability. We succeeded to express all scores from the EUPASS data on one common scale. For instance, the UK turned out to have the lowest mean of activity, 0.7 standard deviations (SD) below the highest mean of Germany. The Netherlands also have a quite low mean, almost 0.7 SD below Germany. Through all countries, young people turn out to be the more physically active than older people, and men than women. Also, people with overweight and bad health were less physically active. Using the Demo CAT is was possible to give a reliable estimation of the individual physical activity level using only 8 questions about PA.

CONCLUSIONS: RC is a very useful method in international comparison of PA data. Currently, we explore the possibilities of using the conversion key to data sets other than the EUPASS calibration data set. In addition, the availability of a conversion key opens up new possibilities in Computer Adapted Testing.

2044  Board #119  10:00 AM - 11:00 AM
Does Reactivity Occur When Objectively Measuring Physical Activity in Free-living Young Adults?
Timothy K. Behrens, Mary K. Dinger, FACSM. 1University of Utah, Salt Lake City, UT; 2University of Oklahoma, Norman, OK.

Activity monitors such as accelerometers and pedometers allow researchers to objectively monitor physical activity (PA) behavior of free-living individuals. However, if study participants change their behavior due to their knowledge that they are being monitored (i.e., reactivity), error can occur. This error may be especially egregious if PA is an outcome measure of the study.

PURPOSE: To examine whether young adults changed their PA behavior when wearing activity monitors (i.e., reactivity).

METHODS: One-hundred nineteen young adults (Males: n = 32, age: 20.9 ± 1.3 yr, BMI: 27.3 ± 4.8 kg/m2; Females: n = 87, age: 20.8 ± 1.6 yr, BMI: 22.7 ± 2.9 kg/m2) were recruited to participate in this cross-sectional, descriptive study. Participants' PA behavior was systematically recorded via accelerometer for two consecutive weeks. During week 1 participants wore an accelerometer at the waist. During week 2 participants wore an accelerometer and an unsealed pedometer at the waist. Counts/24-h from the accelerometer were examined over the two-week study period. Descriptive statistics and 2-factor repeated measures ANOVAs were calculated.

RESULTS: There were significant differences in counts/24-h by day of the study (P < 0.0001) during both weeks of monitoring. However, subsequent investigation by day of the week revealed that these differences were not because of reactivity. Rather, these differences were due to changes in participants' PA behavior by weekdays and weekend days, with more activity accrued on weekdays than on weekend days (P < 0.0001). With respect to gender, males were more active than females during both weeks of monitoring (P < 0.05), but daily PA behavior between the genders followed a similar pattern.

CONCLUSION: Reactivity to accelerometers and unsealed pedometers did not occur in this sample. Further, males were more active than females, and both genders followed similar daily PA patterns. These findings are important to researchers assessing PA with accelerometers and pedometers, and may allow for interpretation of study results with increased confidence.

2045  Board #120  8:00 AM - 9:00 AM
Differences between Subjective and Objective Observations of Physical Activity for College Females
Danielle D. Wadsworth, 1Jeffrey S. Hallam. 1Auburn University; Auburn University, AL. 2The University of Mississippi, University, MS. (Sponsor: Dr. Peter Grandjean, FACSM)

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PURPOSE: Inactive individuals are the primary target of physical activity interventions and self-report measures are often used to assess baseline activity levels. Thus, it is important to identify the strengths and limitations of self-report measures in regard to measuring activity levels of inactive individuals. The International Physical Activity Recall Questionnaire (IPAO) has not been validated for inactive college-aged females. Therefore, the purpose of this study was to examine differences between subjective and objective measures of moderate physical activity (MPA) and vigorous physical activity (VPA) for inactive college females.

METHODS: Subjects consisted of 91 college-aged females who were not engaging in a regular schedule of exercise within the past 30 days. Objective physical activity was measured with the BodyMedia SenseWear Pro Armband (BSWA) for 7 consecutive days. The BSPA is a continuous body monitoring device that measures physical activity and energy expenditure. Subjective physical activity was measured with the IPAQ. The IPAQ was completed as an online questionnaire and concurred with the 7 days of objective monitoring. Physical activity was measured as days, minutes and MTP/week of MPA and VPA for both the IPAQ and BSPA. Frequency of physical activity was defined as accumulating a minimum of 30 minutes of MPA or 20 minutes of VPA per day. Bouts of physical activity (minimum of 10 minutes) were summed for the week from the BSPA (MTP = 3.0-5.9 METs and VPA ≥ 6.0 METs). Weekly minutes were calculated from the IPAQ by multiplying the days per week spent in MPA or VPA times the minutes per day spent in MPA or VPA. MTP/min/week were calculated by multiplying the median IPAQ MET levels (MPA 4.0 METs and VPA 8.0 METs) by the number of minutes per week in MPA and VPA. Paired t-tests examined differences between the two measures. An alpha level of .05 was adjusted with the Bonferroni correction a priori. Pearson-Product moment correlations assessed the relationship between the two measures. Alpha level was set at .05 a priori. Data were analyzed only on subjects who wore the BSPA for seven consecutive days.

RESULTS: Eighteen subjects were removed from analysis due to incomplete BSPA data (N=73). The results showed significant differences between the IPAQ and the BSPA for days, minutes and MTP/week of MPA and VPA (p<.000). Correlations between the IPAQ and the BSPA for days, minutes and MTP/week of MPA and VPA were not significant (p>.005).

CONCLUSIONS: Self-report data underestimated MPA and overestimated VPA when compared to an objective measure.
experiment, furthermore, correlated significantly (r=0.954, p<0.001). -2.3 +/- 12.9 %. The physical activity time detected by NL-1000 in the first and second for assessing the time spent in the moderate to vigorous intensity physical activity was

results:

consumption was measured during the last minute of each 5 minute stage and was

CoNCLUsIoN:

results are 0.80 (p< 0.000), 0.75 (p<0.000), and 0.77 (p<0.000) respectively.

DLW result and the value calculated from the measured RMR , p=0.01, while the TEE

2.59, 13.73 SD 2.32 based on RMR values measured or calculated from the predictive equations respectively. Testing the

MetHoDs:

Participants (N = 196; Mean age = 46.1±9.8 years; 23 males and 173 females, Mean duration of MS = 9.0±7.1 years) with an established definite diagnosis of MS completed 2 self-report measures of physical activity (GLTEQ and IPAQ) and then wore a pedometer (Yamax SW-200) and a single-axis accelerometer (ActiGraph) during the waking hours of a 7-day period.

RESULTS: Repeated measures ANOVA indicated that there was not a statistically significant difference among days for the pedometer (r = .12) and the accelerometer (r = .15). Intra-class correlation (ICC) analyses indicated that the 7-days of monitoring yielded ICC estimates of 0.9 for both the pedometer and accelerometer, and a minimum of 3 days is necessary to achieve a reliability of .80 for both the pedometer and accelerometer. Pearson correlation analyses indicated that there was a strong correlation between scores from the pedometer and accelerometer (r = .82); a moderate-to-strong correlation between scores from the GLTEQ and IPAQ (r = .59); and moderate-to-strong correlations between scores from the objective and self-report measures (range of r = .46-.53).

CONCLUSION: This study provides evidence for scores from self-report and objective measures as valid and reliable measures of physical activity among those with MS.
MEDICINE & SCIENCE IN SPORTS & EXERCISE®

2851 Board #126 8:00 AM - 9:00 AM
Physical Activity Level among Healthy Japanese Adults Estimated by the Doubly Labeled Water Method
Kazuko Ishikawa-Takata, Hoby Hasima Rafamantantsoa, Hirokazu Okazaki, Shigeo Tanaka, Satoshi Sasaki, Hitomi Okubo, Izumi Tabata, FACSM. National Institute of Health and Nutrition, Japan, Tokyo, Japan. (Sponsor: Izumi Tabata, FACSM)
Email: kazu@nih.go.jp

Background: Measurements of total energy expenditure (TEE) and the development of simple questionnaire to determine the physical activity level are required for estimation of the energy requirement in dietary reference intakes for Japanese.

PURPOSE: To measure TEE among healthy Japanese adults, and evaluate the predictability of the International Physical Activity Questionnaire (IPAQ) and the classification of intensity of daily activity (IDA) used in the National Nutrition Survey in Japan.

METHODS: Healthy Japanese men (n=74) and women (n=76) were recruited from four areas in Japan. TEE was measured during a 14-day period with the doubly labeled water. Physical activity status was assessed using the short-version of IPAQ and the IDA in the last 7 days.

RESULTS: TEE and PAL (TEE/basal metabolic rate) were 2,619±406 and 1.74±0.22 for men and 2,032±316 and 1.71±0.22 for women, respectively. There was no significant difference by sex, age and area. IPAQ and IDA distinguished significantly most active groups from other groups. However, PAL was not significantly different among other less active groups.

CONCLUSIONS: The average PAL of healthy Japanese population is around 1.7. Highly active population can be identified by simple questionnaires. However, IPAQ and IDA could not classify the sedentary and moderate active subjects.

2852 Board #127 9:00 AM - 10:00 AM
Relationships of Heart Rate and Movement with Physical Activity Intensity: Comparison of Multiple Levels of Individual Calibration
Soren Brage1, Niels Brage2, Ulf Ekholm1, Paul Franks1, Karsten Froberg1, Nicholas Wareham1. 1MRC Epidemiology Unit, Cambridge, United Kingdom. 2Institute of Sports Science & Clinical Biomechanics, University of Southern Denmark, Odense, Denmark.
Email: soren.brage@mrc-epid.cam.ac.uk

Combining accelerometry (ACC) with heart rate (HR) monitoring may improve the precision of physical activity intensity (PAI) measurement, compared with either method used alone. Considerable between-individual variation exists in ACC/HR-PAI relationships, which may be reduced by individual calibration. However, most existing methods are not suitable for use in large populations.

PURPOSE: To evaluate the precision of different procedures for individual calibration against a criterion calibration procedure.

METHODS: A total of 75 participants (mean (SD): 32.7 (8.4) yrs; 1.71 (0.11) m; 70.3 (14.4) kg) performed a ramp treadmill walking-running test with continuous measurement of PAI by indirect calorimetry (criterion calibration procedure). ACC along the longitudinal axis of the trunk and HR were measured simultaneously. Alternative calibration procedures included treadmill testing without direct measurement of PAI, a sub-maximal step test with and without direct PAI measurement, and non-exercise calibration using sleeping HR, resting HR variability, hemoglobin concentration, and sitting stroke volume obtained by inert gas rebreathing. The model was trained using all exercise data from (N - 1) subjects and then evaluated using the exercise data from the excluded subject; the process was repeated for all subjects. The model was trained using a (fixed-structure) linear predictive model for each individual and then to evaluate model generalization (HRR) followed by HR within 10% (HR<100%) was categorized as non-exercising.

RESULTS: Standard errors of the estimates (SEE) for the criterion ACC and HR models were 78 (R2=0.87) and 35.3 min kg1 (R2=0.97), respectively. Errors increased 10% and 40%, respectively, for the calibration procedure using a treadmill test without measuring PAI. Step test calibration procedures explained 83% (for ACC) and 90% (for HR) of the variance (SEE=6.8 J min1 kg1), irrespective of whether PAI measurement during the step test was included. Non-exercise calibration procedures explained ~80% of the variance in PAI (SEE=93 J min1 kg1). By contrast to hemoglobin, including a measure of sitting stroke volume increased the explained variance in PAI, especially in the model utilizing the step test without direct PAI measurement. Combining ACC with HR improved measurement precision at the extremes of the PAI spectrum.

CONCLUSIONS: A high degree of the between-individual variance in the ACC/HR-PAI relationships can be accounted for with simple calibration procedures, feasible for use in large epidemiological studies.

2853 Board #128 10:00 AM - 11:00 AM
Effect of Lead Placement on Activity Measurement, and Energy Expenditure Prediction Using the Actiheart® Logger
Megan H. Neumann, Megan P. Rothney, Kong Y. Chen. Vanderbilt University Medical Center, Nashville, TN.
Email: megan.neumann@vanderbilt.edu

M. Rothney presenting

The Actiheart® logger (Minimitter, Bend, OR) is a new physical activity monitor which simultaneously records heart rate (HR) and acceleration. These variables are used to predict energy expenditure (EE). Its manufacturer suggests two different electrode placement options: Lead 1 electrode site requires that the primary sensor is placed near the center of the sternum, centered on the arms and with the left lead placed along the mid-clavicular line. Lead II electrode site requires that the main sensor be placed immediately to the left of the sternum at the fourth intercostal space and the left lead is placed at the fifth intercostal space in the mid-clavicular line.

PURPOSE: To determine the agreements in measurement of HR, activity counts, and EE between Lead I and Lead II electrode placement sites.

METHODS: 13 healthy volunteers (7 females and 6 males, age 21.3±7.2 years with BMI 23.9±2.4 kg/m2) participated in an exercise protocol that involved walking and stair climbing (about 2 hours). Each subject was outfitted with two Actiheart® loggers positioned at the Lead I and Lead II sites for synchronous data collection.

RESULTS: Although total activity counts were similar between Lead I and Lead II as a group (6.7±4.8% disagreement, P<0.05), a large range existed (41.217%). Measured HR was similar in 12 subjects (1.2±1.5%, 92-114%) with one subject losing significant HR data on Lead I. The predicted EE were similar as a group (3.3±2.8%) but again with a large range (41.1-141%). In all subjects where activity counts were significantly different, EE was also different. In all cases but one, if HR was different, EE was also different. In the case where HR was different, but not counts, EE was not significantly different (P=0.71).

CONCLUSIONS: Significant placement effects were found. In order to standardize data across subjects a single Actiheart® lead placement should be adopted within a specific protocol. To minimize potential rotational movement of the main sensor, it may be necessary to secure it with tape.

2854 Board #129 8:00 AM - 9:00 AM
Validation Of An Integrated Heart Rate/Physical Activity Monitor
Glenn A. Gaesser, FACSM1; Brian R. Clarke1, B. Eugene Parker, Jr.1; Aaron B. Olowitz1, Neal T. Richardson1; Jason R. Blossinger2; Brandon J. Sawyer1; Christopher K. Davis2; Gregory J. Welk5; Brian A. Irving3; 1University of Virginia, Charlottesville, VA; 2Barron Associates, Inc., Charlottesville, VA; 3Iowa State University, Ames, IA.
Email: gga2@virginia.edu

PURPOSE: To validate a novel physical activity monitor (PAM-III) with the ability to collect inertial sensor and heart rate measurement data simultaneously in a single, discreet, low-profile device.

METHODS: 19 healthy males (age 26.9±6.4 yr.; ht: 179.7±7.2 cm; wt: 79.5±10.4 kg; % fat: 16.9±7.4%) and 25 healthy females (age 24.8±8.4 yr.; ht: 166.1±5.2 cm; wt: 62.2±8.9 kg; % fat: 25.9±11.4%) underwent two separate exercise sessions on different days that consisted of treadmill walking on a level grade at 2.0, 3.0, and 4.0 mph, and running at 6.0 mph. Subjects exercised for 5 min at each speed, with 3 min rest periods between each bout. Pulmonary ventilation and gas exchange were measured breath-to-breath with a Sensormedics VmaxST portable metabolic measurement system. Peak aerobic capacity was assessed during an inclined walking treadmill test to volitional fatigue. During each exercise session subjects wore the PAM-III device (waistband, heart rate monitored via surface electrodes) and a Polar heart rate monitor.

RESULTS: An n-fold cross-validation technique was used to establish the coefficients of a (fixed-structure) linear predictive model for each individual and then to evaluate model performance on unseen data. In particular, the training dataset for each subject excluded a single 30-sec exercise epoch, which was then used to evaluate the model; this process was repeated for all 30-sec exercise epochs for that subject and results accumulated over all subjects. Model inputs were heart rate, rotational kinetic energy, and acceleration vector magnitude and activity counts; model output was total energy expenditure (kcal/min). Data from the VmaxST were 30-second averages. This model produced a mean r2 across all individuals of 0.94 (range = 0.82 to 0.98) and a pooled r2 of 0.95. The mean RMS error across all subjects was 0.76 kcal/min. The second model was a “generic” linear model synthesized across all subjects using an n-fold cross-validation technique. The model was trained using all exercise data from (N - 1) subjects and then evaluated using the exercise data from the excluded subject; the process was repeated for all subjects. Model inputs included heart rate, rotational kinetic energy, acceleration vector magnitude activity counts, height, and weight; the output was total energy expenditure (kcal/min). This model produced a mean r2 across all individuals of 0.91 (range = 0.76 to 0.98) and a pooled r2 of 0.76. The mean RMS error across all subjects was 1.81 kcal/min.

CONCLUSIONS: The PAM-III integrated heart rate/physical activity monitor provides very good estimates of energy expenditure during walking and jogging. Supported by R21 CA112323-01A1 and an NIH grant to the GCRC RR00847

2855 Board #130 9:00 AM - 10:00 AM
Validity and Reliability of an Electronic Pedometer in a Laboratory Setting
J. Andrew Doyle1, David A. Dennison2, Michael S. Green3, Benjamin T. Corona1, Andrew Kimball1. 1Georgia State University, Atlanta, GA; 2HL Science Foundation, Atlanta, GA. Email: adoyle@gsu.edu

PURPOSE: The purpose of this study was to determine the validity and reliability of step counting using the Omron HJ-700IT electronic pedometer.

METHODS: Twenty subjects (10 males, 10 females) completed 2 trials of treadmill
walking (age = 35.0 ± 10.8 y, height = 1.72 ± 0.10 m, weight = 68.5 ± 13.9 kg, body fat = 20.7 ± 9.8%, BMI = 23.1 ± 3.5 kg/m²). Subjects walked for 30 min; 15 min at 67 m/min and 15 min at 93.8 m/min. Steps were counted manually as the criterion measure. Three Omron HJ-700T pedometers were carried in random order (shirt pocket, belt clip on the hip, and pants pocket). A Yamax Digi-Walker SW-200 was carried on the belt at the right hip.

RESULTS: A two-way ANOVA with repeated measures on Trial indicated no significant difference in total steps counted by the HJ-700T pedometer from the manually counted steps between repeated trials or at any of the three carrying locations. There was a significant difference in steps counted by the Yamax pedometer (P<0.001) compared to counted steps. Pearson’s correlation and linear regression of pooled data from Trial 1 and 2 revealed correlations and SEE to the criterion variable (counted steps) for the Omron HJ-700T of: Shirt (0.991, 27.1), Belt (0.988, 30.5), Pants (0.938, 57.9), and Yamax (0.725, 139.9). Percent error for pedometer-counted steps for the Omron HJ-700T in the Shirt, Belt, and Pants location were 0.04, 0.15, and 0.67%, respectively compared to -4.21% for the Yamax SW-200 over an average of 3305 ± 197 steps walked.

CONCLUSIONS: In conclusion, the Omron HJ-700T is a highly accurate and reliable pedometer for counting steps during 30 minutes of walking, and is accurate when carried in a shirt pocket, on a belt clip at the hip, and in a pants pocket.

### Table 1

<table>
<thead>
<tr>
<th>Clothing Style</th>
<th>Denim</th>
<th>Dress</th>
<th>Belt</th>
<th>Elastic</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW</td>
<td>5.5 ± 2.6%</td>
<td>3.6 ± 1.8%</td>
<td>3.6 ± 1.7%</td>
<td>3.4 ± 3.1%</td>
</tr>
<tr>
<td>NL</td>
<td>0.2 ± 0.2%</td>
<td>0.0 ± 0.4%</td>
<td>0.1 ± 0.3%</td>
<td>0.7 ± 0.3%</td>
</tr>
</tbody>
</table>

Values are means ± SEM

CONCLUSION: The results of this study suggest that clothing did not have a significant effect on step counts with either device while walking at 3 mph.

Pedometer Longevity - How Long Will a Pedometer Maintain Step Counting Accuracy?

Thomas F. Manning, Janelle L. Loro, James M. McKenzie, Alin Moss, Shayla L. Swanson, Daniel P. Heil, FACSM, Montana State University, Bozeman, MT.

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PURPOSE: A previous pilot study established the ability of a testing procedure for determining the longevity of pedometers (McKenzie et al 2005; MSSE 37(5):S117). Longevity is the ability of a pedometer to maintain step counting accuracy with repeated use. The present study was designed to expand these findings by testing a broader range of brands over a much longer time period and include accelerometer-based pedometers.

METHODS: 16 brands of new pedometers (n = 10 each brand) were tested including two accelerometer-based brands. To simulate habitual walking activities, pedometers were mounted to a modified benchtop orbital shaker that oscillated at a rate approximating an 80.4 m/s (3.0 MPH) walking speed. Each pedometer brand was “walked” on the shaker table for 75,000-100,000 steps before being tested for accuracy by a lab technician walking on a treadmill at 80.4 m/s for exactly 50 steps on 3 successive trials. Actual step count for each trial (50 steps) was verified using a hand tally counter while the pedometer step count was recorded and reset to zero between trials. A pedometer “failed” when the average pedometer step count (over the 3 trials) differed from the actual step count by >5 steps. Non-failed pedometers were retested in the same manner just described until a failure was recorded or approximately 4.5 million steps had been accumulated. Dependent variables included the number of steps accumulated to testing failure for individual pedometers (STEP < 4 mi) as well as the number of steps accumulated until the first test failure within a brand (STEP < 4 mi). Data were evaluated using a 1-factor ANOVA at the 0.05 alpha level.

RESULTS: STEP < 4 mi for 5 brands exceeded 4.5 million steps (Mann-Whitney U = 4.40 ± 0.07 to 4.55 ± 0.01), while 5 other brands accumulated >4 mi steps (3.72 ± 0.04 to 1.00 ± 0.04) and the last 6 brands averaged >0.9 mi steps. Despite the large range of mean values, STEP < 4 mi differed significantly only between those brands exceeding 4.1 mi steps and those with <0.9 mi steps (p<0.05). In contrast, STEP < 4 mi was significantly highest for 3 brands (3.43 ± 0.004 to 4.55 ± 0.004 mi steps; p<0.05). STEP < 4 mi for the 9 other brands were significantly lower than all other brands (p<0.02; steps = p<0.05). The accelerometer-based pedometers outperformed all other brands.

CONCLUSIONS: Pedometer longevity is highly variable among pedometers commonly used by researchers, clinicians, and the public. In addition to validity and reliability, pedometer longevity may be an important variable to consider for long-term physical activity interventions.

Methodological Considerations for Quantifying Pedometer-Determined Physical Activity

Nicole L. Rogers1, Carolyn R. Ahlers-Schmid2, Rosalée E. Zackula2

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FWomen

FWomen

An inexpensive and practical approach to systematically track daily physical activity (PA) is via a pedometer (PED). Recently, researchers have utilized PEDs to quantify PA levels. Steps are used to quantify and prescribe PA and to compare steps with...
PURPOSE: The purpose of this study was to examine the methodology for quantifying PED-determined PA, including the 8% of days required to characterize daily PA, differences between weekday and weekend PA, and given limited data collection parameters, when in days should be monitored.

METHODS: After screening for medical conditions precluding safe participation in a walking program, 163 subjects (56 males; n = 98, 43.0±10.1 yr; female; n = 65; 40.5±9.3 yr) received a NL-2000 PED to track daily steps for 2 consecutive weeks. Data were collected as part of a PED intervention to increase daily PA. PA was instructed to maintain their normal PA. PEDs were “locked” with lock-ties to prevent re-activity.

RESULTS: Initial analysis revealed non-normality in the step data (W = 0.87, p < 0.001). As assumptions for parametric procedures were not met, nonparametric tests were used. Wilcoxon Signed Ranks, Friedman, and Sign Z. No difference was indicated between Wk1 and Wk2 step averages nor between daily steps within Wk1 and Wk2. There was no difference when days were matched across weeks (Monday of Wk1 vs Monday of Wk2) except on Thursdays. The same procedure was performed to examine gender effects. Analyses did not identify difference between days of the week by gender nor between week averages by gender. However, analyses on matched days across weeks revealed the significant difference on Thursdays between Wk1 and Wk2 was only found in females and not males.

CONCLUSION: It is important to note that step data were not normally distributed, introducing statistical treatment of step data. Excluding Wk2's Thursday steps, there was no difference in steps between weeks or days of the week for males or females. This indicates the sample was consistent in their PA behavior over a 2wk period. This evidence was indicated between Wk1 and Wk2. Hence, in this sample, PA monitoring limited to a few days of a week should result in an accurate week average. This is in contrast to previous findings where researchers have noted a "weekend" and "weekday" effect. The generalizability of these findings are limited to mid-western sedentary professionals with an average age of 42 yr and should be interpreted with caution. Factors such as PA level, age, profession, and weather may all impact step consistency.

2860 Board #135 8:00 AM - 9:00 AM
Invariance of Omron-BI Pedometers in Free-Living: A Preliminary Study
Miyoung Lee, Miye Kim, Weimo Zhu, FACSM. University of Illinois at Urbana-Champaign, Urbana, IL.
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The Omron pedometer (BI) can be worn at different positions and still provide a count. However, it has not been validated in free-living conditions.

PURPOSE: To determine position invariance of the Omron BI pedometer in free-living conditions by comparing recorded steps with actual step count.

METHODS: Twelve healthy male (M±SD of Height, Weight & BMI: 178.65±5.89 cm, 80.40±5.42 kg) were monitored. PA monitoring limited to a few days of a week should result in an accurate week average. This is in contrast to previous findings where researchers have noted a "weekend" and "weekday" effect. The generalizability of these findings are limited to mid-western sedentary professionals with an average age of 42 yr and should be interpreted with caution. Factors such as PA level, age, profession, and weather may all impact step consistency.

CONCLUSION: Invariance of Omron BI pedometers can be achieved in free-living conditions by taking steps recorded at the10 positions ranged from Pkt L: 66.40±21.97 to Wst R: 80.40±5.42, with SW Wst R: 69.00±21.13 and AMP: 44.05±26.07. No statistical difference was found among positions (F = 0.34, p > 0.05). However, a slight increased error when coming down the stairs (e.g., Wst back R increased to 5% from 3% at climbing up), but no difference among positions (F = 2.50, p > 0.05). On free-living walking, the actual steps counted were 1702.50±146.79 and the 10 position recordings ranged from Pkt R: 1674.50±218.71 to Wst R: 1726.45±219.25, with SW Wst R: 1718.10±165.78, SW AMP: 1648.75±234.05 and AMP: 1665.60±206.47. The absolute errors ranged from 0% to 3% except for Pkt R (6%) and AMP (4%). Again, there was no statistical difference among positions (F = 1.70, p > 0.05). The errors decreased (e.g., shift Pkt 3% to 1%) after six outliers were removed.

CONCLUSION: The Omron BI pedometer can accurately count steps at various positions in free-living conditions except for pant pockets and back pack (only positions when claiming stairs) positions.

Acknowledgement: Study sponsored by a research grant from Omron Healthcare, Inc.

2861 Board #136 9:00 AM - 10:00 AM
The Effect of Height on the Validity of Three Accelerometer Models
Dale Estiger, Michelle Stone, Mark Tremblay, FACSM. 1University of Saskatchewan, Saskatchewan, SK, Canada. 2University of Exeter, Exeter, United Kingdom.
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Movement/step frequency has been shown (at least in one accelerometer model) to influence the prediction of accelerometer-based energy expenditure (EE). Uniaxial accelerometers are also limited in their ability to distinguish the intensity of faster running speeds and their data outputs may be confounded by a frequency (i.e., step) dependent filtering limitation within the device. These observations have called into question the validity of accelerometers for physical activity monitoring, particularly among individuals of varying height and consequently stride frequency.

PURPOSE: To determine whether, or the degree to which, the concurrent validity of three popular uniaxial accelerometer models (Actical, Actigraph, and RT3) are affected by differences in subject height.

METHODS: Eighty six participants age 8 to 40 (17.6 ± 8.0) performed three 20-minute bouts of treadmill activity (speed = 1 × walk; 2 × walk/jog; 3 × run) ranging in speed from 4 to 12 km/hr. Height quintiles (1=125.5-138.7 cm, 2=139.0-155.3 cm, 3=156-166.2 cm, 4=166.8-179.6 cm, 5=181.0-196.1 cm) were created to investigate differences between accelerometer predicted EE, and the respiratory gas analysis across speed categories. Validity coefficients between models and within height categories across speed were determined to assess which models provided the most valid EE estimates for individuals of different heights and whether validity changed at different speeds. All analyses were performed using ANOVA and a Bonferroni correction for multiple comparisons (p<0.05).

RESULTS: All speeds considered, each model provided the most valid estimate of EE for height categories 3 and 4 (R2 = 0.54 ± 0.86). For the tallest individuals, validity coefficients from all models were weak during treadmill running, particularly among individuals of varying height and consequently stride frequency.

CONCLUSIONS: When using accelerometry to estimate EE, validity may be affected by changes in treadmill speed and individual differences in height. These factors should be considered when using accelerometry to predict EE or time spent in physical activity, especially in groups with varied heights.

Funded in part by Statistics Canada

2862 Board #137 10:00 AM - 11:00 AM
Preliminary Examination of Triaxial Accelerometer Activity Counts with Pregnant Women
Jennifer M. DiNallo, Guy C. LeMasurier, Danielle Symons Downes, Pennsylvania State University, University Park, PA.
Email: jmd422@psu.edu

Research examining pregnant women’s physical activity behaviors with objective measures is scant; most studies have relied on self-report assessments. To date, no studies have examined accelerometer performance when monitoring pregnant women.

PURPOSE: To examine RT3 triaxial accelerometer output among pregnant women under controlled conditions.

METHODS: Thirty-six pregnant women wore the RT3 accelerometer during treadmill walking at low-to-moderate intensity for 20 min at 20 and 32 weeks gestation. During both visits women walked at 2.0 miles/h (0% grade) for the first 5 min (Acsm, 2006), and then at a self- selected speed for the last 15 min (Pivamik et al., 2002). Mean activity counts for vectors X, Y, and Z, and the average vector magnitude (AVM) were calculated based on the activity counts at min 4 and 5. Oxygen consumption (VO2, ml/kg/min”) was measured via indirect calorimetry. VO2, based on min 4 and 5 were selected to correspond with activity data and to ensure participants reached steady state. A univariate ANOVA, with Bonferroni correction, was used to examine activity counts with vector (X, Y, Z, or AVM) and within height categories across speed were determined to assess which models provided the most valid estimate of EE (R2 = 0.58).

CONCLUSIONS: When using accelerometry to estimate EE, validity may be affected by changes in treadmill speed and individual differences in height. These factors should be considered when using accelerometry to predict EE or time spent in physical activity, especially in groups with varied heights.

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in any of the three planes. However, tilt of the RT3 was not measured in this study and limits interpretation of the results. Determining whether activity count differences are due to gait adjustments made by pregnant women at a later stage of gestation, or attenuation of activity counts due to device tilt, requires further investigation. Future research is needed to understand the sources of accelerometry variability with pregnant women to better understand the association between women’s PA and maternal/fetal outcomes.

2863 Board #138 8:00 AM - 9:00 AM
Validity of a Novel Portable Physical Activity Monitor with a 3D-Accelerometer and a Barometer
Ryoichi Nagatomi1, Xiumin Zhang1, Hitetaka Yamaguchi2, Mitsuhiro Okutsu3, Kenji Ishii2, Akihiro Suzuki4, Yasuaki Ohtaki5, Koki Sagawa2, Hiroki Inooka3, Tohoku University Graduate School of Medicine, Sendai, Japan; 3Kihon International University, Takahashi, Japan; 4Waseda University, Tokyo, Japan; 5Tohoku University School of Engineering, Sendai, Japan. 1Instruments Technology Research Co. Ltd., Sendai, Japan; 2Hiroasaki University Faculty of Science and Technology, Hiroasaki, Japan.

BACKGROUND: Quantitative assessment of physical activity is important in epidemiological and clinical research related to lifestyle-related diseases such as obesity, diabetes, coronary heart disease, hypertension, and hyperlipidemia. We developed a novel portable device with a 3D accelerometer and a barometer, Intelligent Calorie Counter (ICC).

PURPOSE: To examine the reliability and the validity of ICC in the classification of physical activities and in the estimation of energy expenditure during a variety of physical activities.

METHODS: ICC classifies physical activities into following categories according to 3D acceleration and differential atmospheric pressure data; 1) level walking, 2) running, 3) climbing up/down stairs or hill, 4) going up/down in or on a vehicle, 5) sedentary and 6) miscellaneous activities not categorized to the first 5 categories. Energy expenditure was calculated according to the formula for each category of physical activity. The formula of activity category 1-3) for energy expenditure was generated according to the regression of step rate and oxygen uptake of each category of activity measured independently. Eight healthy male subjects [age: 24.9 ± 6.09 (mean ± SE) y] volunteered for the study. This study was approved by the Ethical Committee of Tohoku University School of Medicine, and all the subjects gave their informed consent. Energy expenditure was measured by both ICC and AT-1100, a portable calorimeter. ICC classified physical activity patterns including static, level walking, climbing stairs, going up in elevator, stair climbing down and stair climbing up. In experiment 2, the subjects performed an assigned activity (level walking, or stair climbing up or down).

RESULTS: ICC classified physical activity patterns including static, level walking, down/up on a vehicle or a lift, stair down/up successfully. Energy expenditure was measured by both ICC and AT-1100, a portable calorimeter. ICC classified physical activity patterns including static, level walking, climbing stairs, going up in elevator, stair climbing down and stair climbing up. In experiment 2, the subjects performed an assigned activity (level walking, or stair climbing up or down).

CONCLUSION: ICC is the first successful portable device to assess and quantify daily physical activity 3 dimensionally. It provides a simple and accurate method for classification of activities and estimation of energy expenditure of daily physical activity.

This research is grant aided by Japanese Ministry of Education, Culture, Sports, Science and Technology; Intelligent Cluster Project.

2864 Board #139 9:00 AM - 10:00 AM
Evaluation of Type and Quantity of Low-intensity Physical Activity by Triaxial Accelerometry
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Non-exercise activity thermogenesis, mainly composed of the energy expenditure related to low-intensity daily physical activity (PA), has been highlighted recently for helping to prevent weight gain. However, there are currently no effective methods to objectively evaluate the type or quantity of low-intensity PA in free-living conditions.

PURPOSE: To compare the ability to identify the type and quantity of low-intensity PA and predicted energy expenditure (EE) using either ‘triaxial accelerations’ (vertical [Y-axis], horizontal [synthesized X- and Z-axes] and total [synthesized tri-axes]) or only ‘vertical accelerations’ from a triaxial accelerometer.

METHODS: Twenty-one Japanese adults, aged 21 to 64 years, were fitted with a triaxial accelerometer while remaining in a whole-body human calorimeter for 22.5 hours. The protocol time was composed of sleep (8 hrs), four structured periods totaling 4 hours (sitting; standing; eating; and walking on treadmill [4.3 km/h and 5.7 km/h]; 30min=2 times, respectively) and residual time (10.5 hrs). The different acceleration data (mG/min) from the different periods and their relationship to the physical activity ratios (PAR=energy expenditure per minute / basal metabolic rate) obtained from the human calorimeter allowed for the development of EE equations for each activity. The validation of the EE equations were estimated on the residual times and the % difference for the prediction errors were calculated as (predicted value - measured value) / measured value ×100.

RESULTS: Using data from ‘triaxial accelerations’ and the ratio of horizontal to vertical accelerations, there was a relatively high accuracy of identifying the four different periods of activity, with the predicted EE (852 kcal/10.5 h) being very similar to the actual EE obtained by human calorimetry (846 kcal/10.5 h; 1.6 ± 7.6% difference; p=0.90, p<0.01). On the other hand, when using ‘vertical accelerations’ only, it was not possible to distinguish between sitting and standing positions but other activities (between standing, cleaning and walking, respectively) were identified relatively accurately, with the measured EE being overestimated (p<0.01) by the predicted EE (954 kcal/10.5 h; 13.6 ± 8.0% difference).

CONCLUSIONS: Triaxial accelerometry, when the total, vertical and horizontal accelerations are utilized, can effectively evaluate different types of activities and estimate EE for low-intensity PA-centered activities associated with modern life styles.

2865 Board #140 10:00 AM - 11:00 AM
Number of Days of Monitoring Needed with Accelerometers and Pedometers to Obtain Reliable Estimates of Habitual Physical Activity in Adults
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The number of days of assessment necessary to obtain reliable estimates of habitual physical activity differs for measurement method and population assessed. Tudor- Locke et al. (2005) suggested that at least three monitoring days with pedometers are necessary to sufficiently estimate free-living physical activity over one week in adults.

PURPOSE: The purpose of this study was to establish a minimal monitoring period necessary to reliably assess habitual physical activity in adults (40 to 60 years) with pedometers and accelerometers.

METHODS: Seven consecutive days of data were collected on 120 participants (93 females and 27 males; age = 49.0 ± 5.6 years; BMI = 27.9 ± 5.6) who wore a Yamax SW-200 pedometer and an Actigraph accelerometer. Monitors were randomly selected from among 50 pedometers and 52 accelerometers. Average daily steps, average daily activity counts, and daily minutes in moderate to vigorous physical activity (MVPA) were calculated. Cut-points of Freedson et al. (1998) were used to establish MVPA from the Actigraph. Two-way intraclass correlations (R) were used to determine the number of monitoring days needed to achieve a reliability of .80. Analyses were conducted on participants who had complete data for all 7 days.

RESULTS: Complete data for 7 days were obtained from 97 participants for the Yamax and from 59 participants for the Actigraph. Average daily steps were 10,091 ± 4,124 from the Yamax and 11,885 ± 3,409 from the Actigraph (p <.01). Reliability estimates (95% CI) for 7 days of monitoring were .88 (.84 to .91) for Yamax steps, .84 (.77 to .89) for Actigraph steps, .85 (.78 to .90) for Actigraph activity counts, and .82 (.74 to .88) for Actigraph MVPA. The number of days needed to obtain an acceptably reliable measure of activity was 4 days (R =.80) for Yamax steps, 5 days (R = .81) for Actigraph steps, 5 days (R = .81) for Actigraph activity counts, and 6 days (R = .80) for Actigraph minutes of MVPA.

CONCLUSION: The number of days of monitoring necessary to obtain acceptably reliable estimates of usual physical activity in adults differs slightly by measurement method and type of outcome variable expressed. A slightly longer measurement schedule is needed for Actigraph accelerometers than for Yamax pedometers. In addition, if results are to be expressed as minutes of MVPA, 6 days may be needed to assess usual physical activity.

2866 Board #141 8:00 AM - 9:00 AM
Jeanne D. Johnston, Georgia C. Frey, FACSM, Jaunade Padilla, Jeff L. Webb, Joel M. Stager, FACSM. Indiana University, Bloomington, IN.
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Walking accounts for a large proportion of daily activity and the metabolic cost of normal walking has been shown to be associated with step-to-step transition properties (e.g. stride length).

PURPOSE: To examine the impact of stride length measurements on the accuracy of accelerometry based energy expenditure prediction equations.

METHODS: Forty-two adults (21 men, 21 women) aged 48.9±7.6 yrs completed a 6-min walking bout at a self-selected speed (104.3±14.5 m·min⁻¹) at 0% grade. Subjects
were randomly assigned to an equation development (n=28) or validation (n=9) group. Three accelerometers (RT3, MTI, and Actical) were worn on the right hip. Metabolic variables were measured using indirect calorimetry. The time required to complete 20 strides during each bout was recorded to determine treadmill stride length (Treadt.). Subjects then walked (2.32 meters) at a self-selected pace to determine floor length (Floorf.). Stepwise regression was used to determine which variables significantly contributed to the prediction of EE with significance set at p<0.05.

RESULTS: Correlations existed between EE and demographic variables (height, r = 0.49; weight, r = 0.61; age, r = 0.13) and stride length variables (Treadt. r = 0.57; Floorf. r = 0.64). The correlation between Treadt. and Floorf. (r = 0.54) was significant. Weight, Treadt., and Floorf. were significant predictors as determined by stepwise regression. The model including counts and weight resulted in R² values of 0.74 (Actical & MTI) and 0.80 (RT3). The addition of Treadt. to the model improved values for the Actical (r² = 0.81) and RT3 (r² = 0.86), but not MTI monitor (r² = 0.74). The substitution of Floorf. for Treadt. significantly improved the equations for all monitors (Actical, R² = 0.86; MTI, R² = 0.80; RT3, R² = 0.87). The correlations between measured and predicted EE for all monitors were higher when Floorf. was used as a predictor (Actical r = 0.93, MTI r = 0.89, RT3 r = 0.93) as opposed to Treadt. (Actical r = 0.90, MTI r = 0.86, RT3 r = 0.92). When equations were applied in the validation group, correlations between measured and predicted EE were higher for the model that utilized Floorf. as a predictor. Significant differences between measured and predicted EE (Treadt. & Floorf.) were noted for the Actical and MTI monitors, but not RT3.

CONCLUSIONS: The inclusion of stride length in accelerometer based energy expenditure prediction equations significantly improved energy expenditure estimates. Compared to values obtained on the treadmill, floor stride length had a greater impact on prediction accuracy.

Identification of Factors Impacting the Relationship between Accelerometer Counts and Swimming Energy Expenditure

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PURPOSE: The purpose of this study is to determine the efficacy of utilizing accelerometer counts to predict energy expended while swimming and identify factors which may account for inter-individual differences in swimming energy expenditure (SWE).

METHODS: Twenty three men (28.0 years, +/- 8.8) and 27 women (26.6 years, +/- 8.9) performed three submaximal 365.76 meter (400 yard) front crawl swims. Expired gases were collected for 20 seconds at the end of each bout to determine oxygen consumption. An omnidirectional accelerometer (ODA) was worn on the right wrist, waist, and right leg. Multiple regression techniques were utilized to develop prediction equations for SWE (kcal min⁻¹) based on accelerometer counts, swim velocity, and subject characteristics.

RESULTS: The relationship between SWE (kcal min⁻¹) and predictor variables were significantly different when comparing males and females, recreational and competitive swimmers, and velocity categories (VC) above and below 1.1 m·sec⁻¹. Covariates (sex x ODA, VC x ODA) were included to account for these differences. Significant correlations between OVD and ODA output were noted for both men (r = 0.50, p < 0.05) and women (r = 0.51, p < 0.05). Body surface area (BSA) was included in the prediction equation for both men and women. The simplest prediction equation included leg counts, BSA, sex, sex x VC, and VC x leg (r² = 0.51; sex x leg; BSA x leg; sex x VC x leg SE = 2.95 kcal min⁻¹). The best overall equation was obtained when heart rate (HR) and VC x HR were added to this equation (R² = 0.69, SEE = 2.77 kcal min⁻¹). The equations for the models are as follows: EE (kcal min⁻¹) = -9.67 + 0.001088(VC x Leg) + 9.4 kg/m² x 0.0796744 Sex + 0.0003548(SE x Leg) + 3.73 VC x Leg - 0.000224(VC x Leg) and EE (kcal min⁻¹) = -14.57 + 0.0010796 Leg + 12.68 (BSA x 0.0232 Sex) + 0.0004868 Sex x Leg - 7.15 VC x Leg - 0.000232VC x Leg - 0.000376 (Sex x Waist) + 0.0001216VC x Waist - 0.0338 (Sex x HR) + 0.0313 (Sex x HR) + 0.0051 (VC x HR) for the simplest and best equation, respectively.

CONCLUSIONS: Valid estimates of SWE can be obtained through a combination of variables including ODA accelerometer counts, swim velocity categories, and subject characteristics.

Acknowledgements: Supported, in part, by United States Master Swimming.

The Influence of Bout Duration on Agreement between Accelerometry Data and Self-Reported Physical Activity

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Note: The interpretation of physical activity (PA) accelerometer data is highly dependent upon the post-collection processing of the raw data. Currently, however, there are no universally accepted standards for processing these data.

PURPOSE: The primary purpose of this study was to investigate the influence of different definitions of bout duration (BD) when processing accelerometer data collected for a PA intervention program. A secondary purpose was to evaluate the degree of agreement between the accelerometer data and a questionnaire for assessing PA.

METHODS: Data were collected as part of a church-based program designed to increase daily moderate to vigorous physical activity (MVPA) lasting > 10 mins primarily through walking. Self-reported MVPA (min/d) were assessed after 12 weeks using the International Physical Activity Questionnaire (IPAQ). Daily PA was assessed over a 7-day period using an accelerometer-based activity monitor (Actical, Mini Mitter Co) worn at the waist during all waking hours. Accelerical data were summarized into minutes of MVPA in 1-, 3-, 5-, 8-, and 10-min BDs using a computer program. A BD was defined as a consecutive string of values ≥ the predefined cut-points for moderate intensity activity. Differences between mean Actical across BDs was assessed with RM ANOVA. Spearman’s correlation assessed the linear association between IPAQ and Actical data, while kappa (k) assessed agreement between the IPAQ and Actical variables for whether subjects minimally accumulated at least 30 mins/day of MVPA.

RESULTS: Using complete data for 44 study participants (Mean±SD: 55.7±12.7 yrs; 35.2±9.4 kg/m² BMI), MVPA from accelerometry decreased significantly as BD increased from 1- to 10-mins (Mean±SE: 126.9±3.3, 70.6±3.8, 40.6±3.8, 20.3±3.3, 14.2±2.7 mins/day; p<0.001), while IPAQ data remained fairly consistent across BDs (r² = 0.14, 0.21, 0.24, 0.27, 0.31 mins/day). Correlations were generally low (<0.30) and non-significant but tended to increase as BD increased with the highest correlations occurring between the VPA from the IPAQ and MVPA from accelerometer at 8 and 10 min bouts (r² = 0.23-0.26; p<0.13). Agreement between accelerometer and IPAQ was poor for all bout definitions but tended to be highest for 1-3 min BDs (k = 0.161-0.167) and lowest for 5-10 mins BDs (k = 0.136 to 0.066).

CONCLUSIONS: This analysis supports the premise that the interpretation of accelerometer data is highly dependent upon data processing characteristics such as bout duration. Additionally, the lack of agreement between accelerometer and IPAQ data suggest that satisfaction of MVPA guidelines may be highly dependent upon the instrument of evaluation.
The purpose of this study was to develop and cross-validate an algorithm to improve the precision of the pedometer predicted NEE among 18-60 yr old males and females. We hypothesized that sophisticated statistical methodology and a larger sample for algorithm development and validation were required.

**METHODS:** Ninety-two subjects (44 males, 48 females) completed 12 minutes of treadmill walking at 1.12, 1.34 and 1.56 m sec⁻¹. NEE was measured using indirect calorimetry and subjects had the pedometer secured at the waist. Forty-six subjects comprised the model development sample and 46 were used for model cross-validation. We developed separate linear models for females and males using best subset variable selection. We used this method to find the linear models with largest adjusted R-squared and we considered models that predicted NEE using linear functions of up to two way interactions of mass, height, step rate, stride length and age. The reported correlations were estimated using cross validation.

**RESULTS:** The final model for males included age, body mass, steps per minute and height; for females, predictors were mass, steps per minute, height, age and stride length. The correlation between the criterion and estimated NEE was \( r = 0.85 \) for the male model and \( r = 0.90 \) for the female model. The standard error of the estimate for predicted NEE was 0.65 kcal m⁻¹ and 0.74 kcal m⁻¹ for males and females, respectively.

**CONCLUSION:** These results indicate that the new models can predict NEE with a higher degree of precision than previously available. These improved algorithms to predict NEE will provide pedometer users with a more accurate reflection of their walking energy expenditure.

Funded by Omron Healthcare, Inc.
Purpose: The purpose of this study was to evaluate the ability of women to recall their physical activity performed during a pregnancy and postpartum.

Methods: In a previous study, energy expenditure was quantified in 56 women at 20 and 32 weeks gestation and 12 weeks postpartum. Six years later, thirty women agreed to participate in follow-up research. The Modified Activity Questionnaire (MAQ) was used to assess current and past pregnancy physical activity. Each participant was administered the MAQ for each time period in the order of most distant past (20 weeks gestation) to most current (last week). Leisure time energy expenditure values (kcal/day) calculated from the physical activity recall used in the original study and those from the MAQ used in the follow up study were compared.

Results: Sample demographics included age=36.2 (±5.0) years, weight=65.5 kg (±12.9), height=165.9 cm (±6.9), and parity=2.5 children (±0.94). Sixty percent of the sample met the CDC/ACSM guidelines for current physical activity (≥20 MET/wk). MAQ energy expenditure values (kcal/day) were significantly related (P<0.05) to original physical activity recall measures at all time periods of interest; at 20 weeks gestation (r=0.57, P<0.01), at 32 weeks gestation (r=0.85, P<0.01), and at 12 weeks postpartum (r=0.86, P<0.01). Correlations found using this postpartum population are similar to those found in previous physical activity recall and MAQ validation studies. Body mass index, % body fat, waist-to-hip ratio, and resting HR were not related to MAQ energy expenditure values (kcal/day). At 20 weeks gestation, VO2peak, VO2max, and VO2max/40 kg/bpm were not related to MAQ energy expenditure values (kcal/day).

Conclusion: The MAQ is an appropriate tool to assess past physical activity in postpartum women, six-years after delivery, regardless of their current activity participation levels.

Validation of Four Physical Activity Questionnaires Compared to Heart Rate Record in Young Korean Men

Purpose: To validate and compare four physical activity questionnaires for estimating daily energy expenditure (DEE) as compared to heart rate (HR) recording in young Korean men.

Methods: Twenty-nine healthy Korean men (24.0±1.3 yrs, 73.2±4.9 kg, body mass index 24.3±3.0 kg/m², 16.4±5.7% body fat, waist-to-hip ratio 0.6±0.0, resting HR 68.3±6.6 bpm, VO2max 49.5±4.5 ml/kg/min) volunteered to participate. Baseline and maximal oxygen consumption, and concomitant HR were measured. Three common physical activity questionnaires; International Physical Activity Questionnaire (IPAQ), Baecke Questionnaire of Habitual Physical Activity (BQ), Seven-Day Physical Activity Recall (STP), and佩登 accelerometer (RT3) were administered. Three-day Physical Activity Studies Record (B-PAR) were completed by each subject in a recommended fashion. Using appropriate methods for each instrument, DEE and activity level were calculated. Three-day, 1-min interval HR using automatized HR monitor was recorded during the same time period of B-PAR, and subsequently recorded HR was translated to corresponding VO2, to calculate DEE while 1 liter of O2 assumed as 5 kcal.

Results: Estimated DEE by HR, IPAQ (r=0.20), S-PAR, and B-PAR was 3.23±2.809 kcal/d, 3.103±0.736 MET-min/wk, 3.057±0.439 kcal/d, and 3.110±0.490 kcal/d, respectively, and these measures were not different (ANOVA, P>0.05). Physical activity indices by BQ was 7.66±1.1. The Pearson's correlation coefficient was only significant between B-PAR and BQ (r=0.40, P<0.05), B-PAR and S-PAR (r=0.62, P<0.01), and DEE by HR and IPAQ (r=0.48, P<0.05). Body mass index, % body fat, and waist-to-hip ratio were significantly correlated with DEE by S-PAR (r=0.793, 0.696, and 0.656, respectively, P<0.01) and B-PAR (r=0.606, 0.452, and 0.436, respectively, P<0.05), but not with IPAQ, BQ, and DEE by HR.

Conclusion: Compared to HR recording, DEE obtained by four instruments evaluated in this study provided a reasonable group estimate for young healthy Korean men, although individual DEE among instruments was not identical. The questionnaires appeared to be valid and easy to administer in this population.

Validity of the Flemish Physical Activity Computerized Questionnaire (FPACQ).

Purpose: To validate a new, physical activity computerized questionnaire with triaxial acceleration as a criterion measure in 18 to 60 year old employed Flemish adults. The Flemish Physical Activity Computerized Questionnaire (FPACQ) was developed to assess physical inactivity of a usual week and contains general questions, questions about sports participation and questions about physical (in)activity during work and leisure time.

Methods: 62 males and females, randomly selected, completed the FPACQ. Afterwards, a RT3 accelerometer was worn and an activity log was kept for seven consecutive days. Paired t-tests and Pearson product moment correlations were calculated between physical (in)activity variables from RT3 and FPACQ. Significance level was set at p<0.05.

Results: All activity variables calculated with FPACQ are significantly higher than with RT3: physical activity index (r=0.36 MET), total energy expenditure (r=0.43 MET/kcal/wk), energy expenditure during occupation (r=0.51 MET/kcal/wk) and energy expenditure of sports activities (r=0.52 MET/kcal/wk).

Conclusion: For males and females separately indicate that the overestimates are greater for males. The opposite is true for the inactivity variables. Time spent on watching television and time spent on sleeping calculated with FPACQ is significantly lower (-2.95 h/wk and -7.27 h/wk respectively) than with RT3. Significant moderate to high correlation coefficients between FPACQ and RT3 are found: physical activity index (r=0.35), total energy expenditure (r=0.75), energy expenditure during occupation (r=0.78), energy expenditure of sports activities (r=0.39), time spent on watching television (r=0.76) and time spent on sleeping (r=0.58). When men and women are analyzed separately, correlations vary between 0.19 and 0.77 for men and between 0.38 and 0.82 for women.

Conclusion: Results show that the FPACQ is a valid instrument that can measure physical (in)activity at least as good as other established questionnaires. Considering the fact that a computerized questionnaire is easier to use and to administer, this offers many perspectives for the use of FPACQ in future studies.

The International Physical Activity Questionnaire (IPAQ) short form assesses vigorous, moderate, and walking activities, as well as time spent sitting, during the last 7 days. The psychometric properties of this self-administered questionnaire have not been examined in college students.

Purpose: The purpose of this study was to assess the convergent validity and stability reliability of the IPAQ short form in college students.

Methods: One hundred twenty-three college students (32 males, age: 20.8 ± 1.2 yr, BMI: 21.7 ± 3.9 kg·m-2; 91 females, age: 20.8 ± 1.6 yr, BMI: 22.6 ± 2.9 kg·m-2) wore an accelerometer and unsealed pedometer at the waist for 7 consecutive days, after which they immediately completed the IPAQ. Participants completed the questionnaire again 4-6 days later, recalling their physical activity during the week that they wore the monitoring devices. To assess stability validity, weekly time spent in vigorous (VO2peak), moderate (MPA), walking (WALK), and total physical activity (TOTA) from the IPAQ were compared with step/d-1 from the accelerometer (STP) and pedometer (PED) and count variables from the accelerometer [e.g., min-1·d-1 (CT), min·d-1 (TCT), and accumulated min·wk-1 of bouts ≥ 10 min of at least moderate intensity activity (TOTTIME)]. Spearman correlation coefficients (ρ) and intraintraclass correlation coefficients (ICC) were calculated.

Results: IPAQ was significantly correlated with STP, PED, and all count variables (ρ = 0.30 - 0.47, p < 0.001). MPA was associated with CT, TOTCT, and TOTTIME (ρ = 0.20 - 0.21, p = 0.05), while WALK was not related to STP, PED, or any count variables. TOTA significantly correlated with PED, CT, TOTCT, and TOTTIME (ρ = 0.19 - 0.25, p<0.05). ICCs ranged from 0.71 - 0.89.

Conclusion: In this study, the IPAQ items examining weekly time spent in vigorous, moderate, and total physical activity were associated with most accelerometer variables, while items measuring weekly walking time were not related to any of the pedometer or accelerometer variables. Furthermore, test-retest reliability of the IPAQ was acceptable. Future studies should continue to assess convergent validity of the IPAQ short form, particularly the WALK items, in college students.
evaluation or comparison.

PURPOSE: To compare the prevalence of total walking obtained from two surveys: the International Physical Activity Questionnaire (IPAQ) Short Form Survey and the Behavioral Risk Factor Surveillance System (BRFSS) Optional Physical Activity Module among a national sample of U.S. adults. Both surveys provide a measure of walking for all purposes including occupational, household, transportation, and exercise or leisure related walking.

METHODS: Both surveys were administered to a cross-sectional sample of 10,227 adults (4,359 men, 5,868 women; 18-99 yrs) interviewed via telephone as part of the National Physical Activity and Weight Loss Survey (NPWLS) in 2002-2003. The NPWLS survey and sampling strategy was designed to mimic the BRFSS protocol employed each year by state health departments under the guidance of the Centers for Disease Control and Prevention. NPWLS respondents were classified as “regular” (> 5 days/wk and > 30 min/day), “occasional” (some walking, but not meeting the definition of a regular walker), or “never” walkers.

RESULTS: Overall agreement between the two surveys was moderate [kappa = 0.54 (95% CI=0.52, 0.55)] in classifying respondents as regular (IPAQ=44.6%; BRFSS=49.5%), occasional (IPAQ=44.6%; BRFSS=34.3%), or never walkers (IPAQ=10.9%; BRFSS=16.2%). Across subpopulations of adults the prevalence of regular, occasional, and never prevalence was 3.4-7.0% higher, 7.1-12.7% lower, and 4.3-7.5% higher, respectively, from the BRFSS compared to the IPAQ survey. Agreement ranged from kappa=0.45 (95% CI=0.40, 0.49) among Hispanic adults to kappa=0.57 (95% CI=0.54, 0.60) among adults aged 55+.

CONCLUSIONS: The IPAQ and BRFSS total walking surveys differ in the number of items (IPAQ=2; BRFSS=3), relevant recall time frame (IPAQ-last week, BRFSS-usual week), and question wording. These differences may contribute to the variability in the prevalence estimates between the surveys, however, good overall and subgroup specific agreement was found. Future studies are necessary to compare the IPAQ and BRFSS total walking surveys to validation measures of walking.

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2880 Board #155 10:00 AM - 11:00 AM

Reliability of International Physical Activity Questionnaire in Korean Young Men and Women

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PURPOSE: To test the reliability of International Physical Activity Questionnaire (IPAQ) in Korean young adults and to compare physical activity level between Korean men and women.

METHODS: The short form of IPAQ which was confirmed by back translation methods was completed by 1,311 men (23.2±2.6 yrs, 69.6±8.8 kg, 175.5±5.3 cm, 22.6±2.4 kD/m²) and 1,264 women (21.6±2.0 yrs, 52.8±6.2 kg, 162.6±5.0 cm, 20.0±2.1 kD/m²) with varying physical activity habits. Up to 4 weeks later, 55 men (23.3±2.7 yrs, 70.1±9.4 kg, 175.2±5.5 cm) and 214 women (20.9±2.1 yrs, 53.6±6.9 kg, 162.3±4.6 cm) completed the same questionnaire. Kappa statistics were used to assess reliability of three levels of physical activity activity as ‘inactive’, ‘minimally active or ‘active’.

RESULTS: Calculated physical activity level (PAL) by IPAQ was 3081±2106 for men and 2290±1758 MET/min/week for women (P<0.001). Overall, the interclass correlation coefficients between categorical intensity of activity such as ‘walking’, ‘moderate’, and ‘vigorous’ was 0.17 (95% CI=0.12, 0.22) for men and 0.20 (95% CI=0.15, 0.25) for women. Agreement of sex in minimizing PAL was 0.13 (95% CI=0.06, 0.21) for men and 0.17 (95% CI=0.11, 0.23) for women. Kappa statistics were 0.33 (0.34 for men, 0.24 for women). The test-retest Spearman correlation coefficient was 0.475 (P<0.001) (0.368 for men P<0.01). Correlation between calculated PAL and body mass index (BMI) was 0.151 (P=0.01) (0.61 for men P<0.01, 0.50 for women P<0.05, -0.003 for women P>0.05).

CONCLUSIONS: Generally, the self-administered short form IPAQ had an acceptable reliability for this population and may be a valuable instrument in overall physical activity assessment for men and women. However, test-retest agreement was substantially low, which may be due to four weeks interval between test administration.
S564 Vol. 38 No. 5 Supplement

MEDICINE & SCIENCE IN SPORTS & EXERCISE®

POSTER SESSIONS

10:00 AM - 11:00 AM

Validation of a Modified Version of the Godin-Shephard Leisure-Time Exercise Questionnaire

Katrina D. Dubose, Terrance S. Robinson, David A. Rowe, FACSM, Matthew T. Mahur. East Carolina University, Greenville, NC.

BACKGROUND: The Godin-Shephard Leisure-Time Exercise Questionnaire (LTEQ) is widely used to measure physical activity in adults. The LTEQ assesses the number of 15 minute bouts of strenuous, moderate, and mild physical activity over a week. A modified version of the LTEQ was developed to measure the number of minutes of strenuous, moderate, and mild physical activity for a week.

PURPOSE: The purpose of this study was to validate a modified version of the Godin-Shephard Leisure-Time Exercise Questionnaire as a measure of daily minutes of moderate-to-vigorous activity.

METHODS: One hundred and twenty men (n=27) and women (n=93) between the ages of 40-60 years wore an Actigraph accelerometer for seven days and completed a modified version of the LTEQ each day during the same time period. Cut-points developed by Freedson et al. (1998) were used to determine minutes of moderate- to-vigorous activity for the Actigraph. The modified LTEQ asked the participants to recall the amount of time spent in strenuous, moderate, and mild physical activity for each day over seven days. Time spent in moderate and strenuous physical activity was summed to calculate minutes of moderate-to-vigorous activity from the modified LTEQ.

RESULTS: Reliability (95% CI) for seven days of assessment for moderate-to-vigorous activity was 0.76 (0.69 to 0.83). Minutes spent in moderate-to-vigorous activity was 42.4 for the LTEQ and 31.9 for the Actigraph. There was a similar frequency of under- and over-reporting of physical activity levels (under-report, > -11 minutes = 41.4%, over-report, > 11 minutes = 36.6%, and within +/- 10 minutes = 22.0%) on the self-reported moderate-to-vigorous activity from the Actigraph.

CONCLUSIONS: The reliability of the LTEQ as a novel method for measuring daily moderate-to-vigorous activity was not related to an objective measure of physical activity. The amount of error present was random and resulted in both under- and over-reporting of moderate-to-vigorous activity levels. Modification of the LTEQ to measure daily time in moderate-to-vigorous activity appears to result in invalid estimates of moderate-to-vigorous activity in a middle-aged population.

2884 Board #159 8:00 AM - 9:00 AM

Prediction of Energy Expenditure by Combined Movement and Heart Rate Sensing During Varying Activities in Children

Kirsten Corner1, Calam Mattoche2, Sören Brage3, Andy Ness2, Nicholas J. Wareham1, Chris Riddoch4, Ulf Ekeland1. 1MRC Epidemiology Unit, Cambridge, United Kingdom. 2Department of Exercise and Health Sciences, University of Bristol, Bristol, United Kingdom. 3Department of Paediatric and Perinatal Epidemiology, University of Bristol, Bristol, United Kingdom. 4London Institute of Sports Science, Middlesex University, London, United Kingdom.

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Purpose: Physical activity is difficult to assess accurately, especially in children. Various equations have been derived to estimate physical activity energy expenditure (PAEE) from body movement measured by accelerometry or heart rate (HR) data. However, few studies have utilized combined HR and movement sensing (HR+M).

Purpose: The primary purpose of this study was to compare the accuracy of uniaxial accelerometry and HR+M to predict PAEE during six common activities in children. As a secondary aim, the agreement between movement-derived equations (Corner et al, MSSE 2005) was compared to PAEE from treadmill running.

Methods: PAEE was measured by indirect calorimetry during six activities (lying, sitting, slow walking, walking, jogging and hopscotch) in 181 children (12.4 ± 0.2y). Self-reported and predicted PAEE (accelerometry output and HR+M) were assessed by linear regression analysis. The validity of these equations was cross-validated in a sub sample of participants. The validity of previously derived PAEE equations from treadmill walking and running was assessed.

Results: Data from the Actigraph and the HR+M were significantly associated with measured PAEE values (R² = 0.91 and 0.90, P < 0.01). In cross-validation analyses, significant correlations were observed between the estimation errors of both predictions (Actigraph: r=0.46, P<0.01; Actheart: r=0.27, P<0.01), both manifesting as under-estimations at higher expenditure levels, increasing with PAEE. Systematic errors (i.e. significant correlations between estimation errors) were observed for all treadmill-derived equations. Uniaxial accelerometry over estimated PAEE significantly (r= -0.74, P<0.01). The branched equation model over estimated PAEE at low intensities (r=0.23, P<0.01), whereas the HR+M prediction equation showed less systematic error (r= -0.09, P<0.01).

Conclusions: Both accelerometry and HR+M are valid to predict PAEE during selected physical activities in children. However, both models seem to underestimate PAEE at high intensity physical activity. Accelerometry derived PAEE during a progressive treadmill test was not suitable for predicting PAEE during the six activities. Both the HR+M model and the branched equation model derived from combined HR and movement sensing during treadmill locomotion showed less systematic error and were valid for PAEE prediction. Our results suggest that it may be possible to derive accurate PAEE prediction models using HR+M data that would not be possible using movement data alone due to the mechanical limitations of accelerometers.

2885 Board #160 9:00 AM - 10:00 AM

How Many Days to Monitor Levels of Physical Activity in Children? A Generalizability Approach


Purpose: There has been some debate about the number of days to monitor physical activity (PA). This discussion is relevant to the reliable estimation of the number of days of PA of children and adolescents. Still, the approach taken so far, has not dealt with different levels of daily physical activity in children.

Purpose: The aim of this study is to evaluate the minimum number of days to have reliable data on different levels of PA of children aged 6 to 10 years of both gender.

Methods: PA of 237 subjects aged 6 to 10 years of both gender were continuously monitored during 7 days using the CSA accelerometer. Based on information from counts per day, Freedson formula was used to divide PA in 3 levels: moderate (M), vigorous (V), and very vigorous (VV). SPSS was used for all statistical analysis to estimate reliability (intraclass correlation coefficient, ICC) and to decide on the number of days (generalizability coefficients (G) were based on variance components).

Results: Main results from R according to gender indicated that for moderate and vigorous PA 6 to 7 provide good results (females: 0.786<ICC<0.810; males: 0.776<ICC<0.794). For very vigorous PA 7 days may not be sufficient to have an excellent reliability estimate (females: 0.572<ICC<0.717; males: 0.683<ICC<0.759). When using generalizability estimates (G coefficients), 5 to 6 days may seem adequate for moderate and vigorous PA (results for both gender: GMM=0.789; GVM=0.780; GVV=0.800; GVVM=0.797; GVGG=0.808; GVVG=0.767). For very vigorous PA, 7 days may be required (GVGG=0.696; GVVV=0.736; GVVG=0.821). Conclusions: PA reliability estimates and generalizability coefficients provide a suitable framework to solve a part of the problem on the minimum number of days of monitoring. It seems that for moderate and vigorous PA 5 to 6 days may be sufficient. When dealing with very vigorous PA 7 days may be just enough. Still, it is not clear the impact of different days of monitoring on sample means and variances, and the amount of violation of the
compound symmetry in estimating intraclass correlation coefficients. Increasing the days of monitoring beyond 7 days may pose a lot of problems (costs, attrition of the sample, equipment available, and control of the whole study).

2886 Board #161 10:00 AM - 11:00 AM
Pedometer and Accelerometer Accuracy in Physical Activity Assessment of Preschool Children
Melody Oliver, Grant M. Schofield, Gregory S. Kolt, Philip J. Schluter. Centre for Physical Activity and Nutrition Research, Auckland University of Technology, Auckland, New Zealand.
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Pedometer accuracy in measuring physical activity in preschool children has not been adequately assessed.

PURPOSE: To determine the reliability and validity of pedometers for measuring physical activity in preschool children, and compare results using measures of association and Bland-Altman regression analyses.

METHODS: Children (n = 13) aged 3.0 - 4.7 years were observed on two occasions: 1) during straight line ambulation at three paces (slow walking, walking, running) while wearing pedometers at the left hip, right hip, and back (lumbar spine, waist level); and 2) during a free-play session while wearing a pedometer and accelerometer. Data analysis was conducted using measures of association (Wilcoxon’s signed-ranks test and Spearman’s correlation coefficient) and also Bland-Altman regression analyses and 95% limits of agreement. Percentage differences were also calculated between observed steps and pedometer steps during straight line walking, walking, and running.

RESULTS: Step counts from pedometers worn at the back were significantly higher than observed steps during straight line walking (Z = −1.07, p<0.05). No other significant differences were found between observed steps and pedometer steps, or between pedometer placement sites. Significant moderate correlations were observed between direct observation and both pedometry and accelerometry (r = −0.71, p<0.01), and also between pedometry and accelerometry (r = −0.93, p<0.01). Using the Bland-Altman method, data from all straight line ambulation conditions were combined, and the resulting 95% limits width of the pedometer placed on the back was around 7% wider than the left and right hip measurement sites. Using direct observation as a criterion, the prediction interval for pedometry was approximately 30% wider than for accelerometry. The range of percentage differences between observed and pedometer steps in slow walking, walking, and running were wide (−31% to 25%, −13% to 17%, and −10% to 40%, respectively).

CONCLUSIONS: Pedometer placement at the back of preschoolers was less accurate than hip placement. Pedometry showed more variability than accelerometry in quantifying physical activity in this population. Data analysis using simple measures of association are common in physical activity measurement research but may not be appropriate for the assessment of physical activity measurement tools because the magnitude of agreement and potential systematic bias are unaccounted for.

Melody Oliver is supported by a Tertiary Education Commission Top Achiever Doctoral Scholarship. Part of this study was funded by Sport and Recreation New Zealand.

2887 Board #162 8:00 AM - 9:00 AM
Evaluating Compliance of Grade School-Aged Children To Wear Accelerometers
Bryce M. Abbey1, Kate A. Heelan1, Greg Wels1. University of Nebraska at Kearney, Kearney, NE; Iowa State University, Ames, IA.

MTI Actigraph Accelerometers are a valid, objective measure of children’s physical activity levels. However, little is known about how compliant children are when asked to wear an accelerometer over an extended period of time.

PURPOSE: The purpose of this study is to examine variability in compliance and factors influencing compliance.

METHODS: 210 children (age 8.7 ± 1.4 yrs, BMI 24.2 ± 5.5 kg/m2) wore an MTI accelerometer for 4 consecutive days on 2 separate occasions. Children were instructed to wear the monitor at all times except while sleeping or during activities involving water (i.e. shower, bath or swimming). A full day of wearing was defined as the period from 7:30am to 8:00pm. Compliance in wearing the monitor was checked by looking for continuous blocks of zeroes in the data. Participants with more than 3 blocks of 20 consecutive minutes of zeroes were considered to be non-compliant with the protocol since it is unlikely that this could occur without having removed the monitor.

RESULTS: The results indicated that 49% of the participants were compliant on all 4 days, 76% of participants were compliant 3 of 4 days and 91% of participants were compliant 2 of 4 days. Approximately 4% of participants were non-compliant on all 4 days. There was no difference in age, gender or BMI between compliant and non-compliant participants. The average number of 20 minute blocks of zeroes on non-compliant days was 15.7 ± 9.4 while the average number of 20 minute blocks of zeroes was 0.7 ± 0.8 on compliant days.

CONCLUSION: These results indicate that compliant days can be determined by this simple screening criteria. It appears that children either wear the monitor or they do not as the monitor was off an average of 40% of the day on non-compliant days. Screening accelerometer data to remove non-compliant participants results in fewer days of usable data but the quality of the data would reduce measurement error to offset this loss. The use of 2 days provides a reasonable compromise as 91% had acceptable data using these criteria.

2888 Board #163 9:00 AM - 10:00 AM
Accelerometer Cut-Points and Youth Physical Activity Prevalence
Jorge Mota, Mónica Valente, Luisa Aires, Maria Paula Santos, José Carlos Ribeiro. Research Centre in Physical Activity and Health and Leisure, Porto, Portugal.
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Daily physical activity (PA) plays a key role in strategies targeting youth health and behavioural changes. General guidelines are widely used to describe the amount of physical activity related to health benefits. Since policies and programs strategies are based on prevalence estimates for meeting these guidelines, it is essential that prevalence estimates are accurate. However, different conclusions had been reached depending upon the criterion selected to distinguish activity from inactivity.

PURPOSE: The purpose of this study was twofold. First was to examine the effects of different cut-off scoring points (on the estimated prevalence of meeting health-related guidelines for physical activity in youth and second was to document the differences in gender physical activity patterns according to two different cut-off points.

METHODS: The sample comprised 62 children (boys n=23; girls n= 39) aged 8-16 years-old. PA was assessed by MTI actigraph. Children wore accelerometers for three consecutive weekdays. Based on activities intensity (MET) the daily time spent in moderate-to-vigorous physical activity (MVPA) was calculated using an equation regression developed for youth according to Freedson et al. (1998) and Payau et al. (2002).

RESULTS: The data analysis from Freedson’s cut points showed that both sexes engaged in significantly (p<0.01) more MVPA when compared with Payau’s cut points. Boys engaged in significantly (p<0.01) more MVPA activities than girls regardless the cut-off point used. Our data also showed that except for boys, ages 14-16 years old, and the percentage of students that reach the physical activity-health related criteria (at least 60 min of MVPA/day) was significantly higher in both boys (77.3% vs 69%; p<0.001) and girls (60% vs. 23%; p<0.001) when the Freedson’s cut-off point was used.

CONCLUSIONS: Our data showed that for preventive strategies an youth specific cut-off points still needs to be refined, and as a result health-related criteria for young people need to be based on further research evidence.

Previous published studies have developed different accelerometer cut-points to categorise varying intensities of activity in adults and children based on free-living and laboratory-based activities. There is a need to investigate whether these different cut-points affect estimations of the physical activity and inactivity levels in young children.

PURPOSE: To assess the effect of using different popular accelerometer cut-points to quantify sedentary behavior and moderate-vigorous physical activity (MVPA) in young children.

METHODS: Habitual free-living physical activity data were collected, in 15-second epochs, over 7 days using the MTI Actigraph in n = 85 (42 male and 43 female), mean (SD) age 5.8 years (0.5) children from Glasgow, Scotland. These data, expressed as counts per minute, were analysed for mean daily physical activity using three different commonly used published cut-points for the assessment of sedentary behavior (Payau et al., 2002; Reilly et al. 2003; and Treuth et al. 2004) and three cut-points for the assessment of MVPA (Payau et al., 2002; Janz et al. 2002 and Treuth et al., 2004)). Percentage (%) time spent at these activity levels for each was calculated using these cut-points. ANOVA and Tukey’s pairwise comparison were used to determine if, and where, any differences lay between estimations of % time spent inactive in MVPA, according to these cut-points.

RESULTS: The median % time spent in sedentary behaviour according to Payau, Reith and Reilly cut-points were all significantly different from each other (p < 0.01). The Janz cut-point for MVPA resulted in a much higher % time in MVPA compared with the other two cut-points (p < 0.01) (Table 1).

CONCLUSIONS: Calculated levels of sedentary behavior and MVPA are sensitive to the cut-point chosen. Applying different cut-points to the same data from a single child can significantly alter the assessment of how active or inactive the child appears. This is a potentially important methodological problem and requires urgent attention.
TABLE 1. Percentage time spent sedentary and in MVPA using three Actigraph cut-points (median).  

<table>
<thead>
<tr>
<th>Sedentary</th>
<th>Poyau</th>
<th>Truth</th>
<th>Kelly</th>
<th>Janz</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 800 cpm</td>
<td>37.40</td>
<td>34.84</td>
<td>34.47</td>
<td>34.61</td>
</tr>
<tr>
<td>800 - 999 cpm</td>
<td>34.89</td>
<td>35.97</td>
<td>35.59</td>
<td>34.90</td>
</tr>
<tr>
<td>MVPA</td>
<td>22.71</td>
<td>23.32</td>
<td>24.03</td>
<td>23.07</td>
</tr>
</tbody>
</table>

**Results:** Wrist AC indicated that activity levels were similar during both exercise modes. With corresponding calibration and field-test activity, the flex HR method provided a satisfactory estimate of EE at group level. However, when intermittent or strength-related exercises are monitored, flex HR overestimates actual EE. Irrespective of the mode of activity, the flex HR method is likely to introduce errors of 20% or more on an individual level.

**Conclusions:** The flex HR method likely introduces errors of 20% or more on an individual level.

**Purpose:** This study validated the flex HR method against indirect calorimetry in children attending a stationary 4-week obesity therapy.

**Methods:** Accelerometers can measure both quantity and intensity of physical activity (PA). While calorimetry, direct observation, and doubly-labeled water (DLW) are often considered the most valid methods of assessing physical activity, electronic devices, including heart rate and activity sensor monitors, hold great promise for objectively and conveniently collecting continual activity information at the lowest cost in free-living individuals. Accelerometers, in particular, can measure quantity and intensity of physical activity.

**Purpose:** To compare: 1) reproducibility of accelerometer measures between two sites and levels in a population camp sessions for Asian adolescents; 2) data derived from accelerometers worn on the wrist and the hip; and 3) two regression models (single regression [1R] and double regression [2R], which is intended to accommodate low activity better than [1R]), provided with the manufacturer software.

**Methods:** Fifteen boys (mean ± SD: 13.8 ± 0.7 yrs, body fat % = 36.6 ± 9.2) and 21 girls (13.5 ± 0.8 yrs, body fat % = 45 ± 4.7) wore accelerometers on the non-dominant wrist during the first session (S1) of the camp, and on both the wrist and right hip during session two (S2) for 17 consecutive 24-h days each session. Indepedent and paired t-tests, and Pearson’s correlations were used for analysis.

**Results:** There were no differences between S1 and S2 wrist activity counts/min (AC) for either boys (P = 0.92) or girls (P = 0.56). Although S2 wrist AC were higher (P = 0.0001) than hip AC for both boys (wrist = 833 ± 161; hip = 361 ± 52) and girls (wrist = 704 ± 200; hip = 360 ± 63), they were correlated (r = 0.95, P = 0.0001) in both genders. Boys had higher AC counts at both sites (wrist 1S1 = P = 0.006; S2: P = 0.016 and hip 1S1: P = 0.001 compared to the girls. No difference between 1R and 2R means was observed on the wrist (boys: P = 0.62; girls: P = 0.54). 1R analysis resulted in lower levels of energy expenditure (kcal/min) than 2R analysis utilizing hip data (S2) for both boys (P = 0.014) and girls (P = 0.047). Nine of 47 (S1) and 11 (S2) wrist, and 5/38 hip site monitors failed on upload; however complete or partial data were recovered by the manufacturer from 8 (S1) and 11 (S2) of the failed monitors.

**Conclusions:** Wrist AC indicated that activity levels were similar during both sessions of camp. Anticipated comparison with DLW will determine which site and regression option provide a better representation of physical activity levels in overweight/obese adolescents. The high accelerometer failure rate resulted in design changes by the manufacturer to decrease future problems when accelerometers are utilized for extended periods of time with this age group.
acceptable data for the 7 days of monitoring. Reliability estimates (ICC values) for total weekly activity sessions on the YMCLS were .64 for organized activity and .43 for free-time activity. Correlations between the MTI and the Activity Log were higher for estimates of minutes of MVPA (r = .43) than for estimates of bouts of MVPA (r = .27) and correlated higher for weekdays than weekend days. Correlations between the YMCLS and the Activity Log were higher for bouts of organized activity (r = .67) than for free-time activity (r = .46). Direct comparisons between the MTI and the YMCLS were possible for indicators on the Previous Day of recall. The correlations tended to be higher for estimates of the number of minutes of MVPA (r = .54) than for estimates of the number of bouts (r = .37). With both comparison measures, the correlations were consistently higher for the older sample than for the younger sample.

CONCLUSIONS: The results indicate reasonable reliability and validity of the YMCLS and the Activity Log. Difference in relationships for younger and older suggest that reliability and validity may differ within the 9-13 year age range.

2894 Board #169 9:00 AM - 10:00 AM
Total Energy Expenditure in Children Assessed by Doubly Labeled Water and Physical Activity Questionnaire
Stephen H.S. Wong, FACSM1, Rita Y.T. Sung2, C.S. Ho1, Y.J. Chen1, C.W. Yiu2. 1Department of Sports Science and Physical Education, The Chinese University of Hong Kong, Hong Kong Special Administrative Region of China. 2Department of Pediatrics, The Chinese University of Hong Kong, Hong Kong, Hong Kong Special Administrative Region of China. To examine the 1999-2002 National Health and Nutrition Examination Survey (NHANES) to determine the association between body mass index (BMI; weight/height²) in preschool children, aged 2-5 years, has more than doubled from 5 to 10.4% in the last 20 years. Lack of physical activity has been identified as a predictor of obesity in U.S. children. This study was to assess the total daily energy expenditure in children in Hong Kong using doubly labeled water (DLW) method and physical activity questionnaire.

METHODS: Eight 7-9 years old non-obese boys (Mean ± SD, age: 8.1 ± 0.6 y; Body mass: 25.4 ± 3.0 kg; Body mass index: 16.0 ± 2.1) recruited from local primary school participated in this study. Basal metabolic rate (BMR) was determined by indirect calorimetry. Total daily energy expenditure (TEE) was measured over a 10-day period by DLW method (TEE_DLW) and a 3-day physical activity questionnaire (TEE_Q). Energy intake (EI) was estimated by a 3-day weighed food diary. The physical activity level (PAL) was calculated from TEE_DLW/EI and the 3-day heart rate (HR) recording. The results suggested that the physical activity level in these Hong Kong primary schoolchildren was alarmingly low. The 3-day physical activity questionnaire produced results similar to DLW method in estimating the total energy expenditure in these schoolchildren.

2895 Board #170 10:00 AM - 11:00 AM
Parent Observation of Preschool Child Activity: A Definition Quandary in NHANES 1999-2002?
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Lack of physical activity has been identified as a predictor of obesity in U.S. children. According to a 2004 report from the Institute of Medicine, the incidence of obesity in preschool children, aged 2-5 years, has more than doubled from 5 to 10.4% in the last three decades.

PURPOSE: To examine the 1999-2002 National Health and Nutrition Examination Survey (NHANES) to determine the association between body mass index (BMI; kg/m²) and physical activity in preschool children.

METHODS: Data from 582 children, ages 2-5 years, from the NHANES 1999 and 2002 data sets were combined and analyzed. Children were categorized by BMI as defined by the 2000 CDC growth charts for age (2 to 20 years) and gender. Normal weight (NW) children were categorized as ≥ 85th percentile; “at risk” of overweight (ROW) between the 85th and 95th percentiles; and overweight (OW) at or above the 95th percentile on the growth charts. Physical activity level was based upon the question “How many times per week does play or exercise make your son/daughter sweat and breathe hard?” A multinomial logistic regression was used to determine if the amount of physical activity differed among the three categories of body fitness in preschool-aged children. Significance was established at p < 0.05.

RESULTS: Overweight preschool children were identified by parents/guardians as participating in a significantly greater amount of physical activity (7.60 ± 4.93 times per week) compared to normal weight preschool children (6.08 ± 4.13 times per week). No significant difference in physical activity was observed between NW and ROW preschool children.

CONCLUSIONS: BMI was positively related to the amount of physical activity in overweight compared to normal weight preschool children. This finding is contrary to the typical finding that greater amounts of physical activity correlate with more optimal BMI, thus leading to questions about the validity of this particular NHANES measure of physical activity.

G-19 Free Communication/Poster – Physical Activity, Cognition and Cognitive Function
SATURDAY, JUNE 3, 2006 8:00 AM - 11:00 AM
ROOM: Hall B

2897 Board #172 8:00 AM - 9:00 AM
The Effects of a Mixed-Reality Computer System on Leisure Activity For Brain Injury Individuals: A Pilot Study
Patricia C. Heyn1, Beatrice C. Abreu2, Kenneth J.Ottenbacher2. 1UCHSC, Denver, CO. 2UTMB, Galveston, TX. (Sponsor: Elizabeth J. Protas, FACSM)
Email: Patricia.Heyn@uchsc.edu

PURPOSE: Adults with brain injury (BI) have somewhat few opportunities to participate in dynamic and novel physical and leisure rehabilitation activities due to their physical and cognitive limitations. The purpose of this pilot study is to describe preliminary results from a mixed-reality rehabilitation program designed for brain injury individuals.

METHODS: A quasi-experimental and observational design was used with 12 male patients (mean ± SD age; 33 ± 11.7) from a post-acute brain injury rehabilitation center.
The effects of a 4-wk-mixed-reality program were observed on mood, engagement, presence, and enjoyment level. 

RESULTS: 70% of participants reported enjoyment and satisfaction with the program as compared to other rehabilitation modalities. Five participants response to Presence Questionnaire showed a high level of presence in the mixed-reality environments. In addition, four participants improved performance based on mixed-reality games scoring system.

CONCLUSIONS: These preliminary results suggest that mixed-reality system may provide insight into brain injury rehabilitation outcomes due to improved patient therapy engagement that stimulates longer participation in physical rehabilitation.

2898 Board #173 10:00 AM - 11:00 AM The Effects of Exercise Intensity and Physical Activity Level on Cognitive Processing Keita Kamijo, Yoshiaki Nishihira, Takuro Higashiiura, Seung-Ryol Kim. Comprehensive Human Sciences, University of Tsukuba, Tsukuba, Japan.

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Recently, the psychological effects of exercise on cognitive function have been well documented. Most of these studies investigating the effect of exercise on event-related brain potentials (ERP), particularly on the P300 components, have found some evidence for the relationship between exercise-induced arousal and cognitive performance improvement. However, the often contradictory findings of experimental research have led several authors to identify four methodological factors to control in such studies: (i) the physical fitness of subjects, (ii) the intensity and duration of physical exercise, (iii) the nature of the psychological task, and (iv) the time at which the psychological task is administered to the subjects. The present study focused on the first and second factors.

PURPOSE: The purpose of the present study was to investigate the interactive effects of exercise intensity and the physical activity level on human cognitive processing using P300.

METHODS: Twenty six participants (23.96 ± 0.69 yrs.) were classified into two groups (active: 13, inactive: 13) by International Physical Activity Questionnaires (IPAQ). The physical activity level and maximal oxygen uptake between groups were significantly different. They performed a go/no-go reaction time task in a control condition (no exercise), and again after low-, medium-, and high-intensity pedaling exercises. The go/no-go reaction time task consisted of a warning stimulus (S1) followed 2 sec later by an imperative stimulus (S2). A binural 2000 Hz tone was used for S1. For S2, green and red LEDs at the fixation point appeared randomly, with both colors appearing with the same probability. Subjects were instructed to press a button with their thumb as fast as possible whenever the green LED was presented, but were told not to respond to the red LED.

RESULTS: The P300 amplitude after medium-intensity pedaling exercise was significantly larger than after high-intensity pedaling exercise only in the inactive group. The P300 amplitude after medium-intensity pedaling exercise in the inactive group was larger, and after high-intensity pedaling exercise was smaller than in the active group.

CONCLUSIONS: The changes in P300 amplitude by differential exercise intensity observed only in the inactive group indicated that the inactive group is more sensitive to exercise intensity than the active group. When the exercise intensity is high, facilitative effects of cognitive processing by pedaling exercise are cancelled only in the inactive group. In other words, the active group is better able to withstand the detrimental effects of physical stress than the inactive group.

2899 Board #174 8:00 AM - 9:00 AM The Relationship of Aerobic Fitness to Interference Control in Preadolescent Children Sarah M. Buck, Erika L. Osher, Darla M. Castelli, Charles H. Hillman. University of Illinois, Urbana, IL.

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Physical inactivity during childhood has steadily increased in recent years, leading to an increased prevalence of being overweight and unfit. Despite a growing body of literature indicating that physical activity may ameliorate or protect against decrements in cognitive performance during adulthood, the relationship between physical inactivity and decrements in cognitive health in children remains absent from public health concerns.

PURPOSE: To investigate the relationship between aerobic fitness and executive control cognitive function using a task requiring variable amounts of interference control.

METHODS: Forty-eight preadolescent children (Mage = 9.3 yrs) were grouped (i.e., higher-fit, lower-fit) according to their performance on a field test of aerobic capacity (20.11 ± 3.21 yrs) performed a go/no-go reaction time task, which consisted of a warning stimulus (S1) followed 2 sec later by an imperative stimulus (S2). A binural 2000 Hz tone was used for S1. For S2, green and red LEDs at the fixation point appeared randomly, with both colors appearing with the same probability. Subjects were instructed to press a button with their thumb as fast as possible whenever the green LED was presented, but were told not to respond to the red LED.

RESULTS: Results indicated that higher-fit children performed more accurately across conditions of the flanker task when compared to lower-fit children, while group-differences were not observed for reaction time latency. Further, P1 and P3 component amplitudes of the stimulus-locked ERP were larger for higher- compared to lower-fit children across conditions of the flanker task indicating that fitness may be associated with early visual attention processes as well as the allocation of attentional resources to working memory in the stimulus environment.

CONCLUSION: The findings indicate that aerobic fitness may non-selectively benefit cognitive function on tasks requiring variable amounts of interference control during preadolescent childhood, and suggest that fitness may relate to improved cognitive health.
Purpose of this investigation was to compare the impact of walking, traditional resistance training, and water-based resistance training on memory function among aging women.

Methods: Twenty-two women with mean age of 53.1 ± 5.2 years were randomly assigned to three exercise groups: walking (WALK), traditional resistance training (RES), and water-based resistance training (WATER). The WALK group kept a daily log of miles and minutes walked, while the RES group was given membership to a university fitness center and prescribed a training program based on ACSM resistance training guidelines. The WATER group participated in a resistance exercise class conducted in the pool of the university fitness center. All participants were asked to complete two 15-minute training sessions per week for 36 weeks and to keep a weekly activity log. The Weschler Memory Scale - Third Edition Abbreviated was used to assess total memory (TM), immediate memory (IM), and delayed memory (DM). Measurements were taken at baseline and after 36 weeks of exercise. Twenty women completed both memory tests. A repeated measures analysis of variance was used to examine group differences, time differences, and group by time interactions.

Results: There was a significant difference in IM (F (1,117) = 21.55, p < .0002), DM (F (1,117) = 14.82, p = .00013), and TM (F (1,117) = 20.77, p = .00063) over time. Group differences and group by time interactions of all memory measures were non-significant. The results of this study indicate that mature women participating in three different training programs experienced similar significant improvements in memory after 36 weeks of training.

Conclusions: Exercise helps improve memory, but there is no difference in improvements due to the type of exercise. Among mature women, resistance training (land-based and water-based) causes similar gains in memory scores as walking.

Purpose: The purpose of this study was to test the immediate and delayed effects of an acute bout of moderate intensity exercise on cognitive function in healthy older adults. A repeated measures analysis of variance was used to examine group differences, time differences, and group by time interactions.

Results: There was a significant difference in IM (F (1,117) = 21.55, p < .0002), DM (F (1,117) = 14.82, p = .00013), and TM (F (1,117) = 20.77, p = .00063) over time. Group differences and group by time interactions of all memory measures were non-significant. The results of this study indicate that mature women participating in three different training programs experienced similar significant improvements in memory after 36 weeks of training.

Conclusions: Exercise helps improve memory, but there is no difference in improvements due to the type of exercise. Among mature women, resistance training (land-based and water-based) causes similar gains in memory scores as walking.

Purpose: The purpose of this study was to test the impact of physical activity on memory function independent of each other in older adults.

Methods: Older adults (N = 57, M age = 65.60) enrolled in a structured exercise program completed the Flanker task after performing both baseline and 20 minutes of cycle exercise only for hyper-reaction flow males. Previous research has shown that acute exercise blunts limb blood flow response to mental challenge in individuals exhibiting vascular hyper-reactivity. However, the duration of the dampening effect on limb blood flow reactivity caused by acute exercise is undetermined.

Purpose: To examine the time course of acute exercise on forearm blood flow (RBF) reactivity to mental challenge in males with hyper-reactive (n = 8) and normal limb blood flow response (n = 8). METHOD: Subjects (21±0.5 yr) performed a 10-min Stoop mental challenge 33 and 71 min after 20 min of cycle exercise ergometry exercise at 65-70% maximal oxygen uptake. On a separate occasion mental challenge was performed after an attention control task. All subjects completed both conditions and order was counterbalanced. RBF was measured using venous occlusion plethysmography during post-exercise recovery and Stroop. Blood pressure was measured using a Finapres.

Results: Post-exercise RBF reactivity (RBF change from baseline to Stroop) was significantly blunted compared to the control condition at 33 min (30±8.3% versus 115±26.2%) and 71 min (34±5.2% versus 75±25.1%) post exercise only for hyper-reactive blood flow males.

Conclusion: Acute exercise significantly reduces RBF response to mental challenge for at least 81 min in young adult males possessing vascular hyper-reactivity.

G-20 Free Communication/Poster – Psychological Factors in Exercise Adherence

SATURDAY, JUNE 3, 2006 8:00 AM - 11:00 AM
ROOM: Hall B
Methods: S-E for Ex, S-E, or SAT in the mildly depressed range. There were no significant differences among groups on (group \( F \)).

Conclusions: These findings speak to the importance of identifying characteristics of an exercise video instructor that inspire greater proxy efficacy and that boost exercise motivation among female beginner exercisers.

Methods: 80 female beginner exercisers (Mean age = 26.4 ± 7.4) performed a 30 min aerobic exercise bout led by a videotaped fitness instructor. They completed post-exercise measures of proxy efficacy (i.e., confidence in the instructor’s instructional and motivational abilities), perceived similarity to the instructor, perceived mastery of the exercise, enjoyment of the bout and intentions to use the exercise video in the future.

Results: Consistent with SCT, participants who perceived themselves to be more similar to the instructor in terms of age and physical attractiveness and who reported greater exercise mastery and enjoyment during the bout, also reported greater proxy efficacy (rs range from .19 to .44, \( p < .05 \)). Greater proxy efficacy was associated with stronger intentions to use the exercise video in the future (r = .37, \( p < .01 \)).

Conclusions: There is a need to develop a questionnaire that examines several barriers (e.g., lack of enjoyment, time, childcare, energy, motivation), which would allow researchers and clinicians to assess and intervene on specific types of barriers.

Methods: Nine participants who were either sedentary (i.e., exercising less than 90 minutes per week) or active (i.e., exercising 150 minutes or more each week) participated in a 6-month exercise trial. The Center for Epidemiological Studies Depression Scale (CESD), Physical Activity Group Environment Questionnaire on a sample (N=74) of older adults from a regional area of Central Queensland, Australia. To test the mediation effects, as outlined by Baron and Kenny (1986), three separate regression analyses were conducted.

Results: Analysts showed that attitude and perceived behavioral control were significant predictors of PA behavioral intention. The direct measure of subjective norm failed to display a mediating relationship.

Conclusions: The mediators relationships displayed between attitude and PA behavioral control and PA intention provide insight into potential mechanisms by which group cohesion may affect behavior. More research in the area is recommended.
RESULTS: The resting brachial artery diameter was 4.6 ± 0.7 mm, and FMD was 5.7 ± 4.2%. SBP was 130 ± 10 mmHg, DBP was 74 ± 8 mmHg, PP was 56 ± 9 mmHg, VO2max was 22 ± 5 ml/min/kg and % fat was 35 ± 7%. In regression analyses, each 10 mmHg higher PP was associated with a 1.4% decrease (p = 0.027) in FMD and each 10 ml/min/kg increase in VO2max was marginally associated with a 2.2% higher FMD (p = 0.054). There was no significant association between FMD and % fat, SBP, or DBP. In stepwise regression analysis only PP retained a significant association with FMD. In separate analyses by sex (data not shown), the patterns for these associations were similar.

CONCLUSIONS: While aerobic capacity appears to be a modest determinant of endothelial function even among sedentary individuals, PP, a surrogate marker of arterial stiffness, emerged as the only independent correlate of endothelial function. Fatness had no apparent association with endothelial function.
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lipoprotein (HDL), triglycerides (TG), insulin and glucose. Vascular function was assessed after a 12-hour fast and 24 hour abstinence of exercise and caffeine. Baseline diameter of the brachial artery was measured using a high-resolution ultrasound with a 10-MHz linear probe. FMD was induced by occluding the vessel for 5 minutes by inflation of a blood pressure cuff on the proximal arm to 40 mmHg above resting systolic pressure. Vessel diameter was measured continuously for 90 seconds following cuff release. Maximal oxygen consumption was assessed with a 15 Watt/minute ramped protocol using a bicycle ergometer.

**RESULTS:** No significant differences were found between groups at baseline. Statistical analysis was done using repeated measures ANOVA. There was a group by time interaction in peak VO2 (E: 24.88±5.33 to 27.91±4.95 ml/kg/min; C: 26.57±3.37 to 24.97±3.14 ml/kg/min) and a group difference for FMD (E: 3.07±3.45% to 9.27±5.13%; C: 3.07±3.45% to 3.36±4.38% (p<0.05). Mean insulin values of both groups were within normal ranges at the beginning of the study (E: 15.19±6.68 µU/ml; C: 19.8±11.94). However, at 12 weeks, insulin values in C had increased to the abnormal range, while the E group did not change (E: 13.16±8.46; C: 25.98±25.10).

**CONCLUSIONS:** Twelve weeks of aerobic exercise using DDR, significantly improved endothelial function and fitness in overweight children. Since endothelial dysfunction is an initiating factor in CVD and type 2 diabetes mellitus these results suggest that exercise can be effective in the primary prevention of these diseases.

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**2014 Board #189  8:00 AM - 9:00 AM**

Vascular Function in Individuals with a Predisposition for Type 2 Diabetes

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Alterations in vascular endothelial function are correlated to cardiovascular disease and can be detected in individuals prior to the development of heart or vascular diseases. Reduced vascular function has been found in type 2 diabetics but has not been studied in those who are at increased risk for disease due to family history.

**PURPOSE:** To determine if young individuals with a family history of type 2 diabetes (FH+) have reduced vascular function compared to individuals who have no history of type 2 diabetes in their family (FH-). The FH+ group was defined as individuals who had a parent who was diagnosed with type 2 diabetes after the age of 35 years old (n = 12). Individuals who did not have a grandparent or parent with type 2 diabetes were placed in the control group (n = 13).

**METHODS:** Male and females between the ages of 18-30 years old, who did not perform routine aerobic exercise, smoke, or who were obese (BMI < 32) were recruited to participate in this study. Vascular function was assessed by measuring flow mediated dilation (FMD) in the brachial artery in response to 5 minutes of cuff ischemia using quantitative Doppler Ultrasound.

**RESULTS:** Comparisons between groups indicated that FMD trended (p = 0.100) towards being reduced in the FH+ group, however, there was a significant difference between groups on age (28 ± 4 vs. 23 ± 3 for FH+ vs. FH-, respectively; p = 0.003). Thus, an ANCOVA was used to control differences between groups on FMD. There was no significant difference in FMD between genders, therefore, males and females were combined to determine differences between groups on FMD. FMD was not significantly different between groups after controlling for differences in age (6.6 ± 3.7 vs. 9.0 ± 3.6 for FH+ vs. FH-, respectively; p = 0.293).

**CONCLUSIONS:** Significant reductions in FMD in healthy, young individuals with a family history of type 2 diabetes compared to those with no family history were not found. The data trends towards FH+ individuals having reduced vascular function; however, due to a small sample size, we may have limited power to detect these differences. Thus, further data collection is necessary to completely elucidate the effects of family history of type 2 diabetes on vascular function.

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**2015 Board #190  9:00 AM - 10:00 AM**

Insulin Sensitivity and Endothelial Function in College-Age Subjects with Family History of Type 2 Diabetes

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The pre-clinical phase of type 2 diabetes may precede overt diabetes by 10-12 years and includes increasing levels of insulin resistance (IR). Evidence suggests that the progression of insulin resistance to type 2 diabetes parallels the progression of endothelial dysfunction to atherosclerosis but it is not known how these abnormalities can be detected in the pre-diabetic state. To our knowledge healthy college-age adults are totally unrepresented in this literature especially with control for known independent variables that affect endothelial function (obesity, hypertension, dysglycemia, exercise).

**PURPOSE:** To investigate levels of reduced insulin sensitivity concomitant with the level of impairment in macrovascular endothelial function in the brachial artery of healthy, normoglycemic college-age subjects with a family history of Type 2 diabetes.

**METHODS:** Six young (19-26 y), healthy subjects (3M/3F) with a family history of Type 2 diabetes performed an OGTT [1 g/kg body weight]. Venous blood samples were taken at 0, 30, 45, 60, 75, 90 and 120 min. for measurements of plasma glucose (YSI 2300 glucose oxidase analyzer) and insulin (Mercodia Insulin ELISA). Hepatic insulin sensitivity index was calculated by the HOMA (ISI_MAHOM_Area) Incremental areas under the curve (AUCs-baseline) were used to determined mean OGTT glucose and mean OGTT insulin for a measure of whole-body insulin sensitivity (ISI_COMPOSITE).

**RESULTS:** There was a wide intersubject range of whole body insulin sensitivity (ISI_MAHOM_Area=15.5-18.48) which was highly correlated (r=0.925) with ISI_COMPOSITE. The within normal ranges at the beginning of the study (E: 13.16±6.68 µU/ml; C: 19.8±11.94). However, at 12 weeks, insulin values in C had increased to the abnormal range, while the E group did not change (E: 13.16±8.46; C: 25.98±25.10).

**CONCLUSIONS:** Young college-age adults with a family history of Type 2 diabetes but without clinical symptoms of pre-diabetes or the metabolic syndrome may demonstrate reduced insulin sensitivity that is correlated with markers of macrovascular endothelial dysfunction.

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