TITLE ONLY

1. **Effect of Carbohydrate-Protein Supplement Timing on Exercise-Induced Muscle Damage: 1997: Board #148 9:30 AM - 10:30 AM.**
   Medicine & Science in Sports & Exercise. 38(5) Supplement:S341, May 2006.
   Jim White; Krista Austin; Beau Greer; Noah St. John; Lynn Panton, FACSM; Lynn Panton, FACSM
2. **The Effect of Intermittent Hypoxic Exposure on Hematological Markers and Exercise Performance: 903: 3:15 PM - 3:30 PM.**
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3. **Changes In Oxygenation Of Peripheral Muscle During Aerobic Exercise In Persons With COPD: 1190 Board #45 2:00 PM - 3:30 PM.**
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   Krista G. Austin; Larry Mengelkoch; Jennifer Hansen; Ed Shahady; Prawee Sirithienthad; Lynn Panton, FACSM
4. **The Effects Of Prolonged Endurance Exercise On Markers Of Myocardial Damage: 495 Board #86 3:30 PM - 5:00 PM.**
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   Beau K. Greer; Ben Bograd; Sara A. Chelland; Krista G. Austin; Robert J. Moffatt
5. **Regulation of Erythropoietin Production and Iron Metabolism: Control by Arterial Oxyhemoglobin Saturation vs. Set Altitude Exposure.**
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6. **Iron Status of Young Males and Females Performing Weight-Training Exercise.**
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   KEITH C. DERUISSEAU; LARA M. ROBERTS; MICHAEL R. KUSHNICK; ALLISON M. EVANS; KRISTA AUSTIN; EMILY M. HAYMES
7. **RELIABILITY OF NEAR-INFRARED SPECTROSCOPY FOR DETERMINATION OF MUSCLE OXYGEN SATURATION DURING EXERCISE.**
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8. **THERMOREGULATION IN BURN PATIENTS DURING EXERCISE.**
   Medicine & Science in Sports & Exercise. 34(5) Supplement 1:S224, May 2002.
   K G. Austin; J F. Hansbrough; C Dore; J Noordenbos; M J. Buono, FACSM

TITLE WITH ABSTRACT

1. **Effect of Carbohydrate-Protein Supplement Timing on Exercise-Induced Muscle Damage: 1997: Board #148 9:30 AM - 10:30 AM.**
   Medicine & Science in Sports & Exercise. 38(5) Supplement:S341, May 2006.
   Jim White; Krista Austin; Beau Greer; Noah St. John; Lynn Panton, FACSM; Lynn Panton, FACSM

PURPOSE: The purpose of this study was to examine if the timing of a carbohydrate/protein supplement would have an effect on post resistance exercise muscle damage, function and soreness.

METHODS: Twenty seven untrained male subjects (21±2yrs) were given a supplement before or after a bout of resistance exercise. Subjects were randomly assigned to three groups. The pre exercise group (Pre, n=9) received a carbohydrate/ protein drink immediately before the exercise bout and a placebo drink immediately after. The post

exercise group (Post, n=9) received a placebo drink immediately before the exercise bout and a carbohydrate/protein drink after. The control group (Con, n=9) received a placebo drink before and after the bout of exercise. Subjects performed 50 eccentric quadriceps contractions on an isokinetic dynamometer. Tests for serum creatine kinase (CK), maximal voluntary contraction (MVC) and muscle soreness scores were recorded before the exercise bout then again at six, 24, 48, 72, and 96 hours post exercise. Repeated measures ANOVA (3 × 6; group x time) were used to analyze dependent measures. Significance was accepted at $P \leq 0.05$

RESULTS: There were no group by time interactions for any of the measured parameters; however, there were time main effects. Serum CK increased for all groups ($P<0.01$) when compared to pre exercise values (101±42U/L) reaching its peak at 72 (967±1782U/L) and 96 hours (896±1294U/L) post exercise. Maximal voluntary contraction (MVC) was significantly reduced ($P<0.01$) on average for all groups by 28.9±12% at six hours then dropped to 31.4±14% at 24 hours before gradually returning to pre exercise values. Muscle soreness scores were also significantly increased ($P<0.01$) from pre exercise values peaking at 48 hours post exercise.

CONCLUSIONS: These findings suggest that the eccentric resistance exercise caused significant muscle damage, soreness and loss of strength in all groups. However, the timing or ingestion of the carbohydrate/protein supplement had no effect on these variables.

2. **The Effect of Intermittent Hypoxic Exposure on Hematological Markers and Exercise Performance: 903: 3:15 PM - 3:30 PM.**
   Medicine & Science in Sports & Exercise. 38(5) Supplement:S76, May 2006.
   Krista G. Austin; Emily Haymes, FACSM

PURPOSE: The primary purpose of this study was to examine the erythropoietic response to intermittent hypoxic exposure (IHE) vs. intermittent hypoxic training (IHT), and to assess the effects of IHE and IHT on endurance performance.

METHODS: Nine participants completed two experimental normobaric hypoxic trials (IHE and IHT) and a control (CTR) period of 28 days. Normobaric hypoxic trials were completed at 14.4% O_2 concentration (3,000m) for two hours per day and consisted of: 1) a resting passive exposure and 2) cycling exercise at 60-70% of heart rate reserve. Assessment of erythropoietin (Epo), free testosterone (FT) hemoglobin (Hb), hematocrit (Hct), reticulocytes (Rct), serum iron (SI), transferring saturation (TS), transferrin recptor (sTfr), ferritin (SF) was taken on days 0, 1,5, 14, 28 and 1 day after each trial. Evaluation of VO_{2max}, lactate threshold (LT), submaximal exercise capacity and time trial (TT) was conducted before and after each trial.

RESULTS: Results of a 3 × 6 ANO VA for measures of Epo, Hb, Hct, Rct, SI, TIBC, sTfr, and SF did not demonstrate any significant trial by time interactions.

RESULTS: of a 3 × 2 ANOVA for measures of performance did not reveal any significant trial by time interactions for VO_{2max}, LT, and submaximal exercise capacity. A significant trial by time interaction was found for TT. TT was significantly faster following IHT when compared to pre-exposure times.

CONCLUSION: It is concluded that IHT provides greater gains in time trial performance than training at sea level, and that IHE does not alter factors related to enhancement of performance.

Supported by grants from the American College of Sports Medicine, NASA and Hypoxico Tent Systems, Inc

3. **Changes In Oxygenation Of Peripheral Muscle During Aerobic Exercise In Persons With COPD: 1190 Board #45 2:00 PM - 3:30 PM.**
   Medicine & Science in Sports & Exercise. 37(5) Supplement:S226, May 2005.
   Krista G. Austin; Larry Mengelkoch; Jennifer Hansen; Ed Shahady; Prawee Sirithienthad; Lynn Panton, FACSM

Studies on exercise intolerance in persons with chronic obstructive pulmonary disease (COPD) have primarily focused on limitations in ventilation and gas exchange. However, recent studies have suggested that peripheral skeletal muscle is mechanically compromised in this group, and may play an additional role in the inability of persons with COPD to exercise.

PURPOSE

The purpose of this study was to compare changes in peripheral muscle oxygen utilization in persons with COPD compared to healthy controls.

METHODS

Eight persons with moderate COPD (68±15 yrs; FEV_1 = 1.0±0.3 l/min, 44±11% predicted) and eight healthy age, weight and activity matched controls (69±12 yrs; FEV_1 = 1.8±0.6 l/min, 70±12% predicted) performed a submaximal (70% of maximal heart rate) graded exercise test (GXT), and a six-minute steady state exercise test at 50% of the workload obtained during the submaximal GXT. Measurements included oxygen uptake (VO_2), heart rate (HR), arterial oxygen saturation (SaO_2) and peripheral muscle oxygenation (StO_2) at rest, during exercise, and recovery.

RESULTS

Independent t-tests revealed significantly greater workloads for controls at peak (73.8±36.2 vs. 36.9±11.9 watts) and steady state exercise (36.9±18.1 vs. 18.1±6.5 watts) when compared to COPD. Results of a repeated measures ANOVA (group × time) did not reveal any significant differences in StO_2 between the groups (Control vs. COPD): at rest (29.5±22.8 vs. 30.4±17.3 %), during peak (29.4±19.4 vs. 26.5±15.9%) and constant

load exercise (28.1±12.8 vs. 34.8±23.9%) and during the first (48.0±28.9 vs. 42.6±19.4%) and fifth (46.6±29.1 vs. 44.3±21.7%) minute of recovery from exercise. A significant main effect for group was demonstrated for SaO_2 during the submaximal GXT and steady state exercise test. Individuals with COPD demonstrated significantly lower SaO_2 values for the GXT at rest (96.8±1.0 vs. 93.5±1.7%) and during the first minute of recovery from exercise (96.0±1.3 vs. 92.8±2.4%). During steady state exercise, SaO2 was significantly higher in control participants at rest (96.3±1.3 vs. 93.6±1.5%), at 3 minutes of exercise (95.8±2.1 vs. 92.9±2.6%) and during the fifth minute of recovery from exercise (96.8±0.7 vs. 94.9±1.0%). Regression analysis was utilized to examine the relationship between measures of pulmonary function (FEV1, FVC, % FEV1/FVC), StO_2 and SaO_2, however no significant correlations were found.

CONCLUSION

These results suggest that peripheral skeletal muscle oxygenation is not compromised in individuals with moderate COPD during submaximal aerobic exercise, and that limitations in exercise capacity are most likely a result of muscle disuse and poor lung function.

Supported by Hutchinson Technology, Inc., Hutchinson, Minnesota

4. **The Effects Of Prolonged Endurance Exercise On Markers Of Myocardial Damage: 495 Board #86 3:30 PM - 5:00 PM.**
   Medicine & Science in Sports & Exercise. 37(5) Supplement:S93, May 2005.
   Beau K. Greer; Ben Bograd; Sara A. Chelland; Krista G. Austin; Robert J. Moffatt

Exercise induced cardiac fatigue can be identified by a multitude of symptoms including transitory elevation of cardiac markers indicative of myocardial damage that have been recorded following prolonged endurance exercise (PEE). To date, the study of exercise-induced cardiac fatigue has focused primarily on elite athletes during long duration events such as marathons and Ironman triathlons.

PURPOSE

The present study was designed to examine cardiac function during three consecutive bouts of PEE in healthy, non-competitive males for the determination of cardiac myocyte damage indicative of cardiac fatigue.

METHODS

Nine fit college-age males (VO_2 max 50.7 ± 3.8 ml/kg/min) performed exhaustive cardiovascular exercise on three successive days. The exercise protocol consisted of a 3-stage treadmill run (Stage 1: 10% above ventilatory threshold; Stage 2: a 5% reduction in work rate; Stage 3: an additional 5% reduction in work rate performed until volitional exhaustion). Fasting venous blood samples were taken immediately before (resting) and

after each exercise bout. Creatine kinase (CK), creatine kinase-MB (CK-MB), and cardiac troponin-T (cTnT) were analyzed and adjusted for shifts in plasma volume. Data were analyzed using repeated measures ANOVA with a Tukey post hoc test.

RESULTS

The individual times for exercise bouts 1, 2, and 3 were 70.6 ± 31.4, 70.0 ± 25.4, and 63.90 ± 24.0 minutes, respectively. The average exercise intensity was 81.9 ± 4.4% of estimated VO_2 max. Although significant CK increases of 208% (73.9 ± 77.5 U/L, pre-bout1; 227.7 ± 135.5 U/L, post-bout3) were found, evaluation of cardiac markers (CK-MB, cTnT) revealed no signs of cardiac fatigue. CK-MB activity values increased but were within the normal reference range (0-24 U/L). In addition, no elevation in cTnT was detected.

CONCLUSIONS

Data from the present study suggests that PEE does not induce myocardial damage in healthy, fit male subjects. Considering alternate protocols that have caused cardiac fatigue, the exercise intensity in the present study may have inhibited a duration sufficient to induce a similar response.

5. **Regulation of Erythropoietin Production and Iron Metabolism: Control by Arterial Oxyhemoglobin Saturation vs. Set Altitude Exposure.**
   Medicine & Science in Sports & Exercise. 36(5) Supplement:S108, May 2004.
   Krista G. Austin; Karen Daigle; Jason Cowman; Ben Bograd; Emily Haymes, FACSM

The rise in serum erythropoietin (Epo) concentration due to hypoxia has shown great individual variability. It has been proposed that the magnitude of Epo release is different due to varying magnitudes of hypoxic thresholds (as indicated by arterial oxyhemoglobin saturation [SaO2]). Prior studies have demonstrated an inverse relationship between Epo production and SaO2, suggesting that the variation in Epo levels can be attributed to the variation in SaO2. **Purpose:** The purpose of this study was to examine the variations seen in the Epo response by comparing a normobaric hypoxic exposure that is controlled by a set altitude vs. one that is controlled by the level of an individual's desaturation. **Methods:** Seven competitive collegiate runners performed two experimental trials of continuous normobaric hypoxia (8 hours) for 5 consecutive nights: 1) 14.2% oxygen content (3100 m) and 2) arterial oxygen saturation of 89%. For each exposure changes in serum Epo (Δ% Epo) were determined by radioimmunoassay, serum ferritin (Δ% Fe) by immunoradiometric assay and for serum transferrin receptor (Δ% Tfr) by ELISA. Whole blood samples were utilized to determine changes in hemoglobin (Δ% Hb), hematocrit (Δ% Hct), and reticulocyte count (Δ% Rct). A 2 × 2 ANOVA was utilized to examine differences for trial × time effects and a one-way ANOVA for examining differences in Δ% for all measures. Ranges of Δ% and effect size for each trial were also determined. **Results:** Results of the 2 × 2 ANOVA and one-way ANOVA revealed no significant differences between the two exposures for all measures. For trial 1 (3100m)

Δ% Epo ranged from -6.3% to + 101.1% providing an effect size of 0.13. Trial 2 (89%) Δ% Epo ranged from +45.6% to +55.9% providing an effect size of 1.43. **Conclusion:** Results indicate that controlling hypoxic exposures by SaO2 minimizes the variation seen in Epo production, and suggests that individual hypoxic thresholds need to be taken into account when examining responses to hypoxia.

Supported by Hypoxico Tent Systems, Inc and a grant from the Gatorade Sport Science Institute

6. **Iron Status of Young Males and Females Performing Weight-Training Exercise.**
   Medicine & Science in Sports & Exercise. 36(2):241-248, February 2004.
   KEITH C. DERUISSEAU; LARA M. ROBERTS; MICHAEL R. KUSHNICK; ALLISON M. EVANS; KRISTA AUSTIN; EMILY M. HAYMES

Purpose: To determine the effect of weight training on measures of iron status in young males and females.

Methods: Forty (27 female, 13 male) non-weight-trained college age subjects participated in a 12-wk weight-training program conducted 3 $d \cdot wk^{-1}$. Blood samples and food diaries were obtained pretraining and at 4-wk intervals. Blood was analyzed for hemoglobin, hematocrit, serum iron (SI), total iron binding capacity (TIBC), transferrin saturation (TS), serum ferritin (SF), soluble transferrin receptor (sTfR), and creatine kinase (CK). Subjects were grouped by SF level (FL, females ≤ 20 $\mu g \cdot L^{-1}$; FN, females > 20 $\mu g \cdot L^{-1}$; ML, males ≤ 45 $\mu g \cdot L^{-1}$; MN, males ≥ 50 $\mu g \cdot L^{-1}$) to determine the impact of initial iron status on measured responses.

Results: Weight training increased strength and fat-free mass and decreased levels of percent body fat. Hemoglobin concentration declined after 12 wk of training (13.7 ± 1.6 vs 13.2 ± 1.7 $g \cdot dL^{-1}$), independent of gender or initial iron status. Only the MN group experienced a decline in SF level after 8 wk of training (129.7 ± 77.9 vs 102.0 ± 57.8 $\mu g \cdot L^{-1}$). No significant changes were observed for hematocrit, SI, TIBC, TS, sTfR, or CK measures. Total iron intake, but not heme or bioavailable iron intakes, declined at the 12th week of training compared with baseline (13.4 ± 6.5 vs 10.7 ± 4.8 $mg \cdot d^{-1}$) and was not significantly correlated with hematological or iron status measures.

Conclusions: Hemoglobin concentration declines without alterations in SI, TIBC, TS, or sTfR after 12 wk of weight training. The SF level of males with adequate iron status is lowered with weight training but not among females or males with low iron status.

Traditionally, studies examining the effect of exercise on measures of iron status have focused on endurance athletes. However, weight training has become an important part of exercise programs among both competitive and recreational athletes. This form of training may adversely affect measures of iron status. Damage to red blood cells incurred

as a result of mechanical and oxidative stresses may lead to increased intravascular hemolysis and iron turnover (15,22). An increased level of fat-free mass (FFM) may increase tissue iron demand and result in elevated soluble transferrin receptor (sTfR) levels (19). Additionally, exercise-induced muscle damage may be associated with an acute phase inflammatory response. Indices of iron status including serum iron (SI), serum ferritin (SF), total iron binding capacity (TIBC), and transferrin saturation (TS) are affected by inflammation (11).

Limited data suggest that an alteration in iron status can occur among young individuals participating in weight-training exercise. Young males have experienced impaired measures of iron transport and storage (13,22) and lower hemoglobin levels (22) after 6-8 wk of weight training. A preliminary investigation involving young females has reported an improved iron status following twelve weeks of aerobic-resistance exercise (14). Therefore, the main purpose of this investigation was to further examine the relationship between weight-training exercise and measures of iron status during a program of progressive weight training involving young males and females. In addition, a second purpose was to assess the effect of exercise induced muscle damage on SF levels.

Individuals with initially low iron status were hypothesized to experience a decline in the levels of hemoglobin, SI, TS, and elevations in sTfR as a result of the weight-training program. Individuals with initially adequate iron stores were expected to experience decreased SF levels with no change in hemoglobin or measures of iron transport.

7. **RELIABILITY OF NEAR-INFRARED SPECTROSCOPY FOR DETERMINATION OF MUSCLE OXYGEN SATURATION DURING EXERCISE.**
   Medicine & Science in Sports & Exercise. 35(5) Supplement 1:S193, May 2003.
   K G. Austin; K Daigle; J Cowman; S Chelland; E M. Haymes, FACSM; P Patterson

Near-infrared spectroscopy is a technological tool that is currently used to assess changes in oxyhemoglobin and therefore the oxygen saturation of the muscle during exercise and recovery from exercise. Oxygen uptake, blood lactate levels and heart rate are reliable methods for determining intensity of exercise.

PURPOSE

The purpose of this study was to assess the reliability of near-infrared spectroscopy in determining muscle oxygen saturation in the vastus lateralis during cycling and the gastrocnemius during running for exercise intensities at lactate threshold (LT) and maximal effort (VO2max).

METHODS

Twenty-three runners and twenty-one cyclists completed two incremental tests (3 minute stages) to maximal exhaustion 5 to 7 days apart. Oxygen consumption (VO2), heart rate (HR), blood lactate (HLa), and muscle oxygen saturation (StO2) are reported for LT and VO2max. Test-retest reliability was determined from an intraclass correlation coefficient (R; 95%CI) obtained from a one-way analysis of variance. The root mean square error (RMSE) was also reported.

RESULTS

Reliability of muscle StO2 for the gastrocnemious at lactate threshold was r = .87 (95% CI = .72 to .94; RMSE = 5.34) and at maximal effort was r = .88 (95% CI = .73 to .94; RMSE = 5.00). Reliability of muscle StO2 for the vastus lateralis at lactate threshold was r = .94 (95%CI = .87 to .98; RMSE = 4.09) and at maximal effort was r = .99 (95%CI = .98 to .99; RMSE = 1.61).

CONCLUSION

Reliability results indicate that near-infrared spectroscopy is a reliable instrument with standard errors ranging from 1.6% to 5.3%. Near-infrared spectroscopy appears to be an additional tool that can be utilized when examining exercise intensity.

Supported by Hutchinson Technology, Inc., Hutchinson, Minnesota

8. **THERMOREGULATION IN BURN PATIENTS DURING EXERCISE.**
Medicine & Science in Sports & Exercise. 34(5) Supplement 1:S224, May 2002.
K G. Austin; J F. Hansbrough; C Dore; J Noordenbos; M J. Buono, FACSM

The body's ability to regulate core temperature during exercise is highly dependent on the dissipation of heat via the evaporation of sweat. Burn patients with third degree burns no longer have the full integrity of their dermis and epidermis, and thus have a decreased sweating capability.

PURPOSE:

The purpose of this study was to assess the ability of patients with 30-40/ % and 60/ % or greater total body surface area (TBSA) burn to regulate their core temperature during exercise.

METHODS:

Two groups (A= 3, B = 3) of subjects with healed third degree burns (34.0/%/ + 1.4 and 77.7/%/+12.4 of TBSA, respectively) and a group of unburned subjects (C = 2) exercised for 1 hour on a cycle ergometer at 75 W (watts) in an environmental chamber set at 35 °C and 60/% RH (relative humidity). Subjects were monitored for rectal (Tre) and skin (Tsk)

temperatures, heart rate (HR), whole body sweat rate (WBSR), skin blood flow (SBF) and active sweat gland density (/# per cm 2) in unburned, burned and harvested skin.

RESULTS:

Groups A and B demonstrated that patients with burns on 30-40/% and 60/% of their TBSA do not show a significant intolerance to the heat, as was evidenced by only a moderate rise in rectal temperature and heart rate during exercise. Furthemore, the responses were similar to those of Group C. This indicates that the cessation of exercise in the heat by some burn patients (before 60 minutes) was not the result of hyperthermia or intense cardiovascular demand.

CONCLUSION:

The results demonstrate that patients with burns on 60/% or greater TBSA do not show a significant intolerance to moderate exercise in the heat, as evidenced by only a moderate rise in rectal temperature and heart rate. Furthermore, the responses were similar to those of the unburned subjects.