in specific populations. Due to problems with current methods of defining fat pixel thresholds, we suggest the development of computerized algorithms to portray all pixels of a given tissue with the same pixel value.

Walker, Jerilyn A. THE EFFECT OF BROMELAIN ON RECOVERY FROM EXERCISE-INDUCED SKELETAL MUSCLE INJURY, 1990. M.S., State University of New York at Buffalo (Howard W. Burton). (56pp 1 f $4.00) PE 3343

Bromelain, a proteolytic enzyme which is extracted from pineapple stems, reportedly has therapeutic effects in the treatment of inflammation and soft tissue injuries. The possible use of bromelain in the treatment of exercise induced skeletal muscle injury has not been systematically investigated. We tested the hypothesis that bromelain accelerates the recovery of exercise-induced skeletal muscle injury, as measured by maximum isometric tetanic force (P0). Syrian golden hamsters were anesthetized and the left foot was strapped to a motorized foot pedal. The extensor digitorum longus (EDL) muscle was injured using active lengthening exercise, induced by continuous flexion/extension cycles (21 cycles/min.) synchronized with electric stimulation during extension. The stimulus was 0.2 ms at supramaximal voltage and delivered at 150 Hz. This protocol was repeated for three 5-min sets, each separated by a 5-min rest. Injured animals were randomly assigned to a 0-day group, which was evaluated 3 hours post-exercise, or a non treated, NT, or bromelain-treated, T group, and evaluated at 3, 7 or 14 days post-exercise. Following injury, T groups received 10 mg/kg b.w. of bromelain daily. NT groups received an equal amount of distilled water. P0 was measured in vitro for injured EDL muscles and compared to P0 of non injured contralateral control muscles. Muscles were placed in formalin fixative and saved for analysis of fiber count and muscle cross sectional area. Compared to control muscles, P was 18% lower three hours post-exercise (0-day) and 25% lower 3 days post-exercise in the NT group (P<0.05). P0 in the 3-day T group was reduced by 14%, as compared to control muscles. P0 in muscles from the T group was significantly greater than P0 in muscles from the NT group 3, 7 and 14 days post exercise (P<0.05). P0 in both groups was still significantly lower than control P0 at 14 days. The number of muscle fibers per cross section was significantly reduced in the 3-day NT group compared to controls, while the number of muscle fibers in the 3-day T group was not significantly different from controls. We conclude that oral bromelain treatments of 10 mg/kg daily significantly improve recovery of force production following exercise-induced skeletal muscle injury. Bromelain may influence delayed-onset skeletal muscle damage via the inflammatory response.

Wilson, Timm. EFFECTS OF A MODIFIED STRAIGHT LEG RAISE ON STRENGTH AND MUSCLE ACTIVITY OF THE VASTUS MEDIALIS OBLIQUE IN PATIENTS WITH PATELLOFEMORAL MALALIGNMENT, 1993. M.S., Ball State University (Gale Gehlsen). (64pp 1 f $4.00) PE 3502

The purpose of this study was to determine the effectiveness of a modified sitting position straight leg raise on vastus medialis oblique (VMO) strength and EMG activity as compared to a traditional straight leg raise. A total of twenty-three subjects were recruited for this study. The subjects were randomly assigned to

mometer Model 2A3 and procedures recommended by the American Society of Hand Therapists. The statistical results revealed a significant difference (p<.0001) between males and females, and a significant difference (p<.0001) between the males and females for both the right and left hands. Males had a higher grip strength than females. A significant difference (p<.0001) was also found between age groups and between the right and left hands among the age groups. Grip strength was shown to increase as age increased.

Tanaka, Hirofumi. DRY-LAND STRENGTH TRAINING FOR COMPETITIVE SWIMMING: INTERACTION BETWEEN STRENGTH TRAINING AND SWIM TRAINING, 1992. M.S., Ball State University (David L. Costill). (80pp 1 f $4.00) PE 3497

In an attempt to determine the value of dry-land weight training on swimming performance, two groups of twenty four intercollegiate male swimmers were equated based upon pre-swimming performance, swim power values, stroke specialities, and collegiate swimming experience. At the start of a swimming season there were no significant differences (p>0.05) between the swim training group (SWIM, N=12) and the combined weight and swim training group (COMBO, N=12). Throughout the 13 weeks of their competitive swimming season, both SWIM and COMBO swam together six days a week. In addition, the COMBO engaged in a weight training program three days a week between the third and eleventh weeks (for eight weeks) of the season. The weight training program, using free weights, was intended to simulate arm actions and muscle actions similar to those used during front crawl swimming. Both COMBO and SWIM groups had insignificant but similar power gains (p>0.05) as measured on the biokinetic swim bench and during a tethered swim. Swimmers in both groups experienced a significant (p<0.05) increase in competitive swim performance from 1991 to 1992 (0.89 ± 0.60% in COMBO and 0.87 ± 0.40% in SWIM) whereas no change in distance per stroke (p>0.05) was observed throughout the course of this investigation. Mean total testosterone levels were not altered during the weight training period in either group. No significant (p>0.05) differences were found between the groups in any of the swim power and swimming performance tests. In this investigation, dry-land weight training did not improve swimming performance despite the fact that the COMBO was able to increase the weights used during strength training by 25 to 35%. The lack of positive transfer between dry-land strength gains and swimming propulsive force may be due to the specificity of training.


MR images of phantoms containing known volumes of fat and eight young male volunteers (mean age=22 years) were collected. Each subject was scanned twice. Images were created using a spin echo sequence using a TE of 12 msec, TR of 150 msec, and 20 mm cross sectional slices. Known volumes of fat were underestimated by 10% using the method which defines the fat pixel threshold as the midpoint between the fat and lean pixel distributions. Total corrected MRI %BF using this method was 17.66% which was not significantly different (p<.05) from 15.87% determined by the Siri equation. Test retest total body fat volumes had a correlation of 0.99. Imaging of the total body was timely and incurred very little discomfort for subjects. This appears to be the first attempt in quantifying total body fat from MR images and may be a notable first step to clarify the relationship between body density and %BF in specific populations.
one of the following groups: (group I) modified straight leg raise (MSLR), and (group II) straight leg raise (SLR). The exercise program was three weeks long. University procedures for the protection of human subjects were followed. The subjects began with a 5 minute warm-up on a Cybex stationary bike set at 90 revolutions/minute. The subject then had electrodes placed on the Vastus Lateralis (VL) and Vastus Medialis Oblique (VMO). A Macintosh computer was used to record the EMG data. The subject then performed a standard Cybex test for knee flexion and extension. The Cybex dynamometer was placed at the knee joint line, the chair back tilt was at 85 degrees, the hip, chest, and thigh restraints were all fastened. The subjects in group I (Modified sitting SLR) and II (SLR) then returned the next day for their first rehabilitation lesson. Each subject group then participated in their respected exercise program for a total of three weeks. After three weeks of rehabilitation, the subjects retested using the same procedures followed in the pretest. A two tailed t-test was used to determine significance of the difference between means of the two groups. No significant differences were found between the two groups.

PHYSIOLOGY AND EXERCISE EPIDEMIOLOGY

Arce, Joan C. TESTOSTERONE AND PHYSICAL ACTIVITY: A META-ANALYSIS, 1992. M.S., Springfield College (Barbara E. Jensen). (176pp $8.00) PH 1301

The purpose of this investigation was to determine the effects of physical activity on levels of testosterone in men. The research method utilized for this investigation was a meta-analysis review technique. All articles determining testosterone adaptations to physical training or the testosterone responses to acute exercise were screened for inclusion in this meta-analysis. Effect sizes were calculated for all those articles which clearly identified means and standard deviations. The results of the meta-analysis indicated that testosterone adaptations to physical training may differ between exercise modes. Thus, while endurance training decreases levels of testosterone in men, resistance training produces increases in levels of circulating testosterone. Furthermore, this meta-analysis suggested that a significant positive relationship exists between the duration of the resistance training and the increase in testosterone levels. The response of testosterone to acute bouts of resistance training was determined by the time of day the test was performed. Testosterone responses to acute submaximal aerobic exercise were not related with the intensity or duration of the exercise. However, maximal aerobic exercise produces an initial increase followed by a substantial decrease in testosterone concentrations. In conclusion, physical exercise modifies levels of testosterone in men as indicated by the results of this meta-analysis.


In a placebo-controlled, double-blind study, the age related differences in metabolic rate, blood pressure, heart rate, and behavioral mood state response to caffeine ingestion (5 mg·kg FFM⁻¹, fat-free mass) were examined in 10 older (65 to 80 years) and 10 younger (19 to 26 years) men who were habitual consumers of caffeine (M=145 mg·day⁻¹). Resting metabolic rate, blood pressure, and subjective mood state were measured before and after placebo and caffeine ingestion. Following caffeine: metabolic rate increased significantly (p<.05) in both groups and no differences (p>.05) were noted between groups; systolic blood pressure increased significantly (p<.05) in younger and older men, whereas diastolic blood pressure showed a trend (p=.07) for an increase only in the older men, although there were no differences (p>.05) between groups; heart rate response and self-reported mood state showed no change in either group following caffeine ingestion. In conclusion, this investigation showed that younger and older men have similar increases (10%) in metabolic rate and systolic blood pressure, whereas diastolic blood pressure tends to increase only in the older men following caffeine ingestion. Heart rate and self-reported mood states do not appear to be affected by caffeine intake. The results of this study suggest that older males do not demonstrate an impaired metabolic response to caffeine ingestion compared to younger males.
The existence of a relationship among indices of blood magnesium and maximal aerobic capacity is debatable. When observed, it has been suggested that the relationship is dependent upon physical training status. To explore this hypothesis further, 35 healthy active male cyclists (24±6yr) who differed in training indices were assessed for aerobic capacity (62.0±8.4 ml·kg⁻¹·min⁻¹) 12 hr post prandial using a continuous, incremental, progressive cycle ergometer test to exhaustion. Prior to this, an 8 ml venous blood sample was collected for quantification of whole blood and plasma Mg via wet ashing with nitric acid and analysis by atomic absorption spectrophotometry. Erythrocyte Mg was calculated from these measures and hematocrit. Dietary intake of Mg was evaluated through 4 day dietary record and use of a computer program (Nutritonist III). Similar to previous reports for athletes, blood Mg indices were low when compared to commonly reported values for nonathletes (1.27±0.09 mM, 2.10±0.22 mM, 0.59±0.06 mM; whole blood, erythrocyte and plasma, resp). No significant relationships were identified between aerobic capacity and Mg indices. Conversely, erythrocyte Mg was related to estimates of average intensity of weekly training (r=+.58). Mg intake was associated with the frequency and duration of daily work bouts (r=+.44, & +.36 resp), and to total exercise energy expenditure during the 4-day recording period. Aerobic capacity was related to cumulative weekly exercise energy expenditure (r=+.36). In conclusion, the results confirm reports of low blood Mg indices in athletes when compared to standard values. However, significant relationships were observed and estimated VO₂max (N=49) resulted in radj=+.81, SEE=+.2297 * WEIGHT (kg) - 0.1858 * STEADY-STATE HR (bpm), (N=51) yielded the following validation (V) model: VO₂max=61.94 + 8.663 * GENDER (0=female; 1=male) + 4.02 SPEED (mile·hr⁻¹) - 0.2297 * WEIGHT (kg) - 0.1858 * STEADY-STATE HR (bpm), (radj=+.87, SEE=+.36 ml·kg⁻¹·min⁻¹). Cross-validation (CV) comparing observed and estimated VO₂max (N=49) resulted in radj=+.81, SEE=+.41 ml·kg⁻¹·min⁻¹. This submaximal treadmill test provides a valid and convenient estimation of VO₂max and appears suitable for prescribing individualized jogging programs.

This study examined the relationship of aerobic fitness of children in North Carolina to other North American and European children. Aerobic fitness was estimated by predicting maximal oxygen uptake. The physiological parameter most related to VO₂max (1/min) in children was determined. The VO₂max was predicted for 762 North Carolina Elementary school children (age 8-10) from a submaximal PWC170 cycle ergometer test. Height, weight, tricep and subscapular skinfolds, body fat percentage and lean body mass were also recorded. The children in North Carolina were less fit (males=1.55 1/min; females=1.33 1/min) than the children in previous North American Studies of VO₂max (males=1.74 1/min; females=1.46 1/min), and were very similar in fitness levels to children in a large European study. For females, LBM was a strong predictor of VO₂max in 1/min, whereas in males, height and LBM were strong predictors. The results suggest that North Carolina children are less fit than in earlier studies of children in North America, that LBM is a strong predictor of VO₂max in 1/min in children and that more studies are needed in North America to study VO₂max in children.

This study determined if L-carnitine supplementation can affect aerobic performance in children. Eight subjects performed three experimental trials—control I (CON I, 0 days), control II (CON II, 14 days), and L-carnitine (L-Carnitine II, 14 days). Results indicated significant improvements in muscular strength due to L-carnitine supplementation on blood and muscle lactate concentrations, and carnitine fractions, during high intensity sprint cycling exercise. Eight subjects performed three experimental trials—control I (CON I, 0 days), control II (CON II, 14 days), and L-carnitine (L-...
CN, 28 days). Each trial consisted of a 4 min ride at 90% VO$_{2\text{max}}$ followed by a rest period of 20 min, and then 5 x 1 min rides at 115% VO$_{2\text{max}}$ (2 min rest between each). Following CON II, all subjects began dietary supplementation of L-carnitine for a period of 14 days (4 g/day). L-carnitine supplementation had no significant effect on either muscle carnitine or lactate concentrations following the 4 min 90% ride. Plasma total acid soluble and free carnitine concentrations were significantly higher at all time points following supplementation. Differences observed in blood hydrogen ion and lactate concentrations between CON I and CON II appear to be the result of an order effect. The data from the present investigation indicate that L-carnitine supplementation has no significant effect on blood or muscle lactate accumulation following high intensity sprint cycling exercise.

Basecke, Mark. THE RELATIONSHIPS AMONG EXERCISE BLOOD LACTATE RESPONSE, MUSCLE BLOOD FLOW, AND OXIDATIVE ADAPTATION TO ENDURANCE TRAINING IN THE RAT, 1992. Ph.D., University of Missouri-Columbia (Ben R. Londeree). (226pp 3 f $12.00) PH 1213

The relationships among muscle blood flows (MBFs), arterial blood lactate (HLa), and citrate synthase activity (CS) were studied in untrained and endurance trained (10-13 weeks of treadmill exercise at 30 m/min, 60 min/da, 5 da/wk) rats in an effort to evaluate hypothetical causes for blood lactate accumulation during exercise. Control measures included sampling for glycogen depletion (GD) and measurement of plasma epinephrine (E) and norepinephrine (NE) concentrations. Each rat exercised at a single intensity among a range from 15-53 m/min designed to achieve three classification strata as follows: group 1 (GP 1)=absolute intensity of 15 m/min; GP 2=net (exercise - preexercise) HLa of <1.0 mM; and GP 3=net HLa of 1.0-1.99 mM. MBFs were determined by means of a radiolabeled microsphere technique for 16 hindlimb functional extensor muscles classified according to estimated SO, FOG, and FG fiber populations into the following four classes: SO-FOG, FOG-FG, FG-FOG, and FG. Data appeared inconclusive with respect to confounding influences of E and training effects upon MBFs. However, data for this range of low to moderate intensities suggested the following. 1) Trained rats exhibited suppressed blood lactate (ability to perform at higher speeds than untrained rats for a given lactate response), despite limited indication from CS activity of oxidative enzymatic adaptation. 2) FG muscle from trained rats exhibited GD and appeared to contribute to HLa accumulation. 3) GD and MBFs were not interchangeable indicators of fiber activity within the VL$_{0}$ of trained rats. 4) MBFs generally were higher, regardless of muscle class, for higher levels of blood lactate response. 5) Muscle recruitment patterns differed from MBFs for mixed (FOG-FG and FG-FOG) muscles, combined with considerations for their FG fiber density, supported a generalization that these muscles likely contributed substantially to blood lactate response.

Basta, Susan M. PRESSURE SORE PREVENTION SELF-EFFICACY AND OUTCOME EXPECTATIONS IN THE SPINAL CORD-INJURED: A VALIDITY AND RELIABILITY STUDY, 1992. Ph.D., Ohio State University (Moon S. Chen, Jr.). (427pp 5 f $20.00) PH 1249

The purposes of this study were to (a) develop and test a paper-and-pencil tool (known as the Pressure Sore Prevention Beliefs Scale, or PSPBS) to assess spinal cord-injured persons’ (SCIPs) confidence levels (or self-efficacy) in independently performing various pressure sore prevention (PSP) behaviors and the extent to which they believed that these behaviors were necessary for maintaining healthy skin (outcome expectations); (b) determine the reliability and validity of the PSPBS; and (c) examine the relationships between subjects’ scores on the PSPBS and selected demographic and clinical characteristics. Bandura’s self-efficacy theory was used to guide the study design, which was both methodological and descriptive/correlational. The PSPBS was tested with a convenience sample of 40 SCIPs from seven midwestern/Great Lakes rehabilitation facilities who were within 14 days before discharge from their initial inpatient programs. Data collection occurred between June 1990 and August 1991. Internal consistency reliability estimates for the PSP Self-efficacy and Outcome Expectation subscales of the PSPBS were .899 and .878, respectively. Content validity as determined by a panel of rehabilitation clinical nurse specialists and eight persons with long-term spinal cord injuries was found to be very satisfactory. Subjects (on the average) tended to be less confident in their abilities to check skin with a mirror; differentiate between a normal skin response to pressure and signs of early skin damage; avoid tobacco use; and perform transfers safely. Performance on the PSP Outcome Expectation subscale of the PSPBS was significantly related to age ($r_z = .506$, $p<.05$) and to marital status ($phi = .373$, $X^2 (1, N = 40) = 5.560$, $p<.05$). Based upon its testing in this study, the Pressure Sore Prevention Beliefs Scale was judged to be a reliable, content valid, and suitable tool for assessing perceptions of PSP self-efficacy and outcome expectations with spinal cord-injured persons.

Batjes, Debra J. THE EFFECTS OF A PREVENTIVE/CORRECTIVE STABILITY TRAINING PROGRAM ON SELF-REPORTED SYMPTOMS OF CUMULATIVE TRAUMA IN A FEMALE EMPLOYEE COHORT, 1993. M.S., Purdue University (Gerald C. Hyner). (108pp 2 f $8.00) PH 1340

The purpose of this study was to investigate the effects of a 12 week preventive/corrective stability training program on self-reported symptoms of cumulative trauma in female computer operators compared to a control. The intervention consisted of a 30 minute exercise program performed three times/week. Pre-test and post-test measures included a posture assessment of the exercise group (n=21) performed by a physical therapist, and a symptom questionnaire that detailed location and frequency of symptoms in all subjects in both groups (n=36). The exercise group and the control group were similar at baseline in mean age, hours/day spent on task, and pretest symptom scores. Length of employment categories were associated by group ($p=0.05$), as determined by Mantel Haenzel chi-square, with the exercise group having a greater percentage of employees in the 10 years plus category. At the completion of the study, mean post-test posture scores showed a significant mean increase by paired t-test ($p=0.0001$). Post-test symptom scores showed a significant mean increase in the exercise group ($p=0.0001$) and a mean decrease in the control group ($p=0.06$) by paired t-test. A repeated measures ANOVA showed a significant group by time effect ($p=0.0001$). Post-test symptom scores were significantly different between groups by t-test ($p=0.001$). Pearson’s correlations indicated that deviations in posture were associated with specific symptoms. Multiple regression analysis determined that 68% of the variance in the exercise group’s pre-test symptom scores were explained by six posture points. Shoulder and neck pain, the two most
frequently experienced symptoms, had greater than 50% of the variance in pre-test scores explained by six posture points. At post-test, 76% of the exercise group reported they were “markedly better”. In the control group, 73% reported they were “the same”. A two-tailed Fisher’s Exact Test an association between subjects’ perceived overall change in condition and group (p<0.0001). The results of this study indicate that the specific types of exercises employed in this program decreased self reported symptoms of cumulative trauma in the participant as compared to a control group.

Beidlerman, Beth A. ENERGY BALANCE AND THE COMPONENTS OF TOTAL DAILY ENERGY EXPENDITURE IN ENDURANCE TRAINED AND UNTRAINED WOMEN, 1991. M.S., Springfield College (Jacqueline L. Puhl). (252pp 3 f $12.00) PH 1214

Total daily energy expenditure (TDEE), total daily energy intake (TDEI), and body weight (BW) were evaluated for three consecutive days in eumenorrheic long distance runners (n=10) and untrained women (n=10) comparable on the characteristics of age, height, BW, and fat free weight (FFW). TDEE was estimated from individual heart rate/oxygen uptake curves combined with the use of a 24-h heart rate monitor while 3-d dietary records were used to estimate TDEI. The weight loss of the runners (Loss=-.23 lb/d^1; -796 kcal/d^1) accounted for the energy input/output imbalance (TDEI=2165 kcal/d^1; TDEE=2952 kcal/d^1). The untrained women lost more weight than expected (Loss=-.18 lb/d^1; -616 kcal d^1) given their TDEI (1842 kcal d^1) and TDEE (2225 kcal d^1). The runners did not consume significantly more food than the untrained women but they exhibited a significantly higher energy expenditure. The two groups were comparable in total carbohydrate and fat intake but the runners consumed significantly more total and per kg BW protein while the untrained women had a significantly higher percentage of fat in their diet. The resting metabolic rate (RMR) was significantly higher in the runners when expressed per kg BW (3.39 vs 2.95 ml·kg^-1·min^-1) and per kg FFW (4.15 vs 3.77 ml·kg·FFW^-1·min^-1). There is no significant difference in the thermic effect of the test meal (TEM) between the trained runners and untrained women when expressed as total integrated energy increase or as a percentage of the kcal consumed. The calculated thermic effect of activity (TEA) was significantly higher in the trained runners reflecting their larger amount of activity due to training. There was no evidence for the existence of a negative energy balance in this group of regularly menstruating runners.


This study was conducted to determine the variation in stain intensity between serial sections of muscle biopsies following a periodic acid Schiff (PAS) staining procedure, to assess the reliability of the PAS staining technique for the quantitation of the glycogen content in muscle fibers, and to evaluate the variability in fiber composition between repeated biopsies of the vastus lateralis (VL) muscle. Eight randomly located biopsies (4 right leg and 4 left leg) were obtained from the VL of each of 16 healthy males (26.1±1.1 years). Serial cross sections, 10 um thick, were cut from each biopsy and stained for myosin ATPase following an acid preincubation at pH=4.30 and for glycogen using a PAS staining procedure. No significant difference existed in the fiber composition between the eight repeated biopsies taken from an individual. The variation in type I fiber percentage, expressed as the coefficient of variation, between repeated biopsies of the same leg and between the right and left VL averaged 18.6% and 17.7%, respectively. In many cases, differences of greater than 20% in the percentage of type I fibers were observed between repeated samples. These data suggest an inhomogeneity with regard to the fiber type distribution in the VL of young males and an inability to predict the fiber composition of the muscle with a single biopsy sample. The optical densities (OD) of the same 50 type I and 50 type II fibers were determined in each of three PAS stained serial sections per biopsy using a computer integrated photometric system. Mean total, fiber type specific, and individual fiber OD did not differ significantly between the serial sections although a variability was observed. This variability appears to be primarily due to differences in sectional thickness. The comparison of biochemically determined glycogen content (41.0 - 191.0 mmol·kg^-1·wet weight) to mean total OD in sections from the same samples resulted in a poor relationship (r=0.47) between the two methods for the quantification of muscle glycogen. These results indicate a variability in PAS stain intensity between serial sections of muscle biopsies and an inability to quantify muscle glycogen concentrations with the photometric determination of OD of the PAS stain in cross sections of muscle.


The purpose of this study was to examine the influence of high and low carbohydrate (CHO) diets during the mid-follicular and mid-luteal phases of the menstrual cycle (MC) on blood lactate concentration during rest and submaximal exercise. Eight eumenorrheic women completed a discontinuous submaximal exercise protocol of 4 stages of 6 minutes exercise/6 minutes rest (30%, 50%, 70%, 90% VO_{2,max}) after 3 days of diet alteration. Testing was carried out under the following conditions: low CHO (<35% of total caloric intake)/mid-follicular, low CHO/mid-luteal, high CHO (>75% of total caloric intake)/mid-follicular, high CHO/mid-luteal. Eucaloric status, calories/day, was maintained during the study. MC phase was confirmed by oral temperature records and urinary hormone levels. Blood was drawn during the last 45 seconds of each rest period for lactate analysis. Significant interaction effects between dietary conditions and MC phase were found. Blood lactate was significantly (p<0.01) lower after 70% VO_{2,max} in the low CHO/mid-luteal phase than at the other conditions. The results demonstrate that a low CHO diet induces a MC phase difference in blood lactate, while a high CHO diet eliminates this MC phase difference. This suggests that female athletes who monitor their exercise training by lactate profiling, should consume a high CHO diet to over-ride the MC phase effects on lactate.

Bickel, Marjorie S. THE EFFECT OF A HIGH-FAT MEAL AND A LOW-FAT MEAL ON THE EXERCISE METABOLIC RATES OF COLLEGE-AGED FEMALES, 1992. M.S., Slippery Rock University (Frances J. Brannon). (51pp 1 f $4.00) PH 1341
The problem examined was the effect of prior meal composition on exercise metabolic rates. Subjects included 15 females, aged 20-24, at Slippery Rock University. Resting metabolic rate was measured before each treatment was administered. Treatment A involved a high-fat meal which consisted of 55.2% fat, 16.7% protein, and 28.1% carbohydrate. Treatment B involved a low-fat meal which consisted of 24% fat, 16% protein, and 60% carbohydrate. Following each meal, subjects rested for one hour, then exercised for 30% at an intensity equal to 60% of their maximum heart rate. Oxygen consumption was measured utilizing the Sensormedics 2900 metabolic cart during the exercise period to determine the caloric cost of exercise. Caloric values of the exercise periods following each treatment were compared for the subjects using a dependent t-test. Analysis of data indicated that at the .05 level of significance, the exercise metabolic rate following a high-fat meal was significantly greater when compared to the exercise metabolic rate following a low-fat meal among college-aged females.

Biedermann, Michel C. CORRELATION BETWEEN MUSCLE RELAXATION AND SARCOPLASMIC RETICULUM CA²⁺ ATPASE DURING FATIGUE: AN IN-SITU MODEL, 1992. Ph.D., University of Oregon (Gary A. Klug). (87pp 1 f $4.00) PH 1304

In the last decade it has been firmly established that Ca²⁺ uptake by sarcoplasmic reticulum (SR) is depressed during fatiguing exercise or electrical stimulation. Although various hypotheses have been advanced concerning the mechanism for this observation, almost nothing has been reported with regard to its effect on the relaxation characteristics of the muscle. Fatigue, described as a reduction in isotonic twitch tension, was produced by 1'-60' of 20 Hz electrical stimulation of the gastrocnemius muscle of female Sprague-Dawley rats. Peak isometric tension (PIT) and the maximum rate of relaxation (MRR) decreased (73% and 58% respectively) within the first minute of stimulation, and remained depressed during the longer stimulation periods. Half-relaxation time (RT₁/₂) was prolonged (75%) only within the first minute of stimulation, before subsequently returning to control values. The initial rate of Ca²⁺ uptake measured in muscle homogenates was depressed only during the first minute of stimulation (12%) and after 60' (25%). The data indicate that following electrical stimulation to fatigue, the initial rate of Ca²⁺ uptake does not correlate well with either of the parameters of relaxation investigated here. This could indicate that either SR Ca²⁺ uptake may not be the critical factor in muscle relaxation or that the current methods used for measuring the relaxation process of the gastrocnemius muscle or the Ca²⁺ uptake in vitro are inadequate to correctly establish a relationship with the corresponding in vivo events. Since neither RT₁/₂ nor MRR correlate well with the initial rate of Ca²⁺ uptake, these results do not resolve the controversy over which of these traditionally used variables is a better measure of the characteristics of muscle relaxation. Furthermore, the changes in RT₁/₂ and MRR over time do not correlate well perhaps because each may describe a different phase of the relaxation process. Thus, use of these variables as indices of a muscle’s overall ability to relax should be done with caution until a valid standard of relaxation is established.

Bloomfield, Susan A. SITE-SPECIFIC CHANGES IN BONE MASS AND ALTERATIONS IN CALCIOTROPIC HORMONES WITH ELECTRICAL STIMULATION EXERCISE IN INDIVIDUALS WITH CHRONIC SPINAL CORD INJURY, 1992. Ph.D., Ohio State University (Rebecca D. Jackson, David R. Lamb). (206pp 3 f $12.00) PH 1251

This investigation sought to determine whether the loss of bone mineral density (BMD) in spinal cord injured (SCI) individuals could be reversed with functional electrical stimulation cycle ergometry (FES-CE), which produces muscle contraction in the paralyzed legs. Nine SCI subjects (age 28.2 y, time since injury 6.0 y, injury level C₅-T₇) were enrolled in a 9-month training protocol. Eight sedentary SCI control subjects were tested to quantify seasonal variation in BMD and biochemical and endocrine variables. Testing occurred at baseline and every 3 months. In the experimental SCI group, increases were noted in lumbar spine BMD (assessed by dual energy x-ray absorptiometry) by 9 months; total body BMD declined slightly at 6 months, as did Ward’s triangle BMD at 9 months. Those subjects achieving power outputs of ≥18 W with FES CE exhibited significant increases in distal femur BMD by 9 months and appeared protected against decreased BMD at proximal tibia (6 months) and Ward’s triangle (3 and 9 months) noted in the low power group (≤12 W). Increased lumbar spine and distal femur BMD were significantly correlated (r=0.956 and 0.997, respectively) with quadriceps muscle strength (by isokinetic dynamometry). By 3 months serum osteocalcin increased 78%, suggesting increased bone formation. There were no increases in markers of bone resorption (urine calcium, hydroxyproline). Serum PTH increased 75% by 6 months, with several values in hyperparathyroid range. There was a significant effect of PTH status on change in BMD at distal femur, Ward’s triangle, and lumbar spine. Serum insulin-like growth factor II (IGF-II), a regulator of bone remodeling, increased significantly (+40%) by 9 months. Histomorphometric analysis of proximal tibia biopsies taken at baseline and 6 months suggested an increase in bone formation activity and no change in resorptive activity in a subject training at high power. Four subjects continued training through 12 months while ingesting 500 mg calcium supplements/d; no significant effects of calcium supplementation on any variable were detected. FES-CE training appears to be effective in increasing BMD at lumbar spine and distal femur for subjects able to achieve a threshold workload of 18 W. Increases in bone formation activity, potentially mediated by increases in IGF-II, appear to account for increases in BMD.

Blostein, Ashley C. EFFECTS OF RUNNING ON HORMONAL GROWTH FACTORS, 1993. M.S., Ball State University (Bruce W. Craig). (46pp 1 f $4.00) PH 1342

To determine the influence of running on certain blood-born parameters that are involved in bone metabolism, serum levels of calcium, alkaline phosphatase (ALP, a marker of bone formation), growth hormone (hGH), and parathyroid hormone (PTH), were analyzed in 10 male subjects following a 40 min. run at 70% VO₂max. Each trial was preceded by 1 day of inactivity, a 8-12 hr. fast, and drawing of a baseline blood sample by venipuncture. All other blood samples were taken via an indwelling catheter which was inserted in an antecubital vein immediately following the completion of the exercise bout. When the catheter was in place, an “immediate post” sample was drawn. Subsequent samples were taken at 1, 2, 3, 4, 5, 10, 15, 20, 30, 45, and 60 min. after the immediate post sample. Analysis of serum calcium concentrations demonstrated that levels were significantly elevated by 12% following exercise, going from a fasted level of 9.7 ± 53 mg/dl to
post-exercise levels of 11.8 ± 7.3 mg/dl. Serum calcium remained elevated during the first 4 min. following exercise. By 5 min. post-exercise, calcium levels dropped to levels that were significantly lower than the post-exercise sample. However, serum alkaline phosphatase did not change significantly following exercise, as the values remained within normal range throughout the experimental period. Concentrations tended to decrease over time but were not significantly lower than the pre or post-exercise levels by the end of the sampling period. Serum concentrations of hGH were more than doubled following a single bout of exercise, going from 4.0 ± 0.98 ng/ml before exercise to 8.8 ± 1.6 ng/ml immediately post-exercise. Following this initial rise, hGH progressively declined and returned to baseline values by 30 min. post-exercise. The concentrations of PTH did not change significantly following exercise. The post exercise sample tended to be higher than baseline values but were not significantly different. The results presented here indicate that an exercise bout of 40 min. at 70% VO2max results in an elevation of serum calcium and hGH, but does not alter PTH secretion or ALP activity. The data presented in this study indicate that the temporary rise in calcium following exercise is unrelated to PTH. It is hypothesized that the increase in calcium that we observed is attributable to lactate accumulation that would result from an exercise bout of this nature. The buildup of lactic acid and drop in pH causes a dissolution of the crystalline calcium hydroxyapatite compartment of the skeleton, thus causing an increase in ionized calcium. It is not known whether a single bout of exercise can influence hormonal secretion to a sufficient degree to affect bone density, but the hormonal changes demonstrated here could be involved in long-term effects of training.

Brahler, C. Jayne. VERSACLIMBER EXERCISE ELICITS HIGHER MAXIMAL OXYGEN UPTAKE IN WOMEN ROWERS THAN DOES TREADMILL EXERCISE OR ROWING ERGOMETRY. 1993. M.S., Washington State University (Sally E. Blank). (110pp 2 f $8.00) PH 1277

Collegiate Varsity Oarswomen and Coxswain (n=11) completed maximal aerobic exercise tests on an automated treadmill, a rowing ergometer, and a simulated climbing machine. The climbing and rowing protocols consisted of rapidly-increasing, progressive exercise to 85-95% of maximal oxygen consumption, (VO2max), followed by a two-minute, supramaximal effort; the Bruce Protocol was followed on the treadmill. Successful completion of each test was evidenced by a plateau in oxygen consumption in response to increasing work rates. VO2max (1·min⁻¹ & ml·kg⁻¹·min⁻¹), and minute ventilation (Ve·1·min⁻¹) at VO2max were significantly greater during simulated climbing compared to treadmill running and rowing ergometry. Maximal heart rate (beats·min⁻¹) was significantly greater during climbing than during running. Oxygen uptake at ventilatory threshold (TVent) was significantly higher during climbing than running, but was not different between climbing and rowing exercises. The percentage of VO2max at which TVent occurred was significantly greater during rowing versus climbing. There were no significant differences between exercise protocols for respiratory exchange ratio (RER) or production of carbon dioxide (VCO2) at VO2max. Regression equations for the relationship between relative VO2 and climbing rates were linear (r=0.90). A prediction equation for estimating relative VO2 at four climbing rates was formulated: VO2 (ml·min⁻¹·kg⁻¹)=[(0.2770 * feet climbed·min⁻¹) + 5.3245 (± 6.38)]. Results indicated that simulated climbing exercise was appropriate for measuring VO2max. These findings indicate that progressive, incremental, whole-body climbing exercise elicits significantly greater VO2max values for collegiate oarswomen and coxswain than graded treadmill running or rowing ergometry. Key words: maximal aerobic power, VO2max, VO2peak, oarswomen, coxswain, rowing ergometer, whole-body exercise; VersaClimber, female athletes, criterion VO2max.


The purpose of this study was to examine the influence of high and low CHO diets during the mid-follicular and mid-luteal phases of the menstrual cycle on the oxidation and utilization of CHO and fat during rest and submaximal exercise. Seven eumenorrheic women completed a resting metabolic rate test and a discontinuous, submaximal exercise protocol (6 minutes exercise at 30, 50, and 70% VO2max; 6 minutes rest) under the following conditions: low carbohydrate (~35% of total caloric intake)-midfollicular, low carbohydrate-midluteal, high carbohydrate (~75% of total caloric intake)-midfollicular, and high carbohydrate-midluteal. Carbohydrate and lipid oxidation/utilization was determined by indirect calorimetry techniques. Significant (p<0.05) interaction effects between diet conditions and menstrual cycle phase were observed at rest and 30% only. Lipid oxidation/utilization was found to be greatest during the low carbohydrate-mid-luteal phase than during any other conditions.


A total of 115 third through fifth grade students, ages 9-11 years, volunteered to participate in the coronary heart disease risk factor survey at Hintgen Elementary School in La Crosse, Wisconsin. The subjects were tested for the presence of the following: hypertension, obesity, physical inactivity, and family history of heart disease. Descriptive statistics and percentages were calculated to summarize the data. The results revealed that 13.9% of the subjects were hypertensive, 47.0% have body fat percentages which would be considered above the optimal range, 68.7% were less than physically active, 75.5% of the subjects have 2 or more risk factors, and 52.2% have a positive history of heart disease/attack.

Brown, Doreen E. PREDICTING BLOOD PRESSURE FROM ACTIVITY, FITNESS, AND BODY COMPOSITION OF BORDER-LINE HYPERTENSIVE INDIVIDUALS, 1991. M.S., Springfield College (Steven F. Siconolli). (92pp 1 f $4.00) PH 1215

The activity level, the fitness level (VO2max & PWC: physical work capacity) and the body composition (BMI: body mass index, LBM: lean body mass, fat weight, and percent fat) relative to blood pressure were examined in 40 elderly (69 ± 6 yr) borderline hypertensive subjects. Resting systolic (SBP) and resting diastolic (DBP) blood pressures were measured with a random zero sphygmomanometer. Activity was assessed by the Stanford Physical Activity Questionnaire. Fitness was assessed by graded bicycle testing. Body composition was assessed by bioimpedance and mathematical equations. Multiple regression analysis was used to analyze the data. From this investigation, regression determined the variance (r²%) in SBP (143 ± 23) and DBP (75 ± 12) was explained by activity (2936 ± 794 kcal-wk⁻¹), fitness (VO2max
Brown, Gordon D. A COMPARISON OF SKELETAL MUSCLE RESPONSIVENESS TO EXERCISE IN MALE AND FEMALE SPRAGUE-DAWLEY RATS TREATED WITH AN ANABOLIC STEROID, 1992. Ph.D., Indiana University (James E. Wilkerson, S. Kay Burrus). (112pp 2 f $8.00) PH 1279

Eighty Sprague-Dawley rats (40 male, 40 female) were assigned to one of four treatment groups (10 each sex per treatment): no steroid, no exercise; steroid, no exercise; no steroid, exercise; steroid, exercise; to determine if gender differences as a response to exercise and anabolic steroid administration. Exercised rats were weighted and jumped 16cm high, 20 jumps per day, 5 days a week for 8 weeks. Steroid treated animals were administered 0.20mg Durabolin 6 days a week for the last three weeks of the study. Body weight (BW), M muscle (gastrocnemius) wet weight (MWW), M muscle water content (MWC), and total muscle protein (MP) were determined. Data was analyzed for differences between groups using “Unique” sums of squares MANOVA. Significant gender, steroid treatment, and exercise main effects were noted for MWW, MWC, and MP. Significant steroid with gender interactions were noted for BW, MWW, MWC, and MP. Significant gender with exercise interactions were noted for MWW, MWC, and MP. Female rats accounted for steroid with gender interactions while the male rats accounted for the exercise with gender interactions.

Brown, Kristine. THE RELATIONSHIP BETWEEN EXERCISE AND SYMPTOMS OF PREMENSTRUAL SYNDROME IN COLLEGE AGE FEMALES, 1991. M.S., Brigham Young University (Brent Q. Hafen). (30pp 1 f $4.00) PH 1343

This study evaluated the relationship between exercise and symptoms of premenstrual syndrome among college age, menstruating females enrolled in the required health class at Brigham Young University in Provo, Utah. A total of 141 females were surveyed. Symptoms were measured using a pre and post questionnaire consisting of 14 commonly reported symptoms. An analysis of the data revealed that symptoms of PMS were significantly reduced with exercise. Those symptoms that were significantly reduced were acne, lower back pain, headache, constipation, irritability, and tension/anxiety. At the .05 level of significance, the null hypothesis stating no significant difference exists regarding exercise and symptoms of premenstrual syndrome was rejected.

Brown, Richard L. 31P METABOLIC RESPONSES TO ACTIVITY OF NONSPECIFICALLY TRAINED MUSCLE TISSUE IN ELITE ENDURANCE ATHLETES AND IN HEALTHY, SEDENTARY SUBJECTS AS OBSERVED BY 31P MAGNETIC SPECTROSCOPY, 1992. Ph.D., University of Oregon (Gary A. Klug). (214pp 3 f $12.00) PH 1306

Real-time, noninvasive magnetic resonance spectroscopy of isotope 31 of phosphorus (31P MRS) present in intact contracting muscle is an emerging research technique. In order to establish a range of 31P MRS responses to a specific exercise protocol, healthy, sedentary subjects (N=6) and elite, running-trained, endurance athletes (N=6) were tested. Concentrations of adenosine triphosphate (ATP), phosphocreatine (PCr), and inorganic phosphate (Pi) were determined in the flexor carpi radialis muscles of the dominant and nondominant arms of these subjects. This muscle was chosen for the study because of its accessibility and the low probability of it being specifically trained. The muscle was examined at rest, during two cycles of three exercise intensities, and during recovery. Ranges of 31P concentrations of ATP, PCr, and Pi in healthy subjects were established for these conditions. Between each level of activity there were significant differences (p<.001) in the 31P metabolic responses, but there were no differences between the first and second cycles of exercise. No significant differences were found between flexor carpi radialis muscle responses of the dominant and nondominant arms. The muscles of the elite athletes had significantly higher concentrations of PCr (p<.05) than the healthy, but sedentary, subjects at rest, during exercise, and during recovery. In addition, the Pi/PCr ratios in the elite subjects were significantly lower (p<.05) than in the sedentary subjects during exercise. Ranges of values for healthy subjects were established for the exercise protocol which can be used for comparisons in future therapeutic, nutritional, or training studies. Because there were no differences between the first and second cycles of the exercise protocol, only one cycle is required for future studies. Because there were no differences between nondominant and dominant arms, one arm could be used as a control in nonnutritional studies. Because of differences in levels of PCr and Pi/PCr, it is possible to distinguish between the nonspecifically trained flexor carpi radialis muscles of elite athletes and sedentary subjects. It is possible that results of adaptation to training regimes can be observed.

Bucksworth, Janet. THE EFFECTS OF AEROBIC EXERCISE ON CARDIOVASCULAR REACTIVITY AND BAROREFLEX RESPONSE IN WOMEN WITH PARENTAL HISTORY OF HYPERTENSION, 1993. Ph.D., University of Georgia (Rodney K. Dishman). (170pp 2 f $8.00) PH 1344

The effects of physical conditioning on estimates of sympathetic responsiveness, parasympathetic tone, and baroreflex sensitivity were studied in normotensive women with parental history of hypertension. A detraining study compared aerobically trained women who were highly active with a sedentary control group matched on aerobic fitness. Differences in physical activity did not moderate pre-test differences in cardiovascular reactivity to mental arithmetic, the cold face test, or baroreflex response. Significant reductions in aerobic fitness and physical activity were demonstrated with detraining, along with a significant increase in systolic blood pressure at rest and blood pressure responses to stressors, and decreased vagal tone during baroreflex stimulation. A subsequent cross-sectional analysis did not clarify separate effects for aerobic fitness and physical activity. There were no significant differences in reactivity to mental arithmetic or the cold face test between groups representing relatively high versus low aerobic fitness, and BMI were:

<table>
<thead>
<tr>
<th>Activity</th>
<th>V̇O₂ max</th>
<th>PWC</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP</td>
<td>.02</td>
<td>0.0</td>
<td>.23</td>
</tr>
<tr>
<td>DBP</td>
<td>.18</td>
<td>3.2</td>
<td>-.07</td>
</tr>
</tbody>
</table>

The combination of PWC and BMI significantly improved the multiple correlations (R). These were R=.41 (16.8%) for SBP and R=.37 (13.7%) for DBP. These results suggest both SBP and DBP are influenced independently by fitness (PWC) and BMI in an elderly population.

Brown, Richard L. 31P METABOLIC RESPONSES TO ACTIVITY OF NONSPECIFICALLY TRAINED MUSCLE TISSUE IN ELITE ENDURANCE ATHLETES AND IN HEALTHY, SEDENTARY SUBJECTS AS OBSERVED BY 31P MAGNETIC SPECTROSCOPY, 1992. Ph.D., University of Oregon (Gary A. Klug). (214pp 3 f $12.00) PH 1306

Real-time, noninvasive magnetic resonance spectroscopy of isotope 31 of phosphorus (31P MRS) present in intact contracting muscle is an emerging research technique. In order to establish a range of 31P MRS responses to a specific exercise protocol, healthy, sedentary subjects (N=6) and elite, running-trained, endurance athletes (N=6) were tested. Concentrations of adenosine triphosphate (ATP), phosphocreatine (PCr), and inorganic phosphate (Pi) were determined in the flexor carpi radialis muscles of the dominant and nondominant arms of these subjects. This muscle was chosen for the study because of its accessibility and the low probability of it being specifically trained. The muscle was examined at rest, during two cycles of three exercise intensities, and during recovery. Ranges of 31P concentrations of ATP, PCr, and Pi in healthy subjects were established for these conditions. Between each level of activity there were significant differences (p<.001) in the 31P metabolic responses, but there were no differences between the first and second cycles of exercise. No significant differences were found between flexor carpi radialis muscle responses of the dominant and nondominant arms. The muscles of the elite athletes had significantly higher concentrations of PCr (p<.05) than the healthy, but sedentary, subjects at rest, during exercise, and during recovery. In addition, the Pi/PCr ratios in the elite subjects were significantly lower (p<.05) than in the sedentary subjects during exercise. Ranges of values for healthy subjects were established for the exercise protocol which can be used for comparisons in future therapeutic, nutritional, or training studies. Because there were no differences between the first and second cycles of the exercise protocol, only one cycle is required for future studies. Because there were no differences between nondominant and dominant arms, one arm could be used as a control in nonnutritional studies. Because of differences in levels of PCr and Pi/PCr, it is possible to distinguish between the nonspecifically trained flexor carpi radialis muscles of elite athletes and sedentary subjects. It is possible that results of adaptation to training regimes can be observed.

Bucksworth, Janet. THE EFFECTS OF AEROBIC EXERCISE ON CARDIOVASCULAR REACTIVITY AND BAROREFLEX RESPONSE IN WOMEN WITH PARENTAL HISTORY OF HYPERTENSION, 1993. Ph.D., University of Georgia (Rodney K. Dishman). (170pp 2 f $8.00) PH 1344

The effects of physical conditioning on estimates of sympathetic responsiveness, parasympathetic tone, and baroreflex sensitivity were studied in normotensive women with parental history of hypertension. A detraining study compared aerobically trained women who were highly active with a sedentary control group matched on aerobic fitness. Differences in physical activity did not moderate pre-test differences in cardiovascular reactivity to mental arithmetic, the cold face test, or baroreflex response. Significant reductions in aerobic fitness and physical activity were demonstrated with detraining, along with a significant increase in systolic blood pressure at rest and blood pressure responses to stressors, and decreased vagal tone during baroreflex stimulation. A subsequent cross-sectional analysis did not clarify separate effects for aerobic fitness and physical activity. There were no significant differences in reactivity to mental arithmetic or the cold face test between groups representing relatively high versus low aerobic fitness, and BMI were:

<table>
<thead>
<tr>
<th>Activity</th>
<th>V̇O₂ max</th>
<th>PWC</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP</td>
<td>.02</td>
<td>0.0</td>
<td>.23</td>
</tr>
<tr>
<td>DBP</td>
<td>.18</td>
<td>3.2</td>
<td>-.07</td>
</tr>
</tbody>
</table>

The combination of PWC and BMI significantly improved the multiple correlations (R). These were R=.41 (16.8%) for SBP and R=.37 (13.7%) for DBP. These results suggest both SBP and DBP are influenced independently by fitness (PWC) and BMI in an elderly population.
aerobic fitness or high versus low physical activity. Aerobic fitness and physical activity status significantly moderated heart rate response to mental arithmetic during baroreflex stimulation. Sympathetic activity seemed to dominate in less fit and less active women during baroreflex stimulation at lower levels of applied negative pressure. Baroreflex response during mental arithmetic was more active and more fit women were not different from rest at lower applied pressures, but heart rate response tended to saturate at the higher pressures. Both aerobic fitness and physical activity may modify baroreflex response during stress by improved parasympathetic tone that counters increased sympathetic activity. Additional research is needed to clarify the autonomic balance during carotid baroreflex stimulation at rest, and during stress before and after exercise training.

INDEX WORDS: Baroreflex, Exercise Training, Cardiovascular Reactivity, Women, Physical Activity, Aerobic Fitness, Hypertension


The purpose was to examine the inter-subject variability on the relative change in heart rate (RCHR), at the lactate (LT) and the individual anaerobic thresholds (IAT), during 60 minutes of treadmill running, in elite athletes. Eight runners (mean VO2max=70.08 ml/kg/min + 9.08) volunteered for the study. They performed two incremental exercise tests to determine LT, IAT, and VO2max, and two 60-minute exercise bouts on the treadmill, at running speed corresponding to LT and IAT. Blood lactate, heart rate, plasma volume, core temperature, and VO2 were measured during exercise. Results showed that at both LT and IAT, RCHR was significant due to exercise duration, and inter-subject variability. Exercise duration accounted for 73.7% and 87.0% of the variance, respectively. When examining the effect of both intensities on RCHR, it was found that duration and intensity was significant. Duration accounted for 76.7% and intensity accounted for 4.5% of the variance, respectively. There were significant differences between all measures of duration, and all measures of intensity. Changes in blood lactate, VO2, plasma volume, and core temperature occurred as expected. It was concluded that, although running intensity, and inter-subject variability have a significant effect upon RCHR, duration of exercise accounts for the largest proportion of the variance.


The growth hormone response to exercise at different times of the day was studied in 14 men. Test times were randomly assigned as 0600, 1200, 1800, and 2400 hours, with each trial performed on a different day. Trials consisted of 30 minutes of cycle ergometer exercise at a workload that elicited 80% of VO2max. Resting and post exercise plasma concentrations of hGH were obtained at each trial. Resting hGH was not significantly different between the four trials. Exercise resulted in a significant increase in hGH over rest in all trials. The peak levels during the 1200 and 1800 trials were significantly greater than the 0600 and 2400 trials (p<0.05). The findings suggest exercise induced augmentation of hGH levels will vary depending on the time of day the exercise is performed.

Carling, Jon. THE EFFECT OF TRANSVERSE PEDAL SPACING ON CYCLING EFFICIENCY, 1992. M.S., Brigham Young University (A. Garth Fisher). (46pp 1 f $4.00) PH 1307

This Study was undertaken to determine: a) if transverse pedal spacing (the distance between the feet while pedaling) affects cycling efficiency, and b) if changing from an accustomed transverse pedal spacing affects cycling efficiency. To answer the first question, 29 untrained cyclists were used as subjects to alleviate training effects on efficiency. Oxygen cost measurements were taken on three different spacings for each subject. The spacings were: Narrow—crank spindle width 108 mm, Wide—125 mm, and Very wide—42 mm. The wide spacing was found to be less efficient in terms of oxygen cost than the other two spacings (F=5.96, p<.05). The second question was answered using two groups of 15 trained subjects. The first group trained on mountain bikes, (wide pedal spacings) and the second group trained on road bikes (narrow pedal spacings). Oxygen cost was measured for each subject on both the Narrow (108 mm) and Wide (125 mm) bikes from the first study. Changing from accustomed pedal spacing had no effect on efficiency as measured by oxygen cost for the trained subjects.

Chapek, Constance L. THE EFFECTS OF A TEN-WEEK STEP AEROBIC TRAINING PROGRAM ON AEROBIC CAPACITY OF COLLEGE-AGED FEMALES, 1992. M.S., University of Wisconsin-La Crosse (John P. Porcari). (71pp 1 f $4.00) PH 1308

The purpose of this study was to examine the effects of a 10-week step aerobic training program on the maximal oxygen consumption (VO2max) of college-aged women (mean age=19.4 yrs). Fifty apparently healthy females between the ages of 18 and 25 years participated in the training study. Subjects in the experimental group exercised 3 times per week for 10 weeks. The average heart rate maintained during the training was 150 bpm which represented 76% of HRmax. Twenty-one experimental group Ss and 29 control group Ss performed a maximal treadmill test to volitional exhaustion prior to and upon completion of the study. The variables analyzed included resting HR (bpm), body weight (lbs), rating of perceived exertion (RPE), treadmill run time, absolute VO2max (L/min), relative VO2max (ml/kg/min), VEmax (BTPS) (L/min), RERmax, and HRmax (bpm). The results showed significant (p<.05) between-group differences in mean treadmill run time, absolute VO2max, relative VO2max, HRmax, and VEmax. The experimental group had increases in treadmill run time (33.1%), absolute VO2max (11.5%), relative VO2max (11.7%), HRmax (1.0%), and VEmax (6.7%) which were significantly greater than the control group. No significant (p>0.05) between-group differences were observed in body weight, RERmax, RPE, and resting HR.


The purpose of this study was to determine the relationship between maximal oxygen consumption rate, running economy, ventilatory threshold, and body composition with performance runs of 1.5 and 3.0 miles. The subjects for this study were 13 male and 11 female college students ranging in age from 18 to 33 years old. Following the performance runs, laboratory tests for running...

Forty orchidectomized male pigs (Duroc x Large white x Landrace), were subjected to saline or recombinant porcine somatotropin (rPST) injections twice weekly for either a two month or three month period, and then sacrificed. Previous analysis showed rPST treated pigs tended to have a greater lean body mass than sacrifice weight-matched controls. Therefore, this study was designed to determine the rPST treatment effect on the composition of common calcanean tendon matrix in accordance with the changes in lean body mass. Collagen concentration, proteoglycan concentration and cell density were assessed by measuring tissue concentrations of hydroxyproline, hexuronate, and DNA, respectively. Collagen and proteoglycan concentration were not different between treated and control pigs. Statistical analysis supported that animals treated with rPST for three months and sacrificed at 141 ± 4.0 kg (mean ± s.e.) had a lower (58%) DNA concentration than animals treated for two months and sacrificed at 138 ± 2.6 kg. Results suggest responsiveness of the tendon may be influenced by onset of treatment as well as duration. It is unclear whether or not this difference reflects an indirect response to the tendon's growth or a direct response to the rPST.


The purpose of this study was to compare the myocardial structure and function among endurance athletes (n=12), powerlifters/steroid users (n=5), powerlifters/non-steroid users (n=6), and sedentary controls (n=4). All subjects had a M-mode echocardiographic examination of their left ventricles under resting conditions. The echocardiographic measurements recorded and analyzed were of the left ventricular posterior wall at diastole and systole, left ventricular internal diameter at diastole and systole, and inter-ventricular septal thickness at diastole and systole. Myocardial function measurements consisting of left ventricle ejection time, left ventricular mass, mean ventricular contractile force, and percent fractional shortening were also recorded and analyzed. A One Way Analysis of Variance was used to analyze the data for statistical significance. A Tukey’s HSD post-hoc test was used to determine statistical significance between the groups. A significant difference (p=0.02) was found for inter-ventricular septal thickness during diastole. All three athletic groups had significantly thicker inter-ventricular septal thickness during diastole as compared to the controls.

Powerlifters/steroid users had the thickest inter-ventricular septal thickness (18.7 mm), followed by endurance athletes (18.6 mm), and powerlifters/non-steroid users (16.5 mm). Overall, powerlifters/steroid users had the thickest walls at systole and diastole, while endurance athletes had the greatest internal diameters relative to the size of the left ventricle. Statistically significant differences among the groups were found for all four myocardial functional parameters: left ventricular ejection time (p=0.03), left ventricular mass (p=0.002), mean ventricular contractile force of (p=0.0013), and percent fractional shortening (p=0.05). Powerlifters/steroid users had the fastest left ventricular ejection times, largest left ventricular mass, greatest mean ventricular contractile force, and greatest percent fractional shortening. Endurance athletes had the slowest left ventricular ejection times, second largest left ventricular mass, lowest mean ventricular contractile force, and third lowest percent fractional shortening. The results indicated that not all individuals participating in high level endurance or powerlifting training and competition demonstrated complete adaptations in myocardial structure and function. Powerlifters/steroid users however, demonstrated myocardial functional adaptations that were significantly different from powerlifters/non-steroid users, endurance athletes, and controls. The results of this study cannot attribute these changes either to the use of large amounts of anabolic steroids, or long-term, high-intensity training and competition in powerlifting. However, the study identified alterations in myocardial functions in powerlifters/steroid users, and contributes to the existing body of knowledge regarding the use of anabolic steroids by athletes.

Cobham, Heather W. **THE EFFECTS OF CARDIAC REHABILITATION ON CORONARY HEART DISEASE RISK FACTORS IN POST MYOCARDIAL INFARCTION PATIENTS**, 1991. M.A., University of North Carolina at Chapel Hill (Barbara E. Ainsworth). (137pp 2 f $8.00) PH 1220

The purpose of this study was to determine the effects of 6 months of cardiac rehabilitation on CHD risk factors and to determine the concurrent changes in cardiovascular fitness and CHD risk factors in post MI patients. Subjects included 53 MI patients (43 men and 10 women) enrolled in the Orange Cardiovascular Foundation and Wake Forest University cardiac rehabilitation programs from 1979 to 1991. Comparison of the group mean after 3 and 6 months of cardiac rehabilitation was done using repeated measures ANOVA. Associations between changes in METs and CHD risk factors were tested with partial correlations adjusting for race, gender, and 6 months change in body weight. Results showed a decrease in percent body fat at 6 months (-2%, p<.05), an increase in HDL-C at 6 months (+3 mg/dl), and an increase in MET capacity at 3(+1.3 METs, p<.05) and 6-months (+1.9 METS, p<.05). Significant associations were observed for the 3-month change scores between METs and angina (r=-.038, p<.05) and the 6 month change scores between METs and ST depression (r=-.034, p<.05). The inverse association between the change in MET capacity and the angina scores and ST segment depression suggests that cardiac rehabilitation is effective in improving exercise tolerance in post MI patients.
Counts, Charlene L.M. THE EFFECT OF SWIM TRAINING ON PLASMA SOMATOMEDIN-C LEVELS IN 8- TO 10-YEAR-OLD CHILDREN, 1991. M.S., Texas Woman’s University (Victor Ben Ezra). (78pp 1 f $4.00) PH 1253

This study investigated the effect of swim training on the plasma somatomedin-C (SM-C) levels of 8-to 10-year old children (N= 10). Caloric intake (KCAL-IN), caloric expenditure (KCAL-OUT), and training records were completed before and after 10 weeks of swim training. Descriptive data of height, weight, % body fat, and age was collected pre-and post training. Venous blood was drawn before and after the training period and plasma SM-C was measured by radioimmunoassay (RIA). Subjects swam within a competitive program and maintained a training level of 1500 yards (60 min) 3 times per week. A multivariate t-test showed no difference (p>.05) for SM-C, KCAL IN, and KCAL-OUT. Three-day diet records showed no significant difference (p>.017) in caloric intake of 1801 Kcal pretraining and 1990 Kcal postraining. Activity levels were similar (p>.017) with all estimated caloric expenditure of 1971 Kcal pretraining and 2005 Kcal postraining. SM-C stayed relatively unchanged (p>.017) within the group with values of 1.59 ± 0.78 U/ml pretraining and 1.86 ± 1.03 U/ml postraining. Within the scope and limitations of this study it can be concluded that with a diet of approximately 2000 Kcal, swim training within the yardage found in this study, does not promote a decrease in plasma concentrations of SM-C in 8- to 10- year-old children.

Crowder, Todd A. THE EFFECTS OF VARIOUS EXERCISE MODALITIES ON SERUM CHOLESTEROL AND TRIGLYCERIDE CONCENTRATIONS, 1989. Ph.D., University of Missouri-Columbia (John A. Roberts). (224pp 3 f $12.00) PH 1254

The purpose of this study was to determine the effects different exercise modalities have on serum cholesterol and triglyceride concentrations of adults enrolled in a 10-week corporate fitness exercise program. Auxiliary purposes were the effect of muscle mass utilized on a specific exercise modality and to compare the effects of aerobic and anaerobic exercise and weight-bearing aerobic and nonweight-bearing aerobic exercises on serum HDL-C concentrations. The dependent variables were total serum cholesterol, high density lipoprotein cholesterol (HDL-C), total serum cholesterol / HDL-C ratio, and serum triglyceride concentration. These dependent variables were measured twice during the study via blood analysis. The experimental treatments consisted of five different exercise modality training programs. These included bicycling arms/legs, bicycling legs only, machine rowing, treadmill walking/jogging, and weight training. The control group did not receive any exercise treatment. The exercise program consisted of exercising three times a week for ten weeks. The duration for the exercise treatment was 20-29 minutes. The aerobic exercise groups exercised at a target heart rate zone of 120-150 beats per minute. Only subjects who attended 80% of the exercise sessions were included in the study. Seventy-six subjects were used in data analysis (38 male, 38 female, mean age 34.85). Results indicated that of the eleven research hypotheses, none could be supported. It can be concluded that a 10-week corporate exercise program utilizing the five modalities mentioned does not appear to provide any greater effect on serum lipoprotein concentrations than a condition of no exercise. In addition, among the five modalities, none appear to provide a more beneficial effect in regard to serum lipoprotein concentrations than a condition of no exercise. In addition, among the five modalities, none appear to provide a more beneficial effect in regard to serum lipoprotein concentrations. No relationship appears to exist between the amount of muscle mass exercised and an HDL-C training response. Further, aerobic activities and aerobic weight-bearing exercise do not appear to provide any greater effect on HDL-C concentration than anaerobic activities or aerobic nonweight-bearing exercise, respectively. Finally, there appears to be a tendency for bicycling arms/legs and machine rowing to produce a more beneficial effect on total serum cholesterol / HDL-C ratio than the other three modalities.

Cunningham, Kathryn M. ST SEGMENT CHANGES DUE TO HANDRAIL SUPPORT DURING GRADED EXERCISE TREADMILL TESTING, 1992. M.A., Ohio State University (Timothy E. Kirby). (88pp 1 f $4.00) PH 1221

In order to evaluate the influence of the essentially isometric work of handrail support (HRS) during a dynamic graded exercise test (GXT), the responses of 10 male subjects with diagnosed coronary artery disease with ischemia and ST segment depression (ST) of >1.0 mm were evaluated. Each subject performed 2 peak GXTs, one without HRS (Test 1) and one with HRS as desired (Test 2). Each subject also completed 4 single load 5 minute duration tests at approximately 90% peak heart rate (HR) with varying levels of HRS. These levels were no support (HRSO), and pull on the front handrail of 12 (HRS12), 22 (HRS22), and 34 ft. lbs. of torque (HRS 34) measured by a Cybex II dynamometer with computerized feedback to each subject. Comparison of ST (mean +/- sem) levels during these single load tests follows.

<table>
<thead>
<tr>
<th>HRSO</th>
<th>HRS12</th>
<th>HRS22</th>
<th>HRS34</th>
</tr>
</thead>
<tbody>
<tr>
<td>STmm</td>
<td>-1.52(21)</td>
<td>-0.62(16)</td>
<td>-0.70(15)</td>
</tr>
</tbody>
</table>

*indicates significant difference from HRSO (p<.05)

No significant difference was found between Test 1 and Test 2 when comparing max HR (143 vs. 141), max systolic BP (172 vs. 171), max diastolic BP (75 vs. 78) or max ST (>2.6 vs. <2.3). It is concluded that HRS, when performed as a static contraction during treadmill exercise, may significantly alter ischemia induced ST segment changes.

Damson, Rebecca L. THE EFFECT OF DAILY BEAN INGESTION ON THE LIPOID PROFILES OF NORMOCHELESTEROLEMIC COLLEGE STUDENTS, 1991. M.S., Purdue University (Gerald C. Hyner, Roseann M. Lyle). (87pp 1 f $4.00) PH 1222

Coronary heart disease (CHD) continues to be the leading cause of death in the United States. Determining effective measures to reduce the risk factors for this disease early in life is imperative. Dietary modifications have been shown to beneficially alter elevated cholesterol levels, a primary risk factor for CHD. The purpose of this study was to examine the effect of daily bean ingestion on the lipid profiles of normocolesterolemic college students. Sedentary students from Purdue University volunteered to participate in a bean intervention group (BG) or a control group (CG). The BG subjects (n=13) added 1/2 cup of beans (in the form of soup) to their usual meal selection daily for 6 weeks. The control group (n=19) remained sedentary and maintained their usual diet and at the end of the study. Serum total cholesterol (TC), triglycerides (TG), and high density lipoprotein cholesterol (HDL-C) levels were assessed by the Kodak-DT60 Cholesterol Analyzer. Very
The study was designed to examine gender differences in running economy (RE). The subjects were 12 male and 12 female endurance-trained runners. The males were significantly taller, heavier, and had less percent body fat (%BF) (p<.01) than the females. The males trained at a significantly faster pace than the females, but the groups were not significantly different in years of running experience and distance trained per week (km) (DT) (p>.01). The running economy test was performed on a level treadmill at speeds of 160, 215, and 267 m·min⁻¹ for 6 min at each speed. After the 267 m·min⁻¹ stage, speed was maintained and the grade was raised 2% every 2 min until volitional exhaustion or a maximal effort. The males had a significantly greater absolute (L·min⁻¹) and relative (ml·kgBW⁻¹·min⁻¹) VO₂max than the females (p<.01), but maximal heart rates (HR max) and VO₂max controlled for fat-free weight were not significantly different (p>.01). Analysis of covariance (ANCOVA) with repeated measures was utilized to test for gender differences in submax VO₂ at 160 and 215 m·min⁻¹ with VO₂ max, %BF, and DT as covariates. No comparisons were made at 267 m·min⁻¹ because all but one female experienced a maximal effort during this stage. No gender differences were found with submax VO₂ at 160 and 215 m·min⁻¹ with the effects of the covariates partialed out (p>.01). In conclusion, no differences are expected in the aerobic demand of running at 160 and 215 m·min⁻¹ with male and female runners when the effects of maximal oxygen consumption, percent body fat, and distance trained per week are partialed out.


Nine trained male cyclists were studied to determine the chronology of effects of caffeine use during 90 minutes of cycle ergometry at 75% VO₂max. Doses of 5 mg caffeine/kg body weight were ingested at 60 minutes pre-exercise and immediately pre-exercise. During the CAP trials, mean oxygen uptake was 2.5% higher (p<.05), and RPE values were significantly lower than during the PL trials (p<.05). No statistically significant differences were found in FFA, glucose, lactate, or respiratory quotients; however, the overall mean values for FFA and respiratory quotients suggest a trend toward greater FFA utilization during the final 30 minutes of exercise following caffeine ingestion. Thus, it seems that caffeine may be most beneficial during exercise of more than 60 minutes in duration.


The purpose of this study was to determine the relationship between heart rate (HR) and rate of perceived exertion (RPE) among phase II cardiac rehabilitation patients with various modes of exercise. One hundred subjects were randomly selected from a phase II cardiac rehabilitation program. HR was measured with telemetry recorded EKG tracings. RPE was determined through subject self report using the Borg Rating of Perceived Exertion Scale. Assessments were made during exercise at 4 different exercise modes for each subject on 4 separate exercise sessions: 2, 3, 23, and 24. Exercise modes included a motor driven treadmill, cycle ergometer, arm ergometer, and rowing machine. HR and RPE were obtained during the final 2 minutes of each exercise mode. Pearson product-moment correlations were used to determine the relationship between HR and RPE. A total of 1,600 paired scores were analyzed. The results showed a significant (p<.05) relationship between HR and RPE with the treadmill (r=.23) and rowing machine (r=.21) in exercise session two. No significant relationship between HR and RPE was observed for the 4 exercise modes in exercise sessions 3, 23, and 24. These findings reveal the RPE scale is not a reliable measure of exercise intensity in phase II cardiac rehabilitation exercisers.

Dremsa, Catherine J. HANDRAIL SUPPORT VERSUS FREE ARM SWING TREADMILL FITNESS TEST, 1986. M.A., University of Alabama at Birmingham (Gary Hunter). (68pp 1 f $4.00) PH 1255

The purpose of this research was to compare energy expenditure during handrail support (HS) and free-arm swing (FA) treadmill exercise. Ten young and healthy subjects exercised on the treadmill to exhaustion 3 times, once with free-arm swing and twice with handrail support. Order of the tests was randomized. A modified Bruce protocol was used. An open-circuit computerized system was used to determine oxygen uptake (VO₂) while heart rate (HR) was monitored on an EKG unit. The amount of weight supported on the handrails at each work level was determined from a precalibrated cable tensiometer. All subjects obtained a higher work level during HS with the average difference 1.5 stages. VO₂ and HR were statistically higher during FA. This was especially the case as speed and grade increased with a difference of 15 beats/min and 7.0 ml 02/kg/min found at the 4th stage (3.4 mph and 14% grade). Changes in estimated workrate also increased as work levels became more difficult with the power difference at 1.7 mph, 10% grade only 1 WATT and at 3.4 mph, 14% grade 4.4 WATT. A regression equation predicting VO₂ from work done during handrail support was developed (r=.86;9; VO₂=HS+.6574 + .0098 (Work-HS). The results of this study indicate work capacity may be over estimated if VO₂ is predicted from established treadmill heart rate data. This could be potentially...
dangerous in establishing individual exercise prescriptions. Therefore, corrections in establishing VO\(_{2\text{max}}\) should be made if handrail support is to be used.

Durham, Timothy L. PLASMA FREE FATTY ACIDS AT REST AND EXHAUSTION FOLLOWING THEOBROMINE INGESTION, 1992. M.S., Indiana University (Wayne C. Miller). (89pp 1 f $4.00) PH 1280

Caffeine has been reported to be ergogenic due to metabolic and central nervous system stimulatory effects. Another methylxanthine, theobromine (THB), is less potent as a neuronal stimulant but may have similar metabolic effects. These studies were conducted to determine if THB would 1) affect plasma free fatty acids (FFA) at rest and 2) affect postexercise FFA as well as treadmill run time to exhaustion in untrained rats. In the first study, forty male Sprague-Dawley rats (380 g) were given THB by gavage, approximately 6 hours postprandial, in a control dose and 100 mg/kg body weight dose of THB. Blood samples were taken at 0, 1, 2, 4, and 6 hours postgavage. A 2 x 5 ANOVA for repeated measures (8 rats per cell) revealed a significant elevation in FFA over time, but no treatment effect. To see if the FFA response was dose dependent, an additional 50 mg/kg dose was given. Blood samples were taken at 1 and 4 hours. A 3 x 2 ANOVA for repeated measures performed on the data for control, 50 mg/kg THB, and 100 mg/kg THB doses at 1 and 4 hours revealed a significant treatment effect at 4 hours for the 50 mg/kg dose. In the second study, treadmill runs to exhaustion were performed by 16 rats 1 hour post THB ingestion (100 mg/kg) at 28 m/min with an 8% grade. Upon exhaustion, the rats were anesthetized intramuscularly with ketamine-xylazine (0.15 ml/100 g BW) and venous blood samples obtained. Plasma FFA were significantly higher (p<0.05) at exhaustion in the THB group (0.67 mM ± 0.08; X ± SEM) than in the control group (0.31 mM ± 0.10). Run times were also greater for the THB group (41.3 min ± 6.7) than for the control group (26.4 min ± 1.9). From the first study, it is concluded that FFA levels are increased by theobromine at an appropriate dose. From the second study, it is concluded that theobromine increases run time to exhaustion in rats, possibly by altering mobilization and/or uptake of FFA.

Dwyer, Gregory B. GLYCOSYLATED HEMOGLOBIN AND THE OXYGEN KINETICS IN INDIVIDUALS WITH TYPE II DIABETES, 1992. Ph.D., Indiana University (Janet P. Wallace). (152pp 2 f $8.00) PH 1281

Glycosylated hemoglobin (HbAlc), a measure of metabolic control, was correlated to measures of \(\dot{O}_{2}\), kinetics in 16 individuals with type II diabetes (age=56.5 years ±14.4; wt=81.4 kg ±15.8). All subjects performed a ramp protocol exercise test on a cycle ergometer to max fatigue. On the 2nd testing session, subjects performed 3 submax exercise trials on a cycle ergometer at 10% below the subject’s gas-exchange ventilatory threshold (GVXT) lasting until a steady state was achieved. A breath-by-breath metabolic cart was used to determine the GVXT, VO\(_{2}\) peak, and \(\dot{O}_{2}\) kinetics. 0, kinetics were quantified as the time to steady state (TSS) for VO\(_{2}\) and the slope of the exponential regression line fitted to the VO\(_{2}\)-time graph (slope). A collected venous blood sample was analyzed for HbAlc, p50, and 2,3-Diphosphoglyceraldehyde (DPG). Results demonstrated that HbAlc was not sig correlated with % of VO\(_{2}\) peak at the GVXT (r=0.23), TSS (r=0.12), nor slope (r=0.13). The p50 (r=0.29) and 2,3 DPG content (r=0.02) of the blood were also not sig correlated with HbAlc. Thus, no relationship was found between metabolic control (HbAlc) and \(\dot{O}_{2}\), kinetics in individuals with type II diabetes.

Earnest, Edward K. SEASONAL CHANGES IN SELECTED PHYSIOLOGICAL VARIABLES OF FEMALE BASKETBALL PLAYERS, 1992. M.S., Brigham Young University (Earlene Durrant). (66pp 1 f $4.00) PH 1311

The purpose of this study was to determine the possible seasonal changes in percent body fat (%BF), maximum oxygen consumption (VO\(_{2\text{max}}\)), flexibility (FLX), vertical jump (VJ), anaerobic power (AnP), anaerobic capacity (AnC), and left and right knee extension strength at 60°/sec (K60), 180°/sec (K180), and 240°/sec (K240) of NCAA division I collegiate varsity female basketball players. Pre and postseason measurements were obtained on 13 varsity female basketball players at Brigham Young University ranging from 17-21 years of age. The results indicated that female collegiate basketball players could maintain, and in some instances improve, %BF, VO\(_{2\text{max}}\), FLX, VJ, AnP, AnC, K60, K180, and K240 during a competitive season with no specific training beyond scheduled practices and game situations. Practice sessions and game participation are particular to this program, and other programs may find varying results.


The purpose of this study was to investigate the effects of fatigue on the hamstrings and quadriceps muscle groups during concentric and eccentric contractions of the knee at two angular velocities performed on the Biodex B-2000 isokinetic dynamometer. The dominant leg of twelve subjects, six males (mean age=20.6 ±1.9 yrs) and six females (mean age=22.5 ± 1.9 yrs) was tested on the Biodex B-2000 isokinetic dynamometer. Reciprocal hamstrings and quadriceps muscle testing consisted of each subject completing four test treatments: concentric at 60°/sec, concentric at 150°/sec, eccentric at 60°/sec, and eccentric at 150°/sec. Subjects were tested in a seated position (110° hip flexion) with knee range of motion limited from 10 to 90° flexion. The fatigue test consisted of maximal reciprocal hamstrings and quadriceps contractions until a level of 50% of the torque generated during the highest three of the first five contractions of each test treatment was met. Data analysis consisted of a 2 x 2 x 2 Analysis of Variance with repeated measures on mode of contraction (concentric and eccentric), angular velocity (60°/sec and 150°/sec), and muscle group (hamstrings and quadriceps). Results of the study showed significant (p<.05) main effects for all factors and a significant (p<.05) three-way interaction. The eccentric mode of contraction (mean=54.6 repetitions), 150°/sec angular velocity (mean=50.8 repetitions), and quadriceps muscle group (mean=46.0 repetitions) were levels at which fatigue was significantly delayed than at corresponding levels of concentric mode of contraction (mean=33.2 repetitions), 60°/sec angular velocity (mean=37.0 repetitions), and hamstrings muscle group (mean=41.9 repetitions). Subsequent analysis revealed a significant simple interaction effect for the quadriceps muscle group and mode of contraction and angular velocity only. A significant simple, simple main effect was determined to exist for the quadriceps muscle group at
the 150°/sec angular velocity for mode of contraction; concentric fatigue (mean=35.8 repetitions) was significantly greater than eccentric fatigue (mean=72.5 repetitions).

Etchie, Michael P. A SUBMAXIMAL ONE-MILE TRACK JOG TO ESTIMATE VO2max IN FIT MEN AND WOMEN, AGES 30-39 YEARS, 1992. M.S., Brigham Young University (A. Garth Fisher). (73pp 1 f $4.00) PH 1312

The purpose of this study was to develop a submaximal field test using a one-mile track jog to establish maximal oxygen intake (VO2max) in fit 30 to 39 year old males and females. VO2max was measured in 108 subjects (males=58, females=50) using an inclined motorized treadmill protocol. Subjects performed a one-mile submaximal, steady state track jog with an elapsed jog time ≥8.5 min for males and ≥9.5 min for females and an ending exercise HR ≥175 bpm. To estimate VO2max (ml·kg−1·min−1), multiple regression analysis (n=55) incorporated the predictor variables of gender (G, 0=female, 1=male), body mass (WT, kg), elapsed jog time (T, min) and ending heart rate (HR, bpm) and generated the following validation (V) model: VO2max=101.834 + 9.922G - 0.2585WT - 1.647T +0.92 and SEE=3.0 ml·kg−1·min−1. Cross validation (CV) of the one-mile track jog comparing observed and estimated VO2max (n=53) resulted in radj=0.84, SEE=3.7 ml·kg−1·min−1. The submaximal, steady-state, one-mile jog can accurately estimate VO2max and diminish the problems of pacing, injury, and motivation associated with maximal performance run tests.


The purpose of this study was to examine the effects of an acute bout of heavy resistance exercise on nocturnal levels of human growth hormone (hGH). Eight healthy, resistance trained, young men completed a heavy resistance training session consisting of 3 sets of 6 exercises per formed at 80% of 1 RM to volitional fatigue set with 1 min rest between sets. Blood was drawn pre exercise and immediately, 20, 40, and 60 min. post exercise with subsequent samples drawn each hour, on the hour, overnight until 0700h. Results were compared to control values obtained on a separate day in which no exercise was performed. Significant increases in hGH release was demonstrated immediately following exercise and remained elevated for 40 min. (p<0.05). No change was demonstrated in nocturnal hGH secretion following resistance training. While there was no increase in overnight hGH there was no decrease which when considered with the acute response following exercise should lead to a net increase in hGH production for the day. Thus, nocturnal hGH seems to have a limited role in the anabolic effect of weight training.

Favero, Terence G. THE ABILITY OF SARCOPLASMIC RETICULUM TO REGULATE INTRACELLULAR CALCIUM FOLLOWING A FATIGUING BOUT OF EXERCISE, 1990. Ph.D., University of Oregon (Gary A. Klug). (76pp 1 f $4.00) PH 1256

The primary role of sarcoplasmic reticulum (SR) in skeletal muscle is the regulation of intracellular free Ca2+. By release of Ca2+ in response to t-tubule excitation and its subsequent sequestration by a membrane-bound ATPase, SR controls Ca2+ fluxes within the myoplasmic milieu. Previous experimentation has shown that prolonged exercise or increased muscle activity alters the normal function of SR by reducing the rate and capacity of uptake as well as the Ca2+−ATPase activity. To date, no mechanisms for this dysfunction have been identified nor have the effects of exercise on the kinetics of Ca2+ release been examined. The characteristics of the membrane and the structure of the ATPase are critical factors in the regulation of SR function. Thus, membrane fluidity, sulphhydryl content (SH), and Ca2+−stimulated ATPase activity at varying temperatures were assessed in SR vesicles isolated from rat gastrocnemius muscle following a single bout of prolonged exercise. In addition, Ca2+−uptake and the kinetics of Ag+−induced Ca2+ release were also assessed. Membrane fluidity as described by fluorescence anisotropy was not different between the exercise and control samples. Conversely, Ca2+−stimulated ATPase activity was consistently attenuated by the exercise bout throughout the temperature range of 22-45 °C. These data suggest that, although temperature is an important regulator of ATPase activity, it does not directly contribute to its decline via a mechanism involving the SR membrane. The SR ATPase contains 26 SH groups which contribute to its conformational integrity. Experiments to determine the effect of exercise on the SH groups demonstrated that the amount that could be readily oxidized in vitro was 25% lower following the exercise bout suggesting an alteration in the normal structure. Treatment of the effected vesicles with the SH reducing agent DIT returned the ATPase activity to normal suggesting that the exercised-induced depression was related to SH oxidation. Ca2+−uptake was similar between control and exercise SR samples, whereas the rate of Ca2+−uptake declined concomitantly with the reduction in ATPase activity. Similarly, the amount of Ca2+−release was not different following the exercise bout yet the rate of release declined both at 5 and 10 μM Ag+. These data suggest that alterations in the Ca2+−ATPase activity and Ca2+−transport from SR are most likely due to a chemical modification of the ATPase pump protein. They also show for the first time that the Ca2+−release mechanism is modified by the exercise bout. Considering the direct dependence of muscle contraction on intracellular free Ca2+, it is possible that alterations in SR function compromise force production and contribute to the fatigue that occurs during a prolonged bout of exercise.

Fedler, Joan M. THE EFFECT OF A LIFETIME OF PHYSICAL ACTIVITY ON THE QUANTITY OF BONE IN THE CANINE, 1989. M.A., University of Iowa (Jerry A. Maynard). (83pp 1 f $4.00) PH 1282

The purpose of this study was to determine if a lifetime of activity (weight-bearing physical exercise) would decrease the amount of bone lost through the normal aging process in the canine. Twenty beagles, aged approximately 11 years, constituted the animal model for this investigation. Nine composed the runner group and
The effects of two types of music stimuli on heart rate and blood pressure responses of college-aged students during exercise were examined utilizing volunteers during a 2-week period at Slippery Rock University. Subject’s heart rate and blood pressure were monitored during a submaximal bicycle ergometer test while being exposed to three test conditions: silence, sedative, and stimulative music. A One Way Analysis of Variance for Repeated Measures was used to determine if there was a significant difference in heart rate and blood pressure among the three experimental conditions. A Duncan’s Multiple Range Test was then utilized to determine which of the three variables affected the measured values the most. The results revealed that music had little effect on heart rate and blood pressure during exercise or recovery. However, during the classical music test condition, the systolic pressure was higher both during and after exercise.

Osteoarthritis (OA) of the knees is a common condition affecting the elderly, causing functional limitations and dependency. We postulate that OA symptoms lead to a negative feedback loop, where motor unit inhibition leads to decreased muscle function, mobility, activity, and worsening symptoms. Although no quantitative data have been published, based on this hypothesis, a muscle rehabilitation program, designed to improve muscle function without exacerbating symptoms, would increase both muscle function and functional capacity. Twenty men and 20 women with knee OA were selected from 437 volunteers and then randomly assigned to 3 months of physical therapy (PT) or PT plus quantitative progressive muscle rehabilitation (PT+QPE). QPE emphasized quantitatively prescribing exercise throughout the functional activity range. We quantitatively measured muscle function (strength, endurance, contraction velocity) and motor unit recruitment by integrated electromyography (IEMG) on a specially designed exercise bench. Functional performance (ability to perform activities of daily living) was assessed by the Jette Functional Status Index and functional assessment questionnaires. Testing was conducted initially, after 1 and 2 months and post rehabilitation. In addition, a progressive treadmill protocol, with measurements of heart rate, blood pressure and VO2 evaluated cardiovascular fitness. OA patients had less strength (42%) and function (17%) compared to normals. PT and PT+QPE had increased muscle length, strength (12%), endurance (29%), and function (17%). Maximum IEMG increased after 6 weeks and force after 12 weeks. Increases in aerobic power and walking speed and decreases in submaximal heart rate and systolic blood pressure demonstrated an increase in aerobic fitness, secondary to improved muscle function. Both PT and PT+QPE showed more improvements than a home program using similar measurements (unpublished data). PT+QPE had greater increases than PT, especially at longer muscle lengths and all hamstring measurements. QPE alone (previous study) had greater improvements, especially in contraction velocity, than any of the programs. QPE alone, followed by a cardiovascular program, would result in maximal improvements in muscle function and functional performance in patients with knee OA.

It has been shown that eccentric contractions are capable of creating higher tensions, use less energy metabolically, and can withstand a greater number of contractions before fatigue when compared to concentric contractions of the same muscle. Fifty-three college football players were used to determine if training on equipment that enhanced the eccentric contraction during resistance training would provide for a more thorough training session leading to greater strength gains. All subjects were pretrained for isometric chest strength (dependent variable) on a chest press machine. Subjects were then randomly assigned into either an experimental group or a control group. The experimental group trained once a week for five weeks on a chest press machine.
that was adapted to increase resistance during the eccentric contraction. The control group trained once a week for five weeks using a chest press machine with no adaptation. Both groups were then posttested for isometric chest strength. Gain scores were computed and then compared to determine if strength gains differed between the two groups. There was no difference in strength gains between the experimental group (n=29, M=21.7, s=19.3) and the control group (n=24, M=10.0, s=26.1), t=1.88, p<0.05. Further investigation with a greater number of training sessions over a longer period of time is recommended.

Frangolias, Despina D. CARDIORESPIRATORY AND METABOLIC RESPONSES TO TREADMILL VERSUS WATER IMMERSION TO THE NECK EXERCISE IN ELITE DISTANCE RUNNERS, 1993. M.P.E., University of British Columbia (E.C. Rhodes). (208pp 3 f $12.00) PH 1348

The purpose of this study was to compare the following: a) the cardiorespiratory responses, in elite endurance runners familiar with WI running, at ventilatory threshold (Tvent) and at maximal effort for treadmill and WI running performance to exhaustion (i.e., VO2max), and b) the cardiorespiratory and metabolic responses to prolonged performance (42 min.) at exercise intensities reflecting the treadmill and WI Tvent. Thirteen endurance trained runners familiar with water running completed comparable treadmill and WI VO2max tests. Oxygen consumption (VO2), ventilation (Ve), heart-rate (HR), respiratory exchange ratio (RER), ratings of perceived exertion (RPE) and stride frequency (SF) were measured at Tvent and VO2max. Peak blood lactate [BLa] samples were obtained 30 seconds and 5 minutes post-test Correlated t-tests revealed significantly (p<0.05) higher VO2max (88 vs 54.6 ml·kg·min⁻¹), HRmax (190 vs 175 bpm), RERmax (1.20 vs 1.10), VO2 at Tvent (46.3 vs 42.8 ml·kg⁻¹·min⁻¹), HR at Tvent (165 vs 152 bpm) favoring the treadmill. Similar values were recorded for Vemax (109.0 vs 105.8 l·min⁻¹), Ve at Tvent (66.4 vs 65.7 l·min⁻¹), RER at Tvent (0.99 vs 0.89) and post-test [BLa] at 30 sec (10.4 vs 9.8 mmol·l⁻¹) and 5 min post-test (9.7 vs 9.2 mmol·l⁻¹) for the two conditions. Wilcoxon’s matched pairs signed-ranks test revealed no differences in RPE at Tvent and VO2max level for the two conditions. Significantly higher SF values over time were recorded (88 vs 54 strides·min⁻¹, averaged over time) on the treadmill. The lower WI VO2 with similar peak [BLa] and lower SF suggests that the active musculature and muscle recruitment patterns differ in WI running due to the high viscosity friction of water, and the non-weight bearing nature of WI running. During steady state exercise at treadmill and WI Tvent, VO2max increased with WI running at Tvent. In comparison to the treadmill VO2max was lower, indicating the difference in resistance to movement. The VO2max for WI was 51.0 ml·kg·min⁻¹, and for Treadmill it was 64.4 ml·kg·min⁻¹. A similar trend was observed for Ve, HR, and RER. The VO2max was significantly higher for the treadmill condition, indicating a greater energy expenditure. The VO2max for the treadmill condition was 109.0 l·min⁻¹, and for WI it was 95.4 l·min⁻¹. The HRmax was also significantly higher for the treadmill condition, with a value of 190 bpm compared to 165 bpm for WI. The RERmax was lower for the WI condition, with a value of 1.20 compared to 1.10 for the treadmill. The SF was also significantly lower for the WI condition, with a value of 88 strides·min⁻¹ compared to 109 strides·min⁻¹ for the treadmill. The RPE was also significantly lower for the WI condition, with a value of 10.83 on a scale of 0-20 compared to 12.2 on the treadmill.

Gao, Jiaping. IN VIVO INSULIN ACTION ON WHOLE BODY AND INDIVIDUAL TISSUES IN OBESE SHHF/Mcc-cp RATS WITH OR WITHOUT ACUTE EXERCISE, 1991. Ph.D., Ohio State University (William M. Sherman). (132pp 2 f $8.00) PH 11284

Whole-body glucose disposal, hepatic glucose production and tissue glucose uptake were measured in lean and obese male SHHF/Mcc-cp rats using hyperinsulimemic, euglycemic clamps incorporating infusion of radiolabelled glucose. Lean rats were studied under sedentary conditions, while obese rats were studied under sedentary conditions or after two hours of running on a treadmill at 10 m/min, 0% grade. Compared to the lean rats, the obese rats had significantly higher fasting plasma glucose and insulin concentrations. Despite higher plasma insulin concentrations during the clamps for the obese rats compared to the lean rats, the rates of insulin stimulated whole-body glucose disposal and the inhibition of hepatic glucose production by insulin were significantly reduced in the obese rats. Maximal insulin-stimulated glucose uptake by heart, liver and soleus muscle was similar for lean and obese rats, whereas it was significantly decreased in diaphragm, plantaris, gastrocnemius, red and white quadriceps muscles and epidydimal fat tissue in the obese rats compared to the lean rats. Acute exercise significantly lowered the resting plasma glucose concentration but did not affect the resting insulin concentration in the obese rats. Acute exercise significantly increased whole-body glucose disposal but did not alter the inhibition of hepatic glucose production by insulin in the obese rats. Acute exercise significantly increased glucose uptake in all muscles except plantaris, but did not alter glucose uptake in liver and fat tissues. In conclusion, insulin action on whole-body glucose disposal, hepatic glucose production and tissue glucose uptake is severely impaired in obese male SHHF/Mcc-cp rats. Acute exercise improves whole-body glucose disposal and muscle glucose uptake in the obese rats, but it does not alter hepatic glucose production or adipose tissue glucose uptake.


The physiological responses of oxygen uptake, heart rate (HR), ventilation (Ve), respiratory exchange ratio (RER), blood pressure (BP), and rating of perceived exertion (RPE) were measured in 30 female subjects (Ss) age 20-34, performing arm exercises with one pound hand held weights while stationary bicycling. Ss biked alone, biked plus bicep curls (BC), biked plus arm swings (AS), and biked plus shoulder presses (SP). The oxygen uptake significantly increased from bicycling alone, 16.973 ml·kg·min⁻¹ to 19.047, 20.210, and 22.103 for BC, AS, and SP, respectively. This was an increase of 12.2%, 19.1%, and 30.7% over the bicycling alone. The HR response increased from 130.4 to 140.267, 145.133, and 157.400 for BC, AS, and SP. Ve significantly increased from 29139 ml of stationary bicycling to 34524, 36606, and 41046 ml, again a significant increase of 18.5%, 25.6%, and 40.8%. RER values did not significantly differ. Immediate post exercise (IPE) systolic BP rose from 19 to 34 mm Hg when arm exercise utilizing hand held weights were added to stationary bicycling. IPE diastolic BP did not differ significantly. RPE values increased from 10.833 for biking alone to 11.100, 11.900, and 13.200 for BC, AS, and SP. There was an increase in all physiological responses as exercise intensity increased. However, due to the abrupt rise in systolic BP,
disproportionate to the rise in HR, this activity would not be appropriate for cardiac rehabilitation participants or hypertensive individuals.

Gayer, Christina D. PHYSIOLOGICAL DISCRIMINATORS OF ROWING PERFORMANCE IN MALE, CLUB ROWERS, 1993. M.S., Washington State University (William G. Thorland). (75pp 1 f $4.00) PH 1314

The purpose was to identify the physiological variables that discriminate between faster and slower club, male rowers (n=12; 19-28 years) in 2000m rowing performance. The independent variables investigated were: VO_{max} (L/min), lactate threshold (LT) (watts), peak power output (PP) (watts), relative fat (%), height (cm) and lean body mass (LBM). Intercorrelations between the dependent and independent variables were conducted; VO_{max} was found to be most significantly related to 2000m time (r=-0.748 or 26% shared variance). Discriminant function analysis, a multivariate technique, was employed to determine the variables that separated the two performance groups, fast (n=6) and slow (n=6) (median time to completion for 2000m = 6:42 min.). A performance prediction equation was derived from the unstandardized discriminant function coefficients:

DF = 0.036 (LT) + 0.011 (PP) + 0.099 (LBM) - 21.69.

The model accounted for 61.3% of the variance in 2000m rowing performance (PP: 24.4%; LT: 19.6%; LBM: 17.3%). The cross-validation revealed an overall classification rate of 83.3% resulting from this analysis. It was concluded that when designing training programs for club, male rowers, one should focus on the development of peak power, lactate threshold and lean body mass, since these three variables were the most influential at separating the more successful from the less successful club-level rowers.

Gerhards, Marty D. HANDRAIL ASSISTED VERSUS NONHANDRAIL ASSISTED STAIRMASTER GAUNTLET ERGOMETRY, 1991. M.S., University of Wisconsin-Lacrosse (Nancy Kay Butts). (73pp 1 f $4.00) PH 1315

This study was designed to determine if sig diff existed in physiological responses (VO_{2}, VE, METs, R, kcal, HR, and RPE) between handrail assisted (HA) and nonhandrail assisted (NHA) StairMaster Gauntlet (SG) exercise. Twenty males, ages 21-30, performed 2 exercise tests on the SG. The tests consisted of 4, 4 min stages, representing the SG’s predicted MET values of 8, 11, 14, and 17, for each of the handrail assisted conditions. Expired gases were analyzed with the Quinton Q-Plex I and HRs were monitored with UNIQ-CIC heartwatches. Individual ANOVAs revealed sig (p<.05) higher values for the NHA method for oxygen consumption (VO_{2}), METs, kcal) and VE. Variables not exhibiting sig (p>.05) diff included HR, R, and RPE. Individuals t-tests revealed that values obtained for oxygen consumption were sig (p<.01) higher under the NHA condition for all stages of testing. VE and RPE values were sig (p=.01) higher under the NHA condition for Stages 3 and 4 of the tests. Values representing R were sig (p<.01) higher for the NHA condition for stage 4 only. No sig (p>.01) diff were observed between conditions for HR. The SG’s estimated MET levels sig (p<.01) overestimated actual MET expenditure when compared to the HA condition in stages 2 through 4. The NHA condition resulted in a sig (p<.01) overestimation of MET levels during Stage 1, but not for Stages 2 through 4, when compared to the SG’s estimated MET levels. Further studies are needed to evaluate the possible inherent differences among sexes and fitness levels in regard to hand support variations on the StairMaster Gauntlet and 400 PT.

Goebel, Brenda M. THE EFFECTS OF SUPERVISED CARDIAC REHABILITATION ON SELECTED CORONARY ARTERY DISEASE RISK FACTORS FOLLOWING CORONARY ARTERY BYPASS GRAFT SURGERY, 1991. M.A., University of North Carolina at Chapel Hill (Barbara E. Ainsworth). (111pp 2 f $8.00) PH 1225

The purpose of this study was to determine the effects of cardiac rehabilitation (CR) on selected coronary artery disease (CAD) risk factors in coronary artery bypass graft (CABG) patients. Six men (M age=63 ± 7 years) and 4 women (M age=66 ± 6 years) self-selected themselves into treatment (T) and comparison (C) groups at 8 weeks following surgery. The T group participated in 12 weeks of CR which included information about CAD risk factor reduction, supervised exercise for 3 days a week, and usual care from their physician. Subjects were tested at the beginning of the study (pre) and 12 weeks later (post). Measurements included: treadmill maximal MET capacity (METs), Total Cholesterol (TC), HDL-C, and LDL-C in mg/dl, TC/HDL-C ratio, three month history of physical activity (TMHPA), and dietary food frequency (D). Analyses were performed using ANCOVA, adjusting for age, gender, and pre-treatment values. Results showed significant differences (p<.05) in post-test scores between the T and C groups for METs, HDL-C, total- and household TMHPA. Comparisons between the groups for TC, LDL-C, heavy-, moderate-, light-intensity TMHPA, and D were not statistically different (p>.05). These findings suggest that CR, in addition to usual care, is associated with a reduction in selected CAD risk factors compared to usual care treatment alone in CABG patients following surgery.

Golan, Ron. EFFECTS OF THYMOPENTIN ON THE RESPONSES OF HYPOTHALAMIC-PITUITARY-ADRENAL AXIS TO A HIGH INTENSITY DYNAMIC EXERCISE PROTOCOL, 1993. Ph.D., Temple University (Zebulon V. Kendrick). (139pp 2 f $8.00) PH 1285

The purposes of this investigation were twofold: (a) to determine if high intensity intermittent treadmill exercise at 90% of maximal oxygen uptake (VO_{max}) would elevate the levels of lactate, adrenocorticotropic hormone (ACTH), cortisol, β-endorphin, dehydroepiandrosterone sulfate, and arginine-vasopressin; and (b) to determine if thymopentin would attenuate these elevations at rest, during, and after the exercise. The study was conducted in 2 phases. Ten male subjects (25.4 ± 1.5 yrs) took part in Phase I that tested the first aforementioned purpose. Blood samples were taken 5 minutes prior to, immediately post, and 30 and 120 minutes post exercise. Data was analyzed using a 1 (treatment level) x 4 (time levels) analysis of variance (ANOVA) design with the probability of 0.05 considered significant. Twenty male subjects (25.3 ± 4.5 yrs) participated in Phase II that tested the second purpose. Subjects were subcutaneously administered either 50 mg thymopentin or saline placebo, and 24 hours later performed the exercise task of Phase I. Data was analyzed using a 2 (treatment levels) x 4 (time levels) ANOVA factorial design with the probability of 0.05 considered significant. Exercise in Phase I resulted in significant elevation of plasma ACTH, arginine-vasopressin, β-endorphin, and lactate immediately post-exercise. Serum was significantly elevated at 30 minutes post-exercise. The placebo- and
thymopentin-administered subjects of Phase II did not differ in their physical and performance characteristics. Exercise significantly elevated plasma ACTH, β-endorphin, arginine vasopressin, and lactate immediately post-exercise. Serum cortisol was significantly elevated at 30 minutes post exercise. Plasma dehydroepiandrosterone-sulfate did not change. The administration of thymopentin had no effect on any of the exercise-induced hormonal responses. It was concluded that (a) intermittent exercise at 90% VO₂max was sufficient to increase the circulating levels of lactate and hormones of the HPA axis examined; and (b) 50 mg thymopentin does not attenuate these hormonal response prior to, during, and following intermittent exercise at 90% of VO₂max.

Golden, Jane E. RESPONSES TO GRADED EXERCISE TESTING IN NORMAL CHILDREN AND ADOLESCENTS WITH HIGH AND LOW LEFT VENTRICULAR MASS, 1990. Ph.D., University of Iowa (David H. Nielsen, William R. Clarke). (316pp 4 f $16.00) PH 1286

Increased left ventricular mass (LVM) has been linked with higher risk of developing hypertension in adults, but little research has been performed in children and adolescents. This research, part of the Muscatine Coronary Risk Factor Project, examined exercise efficiency, cardiorespiratory fitness and cardiovascular performance during submaximal and peak exercise in 239 subjects selected on the basis of LVM. The subjects were equally distributed across age (7-17 years), sex, and LVM group (High LVM, 80-99th percentile; Low LVM, 0-19th percentile; and Random LVM - the entire distribution). The exercise test, performed on an electromechanically braked cycle ergometer, consisted of three submaximal steady-state stages followed by 30-second ramps to the subject’s tolerance to obtain submaximal and peak values. Physiological variables for submaximal exercise included oxygen consumption (VO₂, ml/min), heart rate (HR), systolic blood pressure (SBP), rate pressure product (RPP) and 02pulse versus physical workload (watts) and HR, SBP and RPP versus physiological workload (VO₂ in ml/0.,LBM-min). Peak exercise variables included physical work capacity (PWC, highest workload maintained for 30 seconds) and peak VO₂ (L/min), HR, SBP, RPP and 02pulse during that 30 seconds. Normal submaximal and peak mean exercise responses were seen for all LVM groups and for both sexes. Unadjusted mean peak VO₂ peak HR and peak SBP were 40.5 ml0.,/kg-min, 195 bpm and 181 mmHg. For each exercise response parameter, age, height, weight, %bodyfat, lean body mass (LBM) and sexual maturation as confounding factors were investigated and statistically controlled. Lean body mass was the most frequently used covariate adjustment. The following conclusions are justified within the scope of this study: (1) Physical characteristics must be statistically controlled when comparing submaximal and peak exercise responses between groups and sexes. (2) Left ventricular mass is not associated with exercise efficiency or cardiorespiratory fitness. (3) The covariate adjusted mean differences between the High and Low left ventricular mass groups for children and adolescents, ages 7 to 17, for SBP and RPP responses were not large. (4) There is an association between LVM and the ability to generate high unadjusted peak SBP (≥230 mmHg) during dynamic exercise in children and adolescents.

Gray, Georgina L. OXYGEN CONSUMPTION DURING KAYAK PADDLING, 1992. M.P.E., University of British Columbia (Donald C. McKenzie). (66pp 1 f $4.00) PH 1267

Over a typical 10,000 metre race, flatwater kayak paddlers frequently employ a technique termed “wash riding” in an effort to reduce energy expenditure. This technique is characterized by the kayak paddler travelling on his competitor’s wake, and at a strategic moment dropping off the wake to sprint ahead. Investigations to determine actual energy expenditure during flatwater kayak paddling during tactical maneuvers, to date, have been inadequate. Thus, the purpose of this study was to investigate the effects of wash riding on energy expenditure in 10 elite male flatwater kayak athletes (age=25 ± 5.6 yrs., height=183.6 ± 4.4 cm, mass=83.9 ± 6.1 kg) while kayak paddling under “wash riding” (WR) and “non-wash riding” (NWR) conditions. The exercise test was designed to allow for comparison of minute ventilation (Ve), oxygen consumption (VO₂) and heart rate (HR) at submaximal velocities (10,000 metre “steady state” race pace). The exercise protocol consisted of a standardized warm-up, followed by a 2000 metre trial of either WR or NWR. The pace to be maintained (3.7 m/sec), was based on an extrapolation of the 1991 Canadian Canoe Association National Championship 10,000 metre race winning time. Following the first trial there was a twenty minute rest period, which was then followed by a second trial involving the alternate condition. Ve, VO₂ and HR were measured every 15 s over the full 2000 metre distance during both conditions using the Cosmed K2 portable telemetry system. Measurements recorded between the 500 and 1300 metre mark were used for analysis in order to examine the effects of wash riding during the steady state aerobic work. A mean value of the eighteen measurements recorded for each variable between 500 and 1500 metres, was calculated for each subject. Statistical analysis of the mean values for Ve, VO₂ and HR was performed using the Hotelling’s T² statistic and revealed significant (p<0.05) differences between the WR and NWR trials. Mean values for Ve (L·min⁻¹) were (WR) 113 ± 16.5 and (NWR) 126.3 ± 15.7; VO₂ (L·min⁻¹)=WR 3.22 ± 0.32 and (NWR) 3.63 ± 0.3; and HR (bpm)=(WR) 167 ± 9.9 and (NWR) 174 ± 8.0. Confidence intervals calculated for Ve, VO₂ and HR revealed that all three independent variables contributed to the overall significant. There is a considerable saving (11%) in the energy cost of paddling at a standardized velocity utilizing the WR technique. This finding has implications for the design of training programs and competitive strategy plans for flatwater kayak racing.

Gregory, Thomas M. THE EFFECT OF EXERCISE ON THE PRESENCE OF LEUKOCYTES, ERYTHROCYTES, AND COLLAGEN FIBERS IN RAT SKELETAL MUSCLE FOLLOWING EXPERIMENTAL CONTUSION, 1991. Ph.D., Brigham Young University (Rulon S. Francis). (149pp 2 f $8.00) PH 1349

Male albino rats were mechanically traumatized by machine on their biops femoris and subjected to one of four exercise regimens: running with onset immediately after injury, running with a 72 hour delay after injury, swimming immediately, or swimming with a 72 hour delay. The object of the experiment was to determine the treatment regimen which would most speed the healing process. The rate of healing was determined by a count of the nuclei of leukocytes and erythrocytes, a differential count of leukocytes, and a count of collagen fibers from the contusion. Running with delayed onset appears to be the best regimen to increase the rate of healing.
Harbour, Susan K. HEART RATE RESPONSES OF COLLEGIATE FEMALE VOLLEYBALL PLAYERS DURING COMPETITION, 1991. M.S., Washington State University (Sally E. Blank). (10pp 2 f $8.00) PH 1226

The problem was to investigate exercise intensity and estimate the extent to which the aerobic capacity is utilized during a mock women’s intercollegiate volleyball competition at the NCAA Division I level. Heart rate response data were collected from six University of Idaho women volleyball athletes during a competitive match. Heart rate was telemetrically monitored throughout the match and a simultaneous videotape recording was produced to provide rally and rest duration as well as game length and court position corresponding to heart rate measures. Heart rate response during competitive volleyball was generally higher in the front court than in the back for all positions except for the setter who demonstrated higher percentages of maximum heart rates in the back court. During the mock competition, most of the athletes maintained a heart rate equal to that of at least 60% of VO2max for thirty minutes. Relay to recovery ratios (approximately 1.09-1.3) were within the guidelines for effective interval training. Intercollegiate volleyball competition at the NCAA Division I level provides an interval training effect and requires high levels of both aerobic and anaerobic fitness. Exercise intensity levels based on heart rate response vary according to assigned court position as well as whether the athlete is in the front or back court.

Harms, Craig A. INFLUENCE OF BODY FAT MASS ON EXCESS POST-EXERCISE OXYGEN CONSUMPTION, 1990. M.S., Colorado State University (Loren Cordain). (79pp 1 f $4.00) PH 1257

Few studies have dealt specifically with the influence of body fat mass relative to excess post-exercise oxygen consumption (EPOC). This study matched subject’s lean body weights while body fat percentages were kept significantly (p≤.05) different. Two groups of eight healthy males between the ages of 18 and 22 years volunteered as subjects for this study. The criteria for subject selection required all subjects to have a lean body mass of 65-70 kilograms. Additionally, a lean and non-lean group were required to have body fat percentages of ≤10% and ≥17% respectively. Metabolic measurements for oxygen consumption (VO2), carbon dioxide production (VC02), minute ventilation (Vr) respiratory exchange ratio (RER) and core body temperature (Trec) were measured during each minute for maximal exercise, resting metabolic rates (RMR), submaximal exercise and for one hour post-exercise. A 20-minute submaximal treadmill run was performed at an average of 73.0% VO2max for the lean group and 73.3% VO2max for the non-lean group. Following the submaximal run, the lean group displayed greater (p≤.05) VO2 (ml kg-1·min-1) for recovery minutes 0-30 than the non-lean group. Respiratory exchange ratio (RER) was lower (p≤.05) for the lean group for minutes 21-60 post-exercise which perhaps indicated greater fatty acid utilization. The lean group dissipated body heat (Trec) more rapidly than the non-lean group and remained cooler (p≤.05) for minutes 21-60 post-exercise. Decreased core body temperature for the lean group suggests increased (p≤.05) fatty acid utilization during recovery or perhaps less body fat to retard thermoregulation. These data suggest that individuals with lower body fat percentages exhibit a greater metabolic rate, as measured by oxygen consumption, for 30 minutes following strenuous exercise than those individuals with higher body fat percentages. Individuals with lower body fat percentages also utilize more fatty acid as substrate fuel and dissipate body heat more rapidly post-exercise. It may be speculated, therefore, that decreased body fat in individuals serves as an asset in terms of the metabolic benefits of the recovery processes from exercise as well as from the exercise itself. Further research is required to determine if these post-exercise metabolic characteristics of lean subjects are responsible in part for their leanness.

Heil, Daniel P. THE EFFECT OF SEAT-TUBE ANGLE VARIATION ON CARDIORESPIRATORY RESPONSES DURING SUBMAXIMAL BICYCLING, 1992. M.S., Oregon State University (Anthony Wilcox). (136pp 2 f $8.00) PH 1227

The purpose of this research was to study the effect of seat-tube angle (STA) variation on various cardiorespiratory variables in trained competitive triathletes and cyclists during steady-state bicycling. Twenty-five trained competitive triathletes and cyclists participated in four successive submaximal tests at a work rate that approximated 70% of their maximal oxygen consumption (VO2max). Each test corresponded to one of four STA’s being tested (69°, 76°, 83°, 90°). All subjects performed a VO2max test on a cycle ergometer at least 48 hours prior to the submaximal testing. To be considered for the investigation, the following were required of subjects: 1) a minimum of two years competitive experience; 2) be training for the upcoming season; 3) and the subjects must have used aerodynamic handlebars on a regular basis during the three months prior to testing. To test the effect of STA, the ergometer’s dimensions were set to match the subject’s own racing bicycle except for STA. This setup was accomplished with a specially constructed stem and seat post that allowed variable fore aft positioning. The order of STA’s tested was counterbalanced to control for order effects. A three minute warmup was followed by 10 minutes of riding at a work rate that approximated 70% of the subject’s VO2max at 90 RPE while using aerodynamic handlebars. This was followed by 25 minutes of rest until the next submaximal test. A one-way repeated measures ANOVA determined that seven of the eight dependent variables showed significant differences between means at the treatment STA’s (p<.05). Relative and absolute VO2, HR, Vr, RPE, VC02, and RQ all showed significant differences while Vr/VO2 did not. The seven variables with significant differences all had significant negative linear trends (p<.05) that maximized at the means at 69° and minimized at the means at 83° and 90°. All seven variables showed the means at 83° and/or 90° to significantly differ from the means at 69°. These results demonstrate that the 83° and 90° STA’s are more advantageous at a constant work rate than the 69° STA when using aerodynamic handlebars. The findings of this study help to validate the claims made by many top professional triathletes about the performance enhancing potential of using a forward STA from the standard 72°-75°.

Heilman, Paula S. PHYSIOLOGICAL RESPONSES OBTAINED DURING EXERCISE ON THE STAIRMASTER GAUNTLET WITH AND WITHOUT THE USE OF HANDS, 1991. M.S., University of Wisconsin-La Crosse (Nancy Kay Butts). (89pp 1 f $4.00) PH 1316

This investigation was designed to determine if there were sig diffs in the physiological responses (VO2, VE, METS, RER, Kcals, HR, and RPE) with hands (WH) or without hands (WOH) during exercise on the StairMaster Gauntlet (SM). Two discontinuous protocols utilizing 6, 8, 11, 14, and 17 METS were performed on 20
Healthy college females. The ANOVA indicated there were sig (p<.05) diffs between all stages and methods WOH condition which resulted in higher values. Since the ANOVA indicated a sig (p<.05) interaction, the Bonferroni method indicated that all values representing VO₂, VE, METS, kcal, and HR were sig (p<.01) higher WOH. The RER at 11 and 14 METS were sig (p<.01) lower WH. The RPE at 8, 11, and 14 METS were also sig (p<.01) lower WH. As the intensity increased, the differences in methods also increased for all physiological variables except HR. WH was found to overestimate the values at the higher intensities. It was concluded that the use of handrails during SM exercise decreases the metabolic requirements of exercise.


The purpose of this study was to compare the acute heart rate (HR) and blood pressure (BP) responses among isometric (IM), isotonic (IT), and isokinetic (IK) exercise when the submaximal level of exercise intensity was equated by Torque-time index (Tq-t). Tq-t was developed by the investigator in order to equate the intensity of the three forms of exercise, and was the product of the average torque and the duration of exercise. Subjects were 18 healthy males. Right leg extension was chosen for the three forms of resistive exercise. IT exercise was performed on a Hammer leg extension machine, whereas IM and IK exercise were performed on a KIN-COM dynamometer. HR and BP responses were recorded by Polar Vantage XL HR monitor and Apolispulse-10 electronic BP monitor, respectively. BP responses were taken from the left arm throughout the testing. Rate pressure product (RPP) was calculated by dividing the product of HR and SBP by 1000. The Valsalva maneuver was not allowed throughout the testing. HR, SBP, DBP, and RPP of IM exercise were significantly (p<.001) lower than IT and IK exercise. SBP and RPP of IT exercise were significantly (p<.001) greater than IK exercise. However, no differences (p>0.05) were found between IT and IK exercise in terms of HR and DBP responses. In summary, submaximal IM exercise elicits the lowest cardiac responses than submaximal IT and IK exercises.

Inbar, Galit. THE POST-EXERCISE BLOOD PRESSURE RESPONSE TO ACUTE EXERCISE IN BORDERLINE HYPERTENSIVE WOMEN, 1992. Ph.D., Indiana University (Janet P. Wallace). (215pp 3 f $12.00) PH 1288

The study investigate the effect of exercise intensity and duration on the post-exercise blood pressure (BP) response in borderline hypertensive women, and some underlying mechanisms. Twenty seven premenopausal women volunteered for the study. They were screened for borderline hypertension prior to the study. Each subject had a graded exercise test to determine VO₂max and the intensity for the submaximal exercise bout. Then they were randomly assigned to exercise at 50 or 70% VO₂max for 15 or 45 min. Six of the subjects volunteered to serve as non-exercising controls. BP (random zero sphygmomanometer), heart rate, stroke volume and cardiac output (impedance cardiography), total peripheral resistance (calculated), and oxygen uptake (open-circuit) were recorded every 5 or 10 min for 30 min before and every 10 of 15 min after the exercise or control period, depending on the variables. ANOVA and MANOVA were used to find differences among the groups (p<.05). Only those who exercised at 50% VO₂max for 45 min demonstrated significantly lower systolic BP compared to the controls, although the BP reductions, as well as the other variables, were not different among the exercise groups. No correlations were found between the different hemodynamic variables and the change in BP. Therefore, exercise for 45 min at 50% VO₂max intensity is more effective in reducing systolic pressure than sitting for a comparable period, however, the responsible hemodynamics are not clear.

Ipsen, Lillas F. CARDIOVASCULAR AND BODY COMPOSITION RESPONSES TO AEROBIC DANCE TRAINING OF VARYING FREQUENCIES AND TOTAL PROGRAM LENGTHS, 1990. M.S., Brigham Young University (Elmo S. Roundy). (153pp 2 f $8.00) PH 1318

Comparisons were made of cardiovascular and body composition gains in 14 and 7 week aerobic dance programs involving 2 and 4 day frequencies respectively. Also analyzed were influences of gender and initial fitness on this comparison. A nonrandomized design involving 194 male and female college-aged students was used. Cardiovascular condition was determined by 1.5 mile run time and body composition by percent body fat measures from three sites. A t-value of 5.86 indicated that overall cardiovascular improvement was significant (p<.01). No significant differences in cardiovascular improvements resulted between the two programs or between men and women. Differences among conditioning levels were significant with the greatest gains occurring in the least conditioned subjects. A t-value of -0.36 indicated overall percent body fat decreases were not significant (p>.05). Significantly greater decreases in percent body fat for women occurred in the short term, high frequency program. The least fit women experienced the largest decreases in percent body fat.


The purpose of this investigation was to study the relationship between exercise intensity and weight training economy. A major goal of this study was development of a practical model for prediction of metabolic cost of weight training exercises from the vertical external work performed and the weight training economy. Seven subjects performed squat and seated behind the neck press exercises at 60% and 80% of the repetition maximum (1 RM). Addition of the net exercise oxygen uptake (VO₂) to the net recovery VO₂, provided an estimate of the metabolic cost for the exercise. Estimation of work performed was accomplished by calculation of vertical external work (VEW). The weight training economy was then calculated from these values (weight training economy=kcal's consumed * VEW⁻¹). The squat was significantly more economical than the overhead press (p=.002), and exercise at 60% 1 RM was more economical than exercise at 80% 1 RM (p<.001). Correlations between VEW and kcals consumed at each intensity ranged between .85-.98. It was determined that estimation of metabolic cost of weight training exercise must take into account not only the vertical external work accomplished, but also the intensity of the exercise (% 1 RM). The vertical external work performed on the bar (excluding work performed on the involved body segments) appears to be as accurate as the total vertical external work value in prediction of metabolic cost of the squat and overhead press exercises. Use of the weight training economy
values obtained in this study for prediction of metabolic cost will provide values with 4.2%-15.8% prediction error, depending on the exercise performed. KEY WORDS (economy, weight training, metabolic rate)

Kaplan, Linda. THE EFFECT OF WRIST WEIGHT ON THE HEMODYNAMIC RESPONSE TO EXERCISE IN CORONARY ARTERY DISEASE, 1993. M.S., Springfield College (Vincent J. Paolone). (161pp 2 f $8.00) PH 1319

Differences in hemodynamic responses among four treadmill tests on 10 men with coronary artery disease (CAD) were examined. The tests included arm conditions of no weight—normal arm swing (NN) and no weight—exaggerated arm swing (NE) while wrist weight—normal arm swing (WN) and wrist weight—exaggerated arm swing (WE) were the weight conditions. Heart rate (HR), systolic and diastolic blood pressure (BP), and rating of perceived exertion (RPE) were measured and analyzed by separate 2 x 2 (arm x weight) factorial design ANOVAs with repeated measures at the .05 level of significance. The HR, systolic BP, and RPE scores were higher during the WE test condition than during the WN condition and the arm conditions. The NE condition produced higher HR and systolic BP scores than the NN and also the WN test conditions. The RPE during the NE test was greater than during the NN test. Diastolic BP was higher during the WE condition than during the WN and the NN condition. There were interactions between the arm and weight conditions for HR and systolic BP only. The HR, systolic and diastolic BP scores measured during the WE condition were greater than those documented in previous studies under similar conditions. The use of 3 lb weight with an exaggerated arm motion may not be well tolerated by men with CAD due to the increases in HR, systolic and diastolic BP observed. The addition of an exaggerated arm swing alone, yielded significantly greater HR, systolic BP and RPE values and consequently may increase the intensity of the exercise with good toleration. The addition of 3 lb weight with no change in arm motion did not provide any significant differences in the hemodynamic parameters measured.

Kendrick, Raymond J. A COMPARISON OF ISOMETRIC STRENGTH TEST RESULTS BETWEEN LOW BACK INJURED PATIENTS AND NORMALS, 1991. M.A., University of North Carolina at Chapel Hill (Frank Pleasants). (54pp 1 f $4.00) PH 1229

The purpose of this study was to compare isometric strength test results between a group of normals and low back injured patients. The normals were volunteers with no history of low back injury requiring them to miss work. The injured patients had a diagnosis of low back strain which required them to miss six or more months of work. The subjects were administered an isometric arm, leg, and torso lift on an Ergometrics Company Analyzer. Three trials were performed in each position with the average force, coefficient of variation between trials, and number of acceptable trials being recorded. Two of the injured patients could not complete the torso lift, their data was thus omitted. Analysis of variance showed the normals to average significantly more force on each of the three lifts (p<.01). The normals also obtained significantly more acceptable trials on each of the lifts (p<.05) The groups obtained similar coefficient of variations between trials.

Keroack, Christopher R. THE EFFECTS OF α–TOCOPHEROL ON METABOLIC DETERMINATIONS IN GRADED EXERCISE, 1992. M.S., Springfield College (Vincent J. Paolone). (89pp 1 f $4.00) PH 1320

Forty students were divided into pairs matched by gender, height, weight, and age. A total of four groups of 10 resulted. After this, groups were divided by gender and drug administration (800 I.U. of vitamin E per day or placebo). Drug administration groups were selected by a double blind method of research. All groups were tested on a graded exercise protocol. This was done to determine if metabolic determinations between groups were similar. Exercise variables measured were maximal oxygen consumption (VO2max), time to VO2max, maximal carbon dioxide production (VCO2max), and recovery time. No significant differences between vitamin and placebo groups were found on the pretest. Individuals were given a vial of vitamin E or placebo tablets, and supplementation of vitamin E or placebo continued for 14 days. After this time period, exercise variables were measured again. Repeated measured analysis of variance (ANOVA) was conducted for all exercise variables. The ANOVA contained two independent groups factors (gender and drug administration) and one repeated factor (pretest and posttest). Analyses of exercise data revealed significant differences (p<.01) for gender effect in three variables (VO2max, time to VO2max and VCO2max) and a trial effect in VO2max. However, no significant differences (p>.01) for vitamin effect were found for group means. Vitamin E had no effect on the measured exercise variables. In conclusion, there are no significant differences in group means due to mega dosing of vitamin E suggesting that there are no major alterations in performance from high vitamin E supplementation.

Kime, James. PLASMA AND ERYTHROCYTE LACTATE CONCENTRATIONS IN HUMANS AFTER SUBMAXIMAL EXERCISE, 1990. M.A., University of Alabama (Phillip A. Bishop). (51pp 1 f $4.00) PH 1230

This study examined the kinetics of lactic acid transport between the plasma and the red blood cell (RBC) in vitro to assess the effectiveness of lactate transfer across the RBC membrane. Seven subjects (4 male, 3 female) performed two submaximal cycle ergometry tests at intensities that elicited a low (3 ± 1 mmol/l) and a moderate (6 ± 1 mmol/l) blood lactate concentration. Lactate concentrations for blood, plasma, and blood or plasma treated with a lysing agent, Triton X-100, were measured and expressed relative to water content at 0, 8, and 20 minutes post-exercise for both tests. Repeated measures ANOVA revealed that the plasma to RBC lactate ratio did not change from 0 to 20 minutes post-exercise for both the low or moderate concentrations nor was it significantly different at resting, low or moderate lactate concentrations. Expressing lactate concentrations relative to water eliminated differences among sample types. RBC membrane lactate transport mechanisms are effective in maintaining a constant lactate ratio despite increasing lactate concentrations.

Kolkhorst, Fred W. THE EFFECTS OF EXERCISE MODE ON POSTEXERCISE OXYGEN CONSUMPTION, URINARY NITROGEN, AND FAT UTILIZATION, 1990. Ph.D., University of Missouri-Columbia (Ben R. Londeree). (170pp 2 f $8.00) PH 1231
Eccentric exercise has been observed to cause greater muscle damage than concentric exercise. Signs of subsequent muscle repair have been reported to appear approximately 3 d after exercise. Moreover, a correlation between resting metabolic rate (RMR) and protein synthesis has been reported in studies of traumatized patients. Thus, recovery energy expenditure from jogging, which included an eccentric component, was hypothesized to be greater and last longer than from concentric cycling due to repair of exercise-induced muscle damage. Nine males volunteered to participate in both a jogging and cycling exercise protocol in which resting VO₂ and RER measurements were taken on two mornings prior to and seven mornings following three consecutive days of 45 min of exercise at 60% of VO₂max. Total energy and fat energy expenditures were calculated from the VO₂ and RER values. Daily protein intake and urinary N output were measured throughout both protocols. No differences were observed in VO₂ and RER between preexercise and any of the recovery days following the last exercise bout. Urinary N and estimated N balance did not change from preexercise values over time or mode x time. However, muscular soreness was greater (p<.05) and lasted longer in the jogging protocol and overall estimated N balance in the jogging protocol was less positive than the cycling protocol. The results suggested that although muscle damage probably was more severe in the jogging protocol, recovery energy expenditure and fat utilization were not different between the two exercise modes. Furthermore, the failure to detect an increase in N balance and RMR in the jogging protocol suggests that subsequent protein synthesis did not occur during the observation period or that the energy use for repair was of insufficient magnitude to cause an increase in recovery VO₂.

Koskolou, Maria D. ARTERIAL HYPOXEMIA AND PERFORMANCE DURING INTENSE EXERCISE, 1991. M.P.E., University of British Columbia (Donald C. McKenzie). (60pp 1 f $4.00) PH 1289

A substantial decrease in percent arterial hemoglobin saturation (%SaO₂) has been observed in some highly aerobically trained athletes during intense exercise [≥ 90% of maximal oxygen uptake (VO₂max) or oxygen uptake (VO₂) ≥ 3.5 l·min⁻¹] at sea level, and a reduction in %SaO₂ has been associated with impaired performance. In order to explore the level of hypoxemia which is sufficient to impair maximal performance, 7 well-trained male cyclists (VO₂max ≥ 60 ml·kg⁻¹·min⁻¹ or VO₂mean ≥ 5 ml·min⁻¹) who did not develop exercise-induced hypoxemia performed a 5-min performance cycle test to exhaustion at maximal intensity as controlled by the subject, under three experimental conditions: normoxemia (%SaO₂ >94%), and artificially induced mild (%SaO₂=87 ± 1%) and moderate (%SaO₂=90 ± 2%) hypoxemia. %SaO₂ was continuously measured using an ear oximeter. In the two hypoxic conditions, pure N₂ was added to the inspired air throughout the performance cycle test according to the oximeter readings so as to achieve the desired hypoxic level averaged over the 5-min period. Performance was evaluated as the total work output (Work,kJ) performed in the 5-min cycle test. Heart rate and ventilatory parameters were measured continuously during the test. ANOVA for repeated measures was used to compare differences in the results among the three experimental conditions. Performance progressively decreased with increasing %SaO₂ (mean Work,kJ=107±40 kJ, 104±7 kJ, and 102±2 kJ, under normoxemia, mild, and moderate hypoxemia, respectively), but only performance in the moderate hypoxemia condition was significantly different than normoxemia (p=0.0216). Mean heart rate (HR) was similar in the three experimental conditions (p=0.9536). Similarly, mean VO₂ was not significantly different among conditions (p=0.1751). However, end-tidal partial pressure of CO₂ (PₐCO₂) was significantly lower (p=0.0053) during moderate hypoxemia compared with normoxemia, and V̇E/V̇CO₂ was significantly higher (p=0.0052) in both hypoxic conditions when compared with normoxemia, indicating hyperventilation possibly compensating for increasing metabolic acidosis during hypoxemia. It is concluded that maximal performance capacity is significantly impaired in highly trained cyclists working under an arterial oxyhemoglobin saturation level of 87% but not under a milder desaturation level of 90%. Since VO₂ was not different among the experimental conditions, the reduction in maximal performance capacity is possibly related to a worsening of the metabolic acidosis elicited by hypoxemia.


Little data exists concerning the benefits of home-based exercise on patients with Chronic Obstructive Pulmonary Disease (COPD). The purpose of this study was to determine the effects of Home-Based Pulmonary Rehabilitation (HBPR) on two populations of COPD patients. One population consisted of patients who demonstrated no decrease in oxygen saturation (oxygen sat % >85) during exercise, and one population who demonstrated exertional hypoxemia (oxygen sat % <85) during graded exercise testing. The Non-Exertional Hypoxemic (NEH) group consisted of 13 patients (nine male, four female) with a mean age of 64 ± 7.5 years and a mean Forced Expiratory Volume in One Second/Forced Vital Capacity (FEV₁/FVC(%)) of 53 ± 5%, while the Exertional Hypoxemic (EH) group consisted of 12 patients (nine male, three female) with a mean age of 66.1 ± 4.7 years and a mean FEV₁/FVC(%) of 43 ± 7%. All patients trained at home for six weeks by continuous and/or discontinuous walking or bicycling, and by Inspiratory Muscle Training (IMT) using a PFLEX. During training the EH group used supplemental nasal oxygen (2L/min). During the six weeks, each patient was phoned once weekly and given encouragement and exercise progression by an exercise specialist. Utilizing a dependent t-test, significant changes were found in the NEH group in maximal oxygen consumption (14.7 ± 11.95 ml/kg/min to 15.9 ± 12.01 ml/kg/min, MET values (4.2 ± 0.99 to 4.6 ± 0.95) and systolic blood pressure at 2 min (158.9 ± 20.6 mmHg to 147.0 ± 18.4 mmHg). The EH group improved significantly in MET values (2.0 ± 1.1 to 2.6 ± 1.0) and treadmill time (236.5 ± 154.1 sec to 333.9 ± 154.3 sec). A 2 x 2 factorial analysis of variance with two levels of NEH and EH groups, and two levels of before and after six weeks of training, showed significant differences on both factors with the dependent variable of MET values. Both groups increased significantly in MET values with the NEH group having a higher MET mean (4.2 ± .99 at T1 and 4.6 ± .95 at T2) then the EH group (2.0 ± 1.1 at T1 and 2.6 ± 1.0 at T2). No significant interaction indicated that both groups improved similarly in MET values. In the 2 x 2 factorial analysis of variance, with heart rate as the dependent variable, significant differences were found between groups but not within groups. Interaction was not significant. The NEH group had a lower heart rate at 2 min (97.2 ± 12.1 at T1 and
93.6 ± 13.3 bpm at T2) than the EH group (111.3 ± 11.9 at T1 and 106.6 ± 12.5 bpm at T2) before and after six weeks of training. It was concluded that six weeks of HBPR increased functional capacity of both groups of COPD patients. The EH patients improved similarly as NEH patients in functional capacity as measured by METs.

La Mere, Vern J. VALIDATION OF EQUATIONS TO PREDICT LACTATE THRESHOLD, FIXED BLOOD LACTATE CONCENTRATIONS, AND PEAK VALUES FROM A 3200 METER PERFORMANCE TIME, 1991. M.S., University of Wisconsin-La Crosse (Nancy Kay Butts). (114pp 2 f $8.00) PH 1321

The equations examined were developed by Weltman et al. (1987) and presented in “Predictions of lactate threshold and fixed blood lactate concentrations from a 3200-m running performance in male runners”. In the presented study, 27 trained male runners (X=22.5 yrs) completed a horizontal treadmill test for the determination of lactate threshold (LT), fixed blood lactate concentrations (FBLC), and peak values. At the end of each 3 min stage, blood was sampled from a finger tip puncture and later analyzed for blood lactate concentration (bLa) using a Yellow Springs Instruments 23L lactate analyzer. Velocity was increased 13.4 m·min⁻¹ each stage. Subjects also ran a 3200 m time trial (RT) [X=10:18]. Oxygen consumptions (VO₂) at LT, FBLC of 2.0, 2.5, and 4.0 mmol·l⁻¹ were 58.5, 58.4, 60.7, and 65.1 corresponding to 84.5%, 84.8%, 87.8%, and 93.9% of VO₂ peak. Mean VO₂ peak was 69.3 ml·kg⁻¹. Velocities (VEL) at LT, 2.0, 2.5, 4.0 mmol·l⁻¹, and peak were 261.1, 261.4, 272.1, 290.2, and 321.3 m·min⁻¹ corresponding to 81.3%, 81.4%, 84.7%, and 90.4% of VEL peak. Significant (p<0.01) correlations were observed between 3200 M time and VO₂ at LT (VO₂ [r=.-58] and VO₂ at 4.0 mmol·l⁻¹ (VO₂-4.0). All correlations were significant (p<0.01) between 3200 M time and VEL associated with LT, FBLC of 2.0, 2.5, 4.0 mmol·l⁻¹, and peak (r=-.66, -.50, -.58, -.62, and -.65, respectively). No significant (p>.05) differences were observed between predicted and actual scores for VO₂-LT, VO₂-LT, VO₂ peak, and VEL at LT (VEL-LT). A small difference (p<0.05) was observed for VEL at 4.0 mmol·l⁻¹. Significant (p<0.01 to p<0.001) differences were observed between predicted and actual scores for all other variables. The equations to predict VO₂-LT, VO₂-FBLC, and VO₂ peak were accurate and therefore valid for prediction and exercise prescription. In contrast, the SEE values observed for equations to predict VEL-BLa parameters were not within acceptable limits. Therefore, the present study did not find the equations to predict VEL-LT, and VEL-FBLC valid using the present methods. However, the equation to predict VEL peak may be appropriate for prediction and exercise prescription.

Lambert, Christopher M. A COMPARISON OF SELECTED CORONARY HEART DISEASE RISK FACTORS IN WEIGHT TRAINED MALES, 1991. M.S., University of Wisconsin-La Crosse (William Floyd). (44pp 1 f $4.00) PH 1322

The purpose of this study was to assess the coronary heart disease (CHD) risk factor profiles in a select group of weight trained males. Eighteen males (19-26 yr.) participated in the study. All subjects engaged in rigorous weight training regimens exclusively as their form of regular physical activity. The CHD risk factors evaluated included total cholesterol (TC) levels, high density lipoprotein (HDL) levels, the TC:HDL ratio, systolic and diastolic blood pressures, and % body fat. The dietary intake levels of protein, complex and simple carbohydrates, fat and alcohol were evaluated in 50% of the Ss. The mean values for TC (189.17 mg/dl), HDL (56.94 mg/dl), TC:HDL ratio (3.43), systolic blood pressure (120.67 mmHg), diastolic blood pressure (74.44 mmHg), % body fat (12.83%), protein intake (18.67%), and fat intake (25.84%) fell within recommended ranges. Only carbohydrate intake (49.11%) did not meet recommended levels. TC levels, while within recommended levels, were higher than those reported by other investigators in similar populations and may have been relatively high for this age group. Mean levels for HDL, TC:HDL ratio, blood pressures, and % body fat fell within ranges deemed protective against the development of CHD. It was concluded that this group did not seem to be at increased risk of developing CHD, but further longitudinal and cross-sectional research is needed to fully evaluate the effects of this type of physical activity on CHD risk factor profiles.

Lambert, Gerald P. THE RELATIONSHIP BETWEEN PHYSIOLOGICAL MEASUREMENTS AND CROSS-COUNTRY RUNNING PERFORMANCE, 1990. M.A., Ball State University (David L. Costill). (69pp 1 f $4.00) PH 1299

Seven highly trained male collegiate distance runners were studied throughout a competitive cross-country season. Common laboratory and field measures were used to assess physiological adaptation and performance capacity. The subjects were tested pre-, mid-, and post-season for maximal oxygen consumption (VO₂ max), running economy (RE), heart rate at 268 m·min⁻¹ (HRmax), fractional utilization of the aerobic capacity (% VO₂ max), fractional utilization of the maximal heart rate (% HRmax), ventilatory threshold (VT), and time to exhaustion (TTE). Prior to each scheduled competition submaximal heart rate (HR) and submaximal blood lactate accumulation (bLa) were determined from a one-mile run on an indoor track. Five subjects ran at 5 min 30 sec per mile pace and two ran at a 6 min per mile pace (mean intensity=.83.14 ± 4.44% VO₂ max). VO₂ max, RE, %VO₂ max, %HRmax and TTE all significantly improved over the season (p<0.05). VT and HRmax remained unchanged. %VO₂ max, and %HRmax exhibited the highest correlations to performance within a given competition (range r=.525 to .722 and .571 to .844, respectively). HR and bLa did not change during the season. These results suggest: 1) %VO₂ max and %HRmax are the best predictors of cross-country running performance among the variables measured, whereas 2) field trials employing single HR and single bLa measurements are not valid indicators of endurance running performance in highly trained distance runners.

Landle, Kelly M. A SUBMAXIMAL TREADMILL WALKING PROTOCOL FOR PREDICTING MAXIMAL OXYGEN CONSUMPTION, 1991. M.S., Washington State University (Lawrence D. Bruya). (69pp 1 f $4.00) PH 1232

The problem was to design a submaximal walking treadmill protocol for predicting VO₂ max in fifteen male, recreational runners, aged 19-32 years. Each subject commenced treadmill walking at 2.4 METS. Workload was increased 2 METS·min⁻¹ until the first stage (HR=120-140). The subject continued to walk at the first stage until a $S$ HR (HR, ± 5 bpm) was established. Workload was increased at the rate of 2 METS·min⁻¹ until the second stage (HR=150-170). The subject continued to walk at stage two until $S$ HR was established. Treadmill grade was then reduced to 10% incline with a maintenance of speed for 2 minutes. Treadmill velocity then was increased 1 mi·hr⁻¹·min⁻¹ until volitional
exhaustion of the subject. Expired pulmonary ventilation were collected and analyzed for O₂ and CO₂ content. HR was recorded with an ECG monitor. A validation test was performed 5 to 7 days later. A weighted regression equation developed utilizing SS HR at stages 1 & 2, workload, and MET level at stages 1 & 2 was significant (p<0.05) with a standard error of 1.38 METs and a SEE of 8.3% of actual measured VO₂max.

Laporte, Rebecca J. THE EFFECTS OF AMINO ACID SUPPLEMENTATION ON ENDURANCE PERFORMANCE, 1993. M.S., Springfield College (Vincent J. Paolone). (114pp 2 f $8.00) PH 1323

The investigator examined the effects of amino acid supplementation versus a placebo on the endurance performance of trained male runners with comparable statistics of age, height, weight, body fat and, VO₂max. Exercise time to exhaustion at 60% VO₂max, end exercise RER, and urea nitrogen (mg/dl) excreted in urine and sweat samples were the parameters measured. All subjects performed a submaximal run to exhaustion at 60% of their VO₂max. Beginning on the following day subjects were randomly assigned into two groups, an amino acid supplement group and a placebo control group via double blind procedure. There was an attempt to match subjects in terms of height, weight, and prior fitness level. At this time the 4-week supplementation period began for all 8 subjects. All the subjects consumed 3 amino acid capsules 30 min prior to training and 1 immediately posttraining. Subjects were asked to train aerobically 3 times per week for a minimum of 30 min at a heart rate corresponding to 70-85% of their VO₂max. Subjects were asked to consume the supplements three times a week for 4-weeks. After the 4-week supplementation period subjects were retested under the same conditions. Urea nitrogen was measured in urine samples taken preexercise, postexercise, and 24 hr postexercise and in serial sweat samples collected every 15 min from the upper back. Repeated measures ANOVA with independent groups showed no significant differences in exercise time to exhaustion, urea nitrogen levels in urine or sweat samples, or end exercise RER for the amino acid and placebo groups for both pretreatment and posttreatment exercise tests. These results suggest that amino acid supplementation has no ergogenic effect on the performance of trained male runners.

Larkin, James M. AEROBIC RESPONSES TO 12 WEEKS OF EXERSTRIDING OR WALKING TRAINING IN SEDENTARY ADULT WOMEN, 1992. M.S., University of Wisconsin-La Crosse (Nancy Kay Butts). (92pp 1 f $4.00) PH 1324

86 sedentary women ranging in age from 20 to 50 (X=37 yrs) were randomly placed in a walking (W=30), exerstriding (ES=29), or control (C=27) group. All 86 completed a walking VO₂max test prior to and after completing a 12 week walking program. Metabolic responses were obtained each min throughout the treadmill tests using standard open-circuit techniques. HR and RPE were also obtained throughout the tests. Both W and ES trained for 30-45 min per day, 4 days per week at 70-85% of max HR. In addition, the ES group used rubber tipped walking sticks (Exerstriders) to supplement their traditional walking workout. None of the C group’s physiological responses to the VO₂max tests were significantly (p<0.05) altered. A slight increase (p<0.05) in max VO₂ occurred from pre- to posttesting in E, but not the W group. VO₂max significantly (p<0.01) increased by 7.6% (36.5 to 39.5 mlO₂·kg⁻¹·min⁻¹) for the W and 7.7% (33.7 to 36.5 mlO₂·kg⁻¹·min⁻¹) for ES. Treadmill time significantly (p<0.01) increased by 17.9 and 20.7% in ES and W, respectively. No difference in the changes between the ES and W groups existed. There were no significant (p>.05) differences in max R value, HR, or RPE for either groups. Both groups exercised at the same intensity, but the Exerstriders walked significantly (p<.05) slower than the walkers. Both walking and using Exerstriders provide a sufficient training stimulus to increase aerobic performance in previously sedentary women. The physiological benefits of Exerstriding can occur at a lesser training speed and shorter distance traversed compared to walking.


There have been few well-controlled studies to date on the influence of different phases of the menstrual cycle on athletic performance, and information is even more sparse on potential effects of oral contraceptive agents (OCAs) on performance. Many of the earlier studies failed to accurately document the phase of the cycle, or used a variety of different oral contraceptives with higher dosages of estrogens and progestins than those in current usage. Thus, the purpose of this study was to examine the effects of the endogenous hormonal variations of a normal menstrual cycle and the administration of a low-dose triphasic oral contraceptive agent (OCA) on selected measures of athletic performance in a group of elite female athletes. Nineteen eumenorrheic women were studied during the midfollicular (day 5.7 ± 0.5; mean ± SE) and midluteal (day 23.3 ± 0.9) phases of a normal menstrual cycle. Cycle phases were confirmed by plasma estradiol and progesterone assays. Following the two menstrual cycle tests, subjects were randomly assigned in a double blind fashion to either a placebo group (n=7, age=28.3 ± 1.6 yr, height=168.6 ± 2.0 cm, weight=60.0 ± 3.5 kg) or an OCA group (n=7, age=27.1 ± 1.6 yr, height=168.5 ± 1.9 cm, weight=60.2 ± 1.7 kg). A third test was carried out during the midcycle (day 14.4 ± 0.54) of the second cycle of the placebo/OCA administration. In the 16 women with hormonal evidence of ovulation, no significant differences were observed between the follicular phase and luteal phase tests in weight, percent body fat, sum of skinfolds, maximum heart rate, maximum minute ventilation, maximum respiratory exchange ratio, anaerobic performance, endurance time to fatigue (at 90% of VO₂max), or isokinetic strength of knee flexion and extension. There was, however, a small decrease seen from the follicular to the luteal phases in absolute VO₂max; from 3.19 ± 0.09 l·min⁻¹ to 3.13 ± 0.08 l·min⁻¹ (p=0.04), as well as in relative VO₂max from 53.7 ± 0.9 ml·kg⁻¹·min⁻¹ to 52.8 ± 0.8 ml·kg⁻¹·min⁻¹ (p=0.06). There was a very slight increase in both hemoglobin and hematocrit during luteal phase. With regards to the effect of the OCA on performance, there was a significant difference in the responses of the two groups while on medication or placebo, in both absolute VO₂max (p=0.05) and in relative VO₂max (p=0.02). The 7 subjects on OCA had a slight decrease in maximal oxygen consumption from follicular phase values to the third test (absolute VO₂max 3.29 ± 0.12 l·min⁻¹ to 3.18 ± 0.09 l·min⁻¹; relative VO₂max 54.7 ± 1.2 ml·kg⁻¹·min⁻¹ to 52.0 ± 1.0 ml·kg⁻¹·min⁻¹); while the 7 women on placebo showed a slight increase over the same time period (absolute VO₂max 3.16 ± 0.15 l·min⁻¹ to 3.18 ± 0.13 l·min⁻¹; relative VO₂max 53.0 ± 1.1 ml·kg⁻¹·min⁻¹ to 53.8 ± 1.7 ml·kg⁻¹·min⁻¹). Weight and percent body fat did not vary significantly in either group, but the sum of skinfolds changed differentially with a significant increase (p<0.01) in the OCA group as compared to placebo. There were no associated
alterations in maximum heart rate, maximum respiratory exchange ratio, maximum minute ventilation, hemoglobin concentration or hematocrit as a consequence of OCA administration. There were no significant differences over all three tests between the two groups in anaerobic performance, endurance time to fatigue, or isokinetic strength of knee flexion and extension. There were, therefore, no statistically significant changes in selected physiological variables or in the majority of the tests of performance occurring as a function of either the phase of the menstrual cycle or administration of a low-dose triphasic OCA. However, the small decreases in VO2max during the luteal phase and while on OCA suggest that the female steroid hormones, estrogen and progesterone, both endogenous and exogenous, may exert a slight deleterious effect on aerobic capacity with potential implications for elite level performance.


The purpose of this study was to investigate the effects of exercise intensity on the body composition of obese subjects during severe caloric restriction. Forty obese subjects (33 women, 7 men; 41 ± 7.7 years; 106 ± 26 kg; body fat >25% men, >30% women) on a commercially prepared, 420 Kcal/day, supplemented fast were randomized into groups that exercised at 40% and 60% of the heart rate reserve (HRR). Training volume was similar for both groups, at approximately 300 Kcal/day, three days per week for 12 weeks. Body weight (BW), body fat (BF) and lean weight (LW) were similar for both exercise intensity groups at week one. Overall, body weight decreased by 15.3 ± 6.7 kg (p<.05), and body fat decreased by 14.9 ± 5.0 kg (p<.05) for the 40% groups, while lean weight remained unchanged. No significant differences in body weight, body fat or lean weight were observed between the two groups. Gain scores in body weight, body fat and lean weight for each group:

<table>
<thead>
<tr>
<th>Group</th>
<th>BW (kg)</th>
<th>BF (kg)</th>
<th>LW (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40% (n=20)</td>
<td>-15.0 ± 8.4</td>
<td>-13.8 ± 5.2</td>
<td>-1.2 ± 3.8</td>
</tr>
<tr>
<td>60% (n=20)</td>
<td>-15.7 ± 5.3</td>
<td>-15.9 ± 4.9</td>
<td>+0.2 ± 2.1</td>
</tr>
</tbody>
</table>

The results of the current study showed that, while on a supplemented 420-Kcal/day fast, exercise at 40% and 60% of the HRR affected body composition similarly when total training volume was held constant at 900 Kcal/week. Lean weight remained unchanged and accompanied a 14.9 ± 5.0 kg decrease in body fat. These results suggest that exercising at 60% of the HRR offers no advantages for body composition changes over those obtained from exercising at 40% of HRR.


The purpose of this investigation was to study the training effects of endurance and high intensity treadmill running on the mechanical performance of the rat heart during reperfusion following ischemia. Fifty-one male, 12 week old, Sprague-Dawley rats, weighing 150 to 175g at the initiation of the experiment were randomly assigned into a sedentary control (n=18), an endurance trained (n=20), or high intensity trained (n=13) group. A Temple University Animal Care and Use Procedure Protocol Review form was approved. Rats exercised 5 days/week for six weeks at the following intensities: endurance (20 m/min, 0% grade, 60 min/day; high (5 x 1 minute sprints at a speed of 75 m/min, at a 15% grade, interspersed with 1 minute of active recovery runs at 20 m/min, 15% grade. To maintain familiarity with the treadmill sedentary controls were run once weekly at 20 m/min, 0% grade for 10 min/day. To assess the effectiveness of the exercise training protocol, all groups were made to perform an endurance treadmill and graded intensity treadmill test. The trained rats performed significantly (p<0.05), more work (kgm) on the endurance treadmill test (low, 65.77 ± 25.90; high 40.53 ± 17.65 vs. control, 21.06 ± 3.56) and the graded intensity test (low, 25.65 ± 7.02; high, 24.50 ± 6.38 vs. control, 15.21 ± 3.49). Between 48 to 72 hours following the last bout of exercise, rats were anesthetized and weighed. While being mechanically ventilated, the chest was opened and the aorta was cannulated for in situ retrograde perfusion. Hearts were trimmed of excess tissue, weighed, and transferred to a Langendorff apparatus, where a latex, intraventricular balloon was situated in the left ventricle for measures of the following: systolic, end-diastolic, and developed pressure as well as +dP/dtmax, -dP/dtmax, and coronary flow. The hearts were allowed to equilibrate for 20 minutes, and performance was measured at baseline, during 20 minutes of global ischemia, and during 30 minutes of reperfusion. During reperfusion, the high intensity trained hearts generated significantly higher systolic pressures, developed pressures, and +dP/dtmax, while having the lowest end-diastolic pressure (p<0.05). Endurance training was not different from sedentary controls. This data suggests high intensity training attenuates the contractile dysfunction associated with stunning and that endurance training does not provide such protection.

Linderman, Jon K. GLUCOREGULATION AND WORK PERFORMANCE IN GLUCONEOGENESIS-INHIBITED IRON DEFICIENT RATS, 1991. Ph.D., University of California at Berkeley (George A. Brooks). (164pp 2 f $8.00) PH 1233

The purpose of the present study was to evaluate glucoeleaguladon and work performance in gluconeogenesis-inhibited iron deficient rats. To evaluate the hypothesis that iron deficiency results in increased dependence upon gluconeogenesis for maintenance of euglycemia, female Sprague-Dawley rats were injected with mercaptopyclic acid (MPA), a known inhibitor of gluconeogenesis (Di Tullio et al. Biochem. J. 138: 387-394, 1974). In addition, to evaluate the hypothesis that an increase in lactate supply was responsible for increased gluconeogenesis in -Fe rats, additional rats were injected with a specific inhibitor of β adrenergic receptors (ICI 118, 551) (Trudeau et al. Can. J. Physiol. Pharmacol. 67: 192-196, 1989). Female Sprague-Dawley rats were obtained at 21 days postpartum, and assigned into dietary groups that were either iron sufficient (50 mg Fe²⁺/kg diet, +Fe), or iron deficient (15 mg Fe²⁺/kg diet,-Fe). At approximately 40 days of age rats were injected with either MPA (300 mg/kg body weight, 50mg MPA/ml 350 mM HCO₃⁻), ICI 118,551 (1.0 mg/kg body weight; lmg ICI 118,551/ml 0.9% NaCl) or the injection vehicle (SHAM). Animals were studied at rest or after 30 minutes of treadmill running at 13.4 m/min on a level grade. Results from the present study are consistent with previous reports that glucose dependence is increased in resting -Fe rats (Brooks et al. Am J. Physiol. 253 (Endocrinol. Metab. 16): E461-E466, 1987) and exercising anemic rats (Gregg et al. J. Appl. Physiol. 64(4): 1874-1880, 1989). In the present study arterial glucose concentrations ([Glucose]) were 9.4 ± 0.8,
and 8.6 ± 0.5 mM (mean ± SEM), in resting -Fe and +Fe SHAM-treated rats, respectively. Exercise decreased [Glu] 18% in -Fe rats, but had no effect on [Glu] in +Fe animals post-exercise. Arterial glucose concentration was decreased 50% and 22% in resting -Fe and +Fe MPA-treated rats, respectively. Following exercise [Glu] was decreased 56% and 49% in -Fe and +Fe MPA-treated rats, respectively. Iron deficiency had no affect on arterial lactate concentration ([$\text{La}$]) at rest. However, [$\text{La}$] increased 35% due to exercise in -Fe SHAM-treated rats, and 71% in exercising -Fe MPA-treated rats. In contrast, [$\text{La}$] was unaffected by exercise, MPA treatment, or a combination of these two factors in +Fe rats. Arterial alanine concentration [Ala] was unaffected by exercise or MPA treatment in -Fe rats. However, [Ala] was reduced approximately 30% in resting and exercising +Fe MPA-treated rats. Collectively, the response of arterial concentrations of glucose and lactate reflect an increased dependence upon glucose metabolism in -Fe rats during exercise. Furthermore, results obtained in MPA treated rats indicate that inhibition of gluconeogenesis had a more profound affect on maintenance of arterial glucose concentration in resting and exercising iron deficient rats. The changes in pancreatic and sympathoadrenal hormones observed in the present study indicate that there is an increased neuro-endocrine drive for glucose production in -Fe rats. At rest arterial insulin concentrations were 1750 ± 274 and 2051 ± 236 pg/mI in -Fe and +Fe SHAM-treated rats, respectively, and values decreased due to exercise and MPA treatment in -Fe and +Fe rats. In addition, arterial glucagon concentration was unaffected by diet or exercise in SHAM-treated rats, and increased approximately 150% at rest and post-exercise in MPA treated -Fe rats. Epinephrine was unaffected by diet or exercise in SHAM-treated rats. However, epinephrine was increased approximately 150% in resting Fe MPA-treated rats (1372 ± 351 and 542 ± 180 pg/mI for MPA and SHAM, respectively) and nearly 200% post-exercise in MPA-treated -Fe rats (1621 ± 416 and 548 ± 134 pg/mI for MPA and SHAM, respectively). Thus, the changes in pancreatic hormones were greater in -Fe rats at rest, while epinephrine increased in response to exercise more in -Fe rats with gluconeogenic blockade. Tissue glycogen concentrations and changes in tissue glycogen utilization during exercise in -Fe rats support the hypothesis that glucose dependence is increased with iron deficiency. In general muscle glycogen was not significantly different between -Fe and +Fe rats at rest, while liver glycogen was greatest in +Fe rats at rest. Muscle and liver glycogen were not significantly different between groups post-exercise, and liver glycogen utilization was 300% greater in +Fe SHAM-treated rats (1.2 ± 0.2 μmoles/g/min and 0.3 ± 0.1 μmoles/g/min for +Fe and -Fe, respectively) and increased further with MPA treatment in +Fe animals (1.6 ± 0.2 μmoles/g/min). Thus, the low rate of liver glycogenolysis resulted in hypoglycemia during exercise in -Fe rats. Results obtained from rats administered ICI 118,551 (β-blockade) support the hypothesis that lactate supply is primarily responsible for maintenance of euglycemia in -Fe rats. With the exception of changes in [$\text{La}$] metabolic and endocrine responses were similar between MPA treatment and -Fe rats. Beta-blockade decreased [$\text{La}$] 51% at rest in -Fe rats (3.1 ± 0.5 and 1.5 ± 0.2 mM for SHAM and B-blockade, respectively) and 60% following exercise in -Fe animals (4.2 ± 0.4 and 1.7 ± 0.3 mM, for SHAM and β-blockade, respectively). However, β-blockade had no affect on [$\text{La}$] in +Fe rats at rest or post-exercise. Similar to hypoglycemia induced by MPA treatment [Glu] was decreased 32% and 44% with β-blockade in -Fe rats at rest and post-exercise, respectively. Furthermore, the affect of β-blockade on [Ala] was equivalent to MPA treatment. Arterial alanine concentrations were unaffected by exercise or β-blockade in -Fe rats, and similar to MPA treatment decreased approximately 30% with β-blockade in resting and exercising +Fe rats. Therefore, decreased [Ala] with corresponding hypoglycemia in response β-blockade support the contention that lactate supply is critical to maintenance of euglycemia in -Fe rats. Changes in the arterial concentrations of pancreatic hormones with β-blockade are consistent with the hypothesis that lactate supply is responsible for an increase in gluconeogenesis in -Fe rats. Arterial insulin concentrations were decreased 42% and 55% by β-blockade in resting -Fe and +Fe rats, respectively, and arterial insulin concentrations were decreased 67% and 78% post-exercise in -Fe and +Fe respectively. In addition, plasma glucagon was increased approximately 50% by β-blockade in both dietary groups at rest and post-exercise. However, the observed increase in plasma glucagon post-exercise was significantly greater in -Fe rats. Arterial catecholamines were not affected β-blockade, exercise or a combination of these factors in -Fe rats, and epinephrine was significantly elevated post-exercise with β-blockade in +Fe rats. Thus, changes in pancreatic hormones in response to β-blockade were similar to MPA treatment, but gluconeogenic blockade with MPA elicited a greater sympathoadrenal response in -Fe rats than β-blockade. Results obtained in the present study indicate that β-blockade attenuated glycogenolysis in inactive fast-twitch muscles from -Fe rats, and slow-twitch muscle in +Fe rats. Compared with MPA treatment. Beta-blockade decreased glycogen utilization in the soleus muscle of +Fe rats (0.8 ± 0.1 and 0.3 ± 0.1 μmoles/g/min for MPA and β-blockade, respectively). In addition, superficial vastus lateralis glycogen utilization in -Fe rats (0.6 ± 0.3 and 0.2± 0.1 μmoles/g/min) for MPA and β-blockade, respectively) and deep vastus glycogen utilization in -Fe rats (1.2 ± 0.4 and 0.1 ± 0.1 μmoles/g/min) were attenuated by β-blockade. Thus, the effect of β-blockade in -Fe rats suggests that fast-twitch muscle is a source of lactate supply for gluconeogenesis. Taken in aggregate the results of the present investigation can be interpreted to support the following conclusions: First, iron deficiency is associated with increased dependence upon glucose and gluconeogenesis at rest and during exercise. Second, increased lactate supply is primarily responsible for the increase in gluconeogenesis in iron deficient rats. Third, neuro-endocrine drive for gluconeogenesis is increased in iron deficient rats with gluconeogenic blockade or decreased lactate supply.


The purpose of this investigation was to compare the ventilatory threshold (T(vent)) with the lactate threshold (T(lact)) during 60 minutes of steady-state exercise at the calculated thresholds. Eight trained, male cyclists (mean age =23.3 yrs, ht=176.4 cm, wt=70.7 kg, VO2max=61.02 ml/kg·min-1) performed at 23 W/min progressive intensity cycling test for determination of T(lact) and T(vent). T(vent) was determined by the non-linear increase in excess CO2 (ExCO2) while T(lact) was calculated by the ‘individual anaerobic threshold’ (IAT) method. Subsequently, subjects performed up to 60 minutes steady-state exercise at the threshold workloads. Results at T(vent) and T(lact) indicate significant differences (p<0.01; T(lact)>T(vent)) between VO2, ExCO2, HR, [BLA] and workload as calculated by Hotelling’s T2-test. During the steady state exercise at each specified workload, VO2, [BLA], heart rate...
and ExCO₂ were measured at 15 minute intervals. All subjects completed the steady-state exercise at T(vent) (VSS) while only 2 subjects completed the steady-state exercise at T(lact) (LSS) (avg time=48.4 min). Comparison of metabolic variables using MANOVA and multiple comparisons revealed significant differences between VSS and LSS for HR and VO₂ at all time intervals, for [BlA] at 30 and 45 minute intervals and for ExCO₂ at the 30 minute interval. Furthermore, examination of [BLa] over time using trend analysis resolved a stabilization during VSS (x=3.05 mmol.L⁻¹) whereas [BLa] continuously increased over time during LSS. Findings indicate that T(lact) (IAT method) overestimates the ability to perform prolonged work over 45 min. while T(vent) (ExCO₂) allows for steady-state exercise greater than 60 minutes.

Lough, Loretta K. THE EFFECTS OF FIXED AND HINGED ANKLE FOOT ORTHOSES ON GAIT MYOELECTRIC ACTIVITY AND STANDING JOINT ALIGNMENT IN CHILDREN WITH CEREBRAL PALSY, 1990. Ph.D., University of Iowa (Gary L. Soderberg). (226pp 3 f $12.00) PH 1260

This investigation determined the effect of fixed ankle foot orthoses (AFOs), hinged AFOs, and no orthotic support on standing foot pronation, sagittal plane knee and ankle kinematics, and activity of four lower extremity muscles during gait. Fifteen children with mild or moderate spastic diplegic cerebral palsy participated in the study. All but one had worn AFOs previously. Only the right lower extremity was studied. Dorsoplantar weightbearing radiographs were taken under the three treatment conditions and angles indexing valgus and pronation were measured. For the gait tests, multiple trials were completed.

Velocity was determined over the central six meter segment of an eight meter walkway. Videotapes were subjected to digitization to yield sagittal plane knee and ankle joint angles at mid stance from the gait cycle closest to the center of the walkway for each trial. Surface electromyographic (EMG) recordings were obtained from vastus lateralis, medial hamstrings, anterior tibialis, and lateral gastrocnemius muscles with referencing to the gait cycle via a footswitch. Analysis of EMG data occurred using an interactive computer program that produced values for each five percent of the normalized gait cycle. Analysis of variance procedures showed: 1) improved midfoot alignment with fixed AFOs compared to shoes, 2) greater midstance ankle dorsiflexion and faster walking velocity with hinged AFOs compared to shoes, and 3) non-statistically significant changes in amplitudes and duration of electromyographic activity across the three treatments.

Sufficient changes in variables measured established that the type of orthosis used has implications for patient management.

Luckin, Kristen A. A BIOCHEMICAL ANALYSIS OF THE EXERCISE-INDUCED DYSFUNCTION OF THE RAT GASTROCNEMIUS SARCOPLASMIC RETICULUM CA²⁺-ATPASE PROTEIN, 1992. Ph.D., University of Oregon (Gary A. Klug). (143pp 2 f $8.00) PH 1261

Sarcoplasmic reticulum (SR) isolated from the deep red portion of the rat gastrocnemius muscle after a single bout of prolonged exercise displayed depressed Ca²⁺-stimulated ATPase activity over a temperature range of 15-42.5°C when compared to SR obtained from control muscle. Inclusion of calcium ionophore failed to restore the depressed ATPase activity to control values, but it did eliminate the temperature induced ATPase activity transition of both groups. This depression was also manifest as an increased activation energy. SR vesicles from both groups showed no differences in steady-state fluorescence anisotropy measurements indicating no gross structural inongruiities in the vesicular bilayer. Binding analyses of fluorescein isothiocyanate (FITC) indicated that SR vesicles prepared from exercised muscle displayed a 40% reduction in FITC binding capacity with no apparent change in Kₐ. Additionally, these vesicles showed a depressed rate of ATP hydrolysis over a broad concentration range. Calculated affinity constant Kₐ yielded no differences between groups (ex. 4.25 ± 2.13, con. 5.22 ± 1.63) (M x 1x10⁻⁶ ± S.E.M.); however, a significant depression in reaction rate constant V₉₄ was observed (ex. 0.89 ± 0.10, con. 1.83 ± 0.12) (min⁻¹ mg⁻¹ ± S.E.M.). Neither trypsin digestion nor vanadate induced crystallization revealed any structural dissimilarities of Ca²⁺-ATPase between groups. Furthermore, inhibition of ATP hydrolysis with dicyclohexylcarbodimide (DCCD), indicated that the Ca²⁺-binding site of Ca²⁺-ATPase was unaltered in response to the exercise bout. However, SR vesicles isolated from exercised muscle showed a depressed ability to accumulate phosphoprotein (ex. 0.34 ± 0.02, con. 0.54 ± 0.07) (nmol/mg SR). These findings support the conclusion that a single bout of exercise induces a structural change in the Ca²⁺-ATPase protein that is restricted to the nucleotide binding region with no association to the tryptic cleavage or dimer contact and is not a direct result of gross lipid alterations or increased muscle temperature. Reversal of this phenomenon (as measured by Ca²⁺ uptake, Ca²⁺ release, Ca²⁺-ATPase activity and accumulation of phosphoprotein) was complete within 2 hours of the exercise bout. These data support the conclusion that the depression and the recovery of Ca²⁺ uptake and ATPase activity are linked to the capacity to carry out the obligatory ATPase protein phosphorylation during the catalytic cycle.

Lungo, Diane. THE EFFECT OF AEROBIC EXERCISE ON TOTAL CHOLESTEROL, HIGH-DENSITY LIPOPROTEIN, APOLIPOPROTEIN B, APOLIPOPROTEIN A-I AND PERCENT BODY FAT IN ADOLESCENT FEMALES, 1990. M.S., Brigham Young University (Earlene Durrant). (79pp 1 f $4.00) PH 1350

The effect of aerobic exercise on total cholesterol (TC), high-density lipoprotein (HDL), apolipoprotein B (Apo B), apolipoprotein A-I (Apo A-I), and percent body fat in adolescent females was studied. The control (n=86) and the treatment (n=79) subjects were volunteers who either had completed their physical education classes from one of the investigators prior to the commencement of the study or were enrolled at the time of the study in this investigator’s physical education classes. All subjects were pretested and posttested on the dependent variables. Treatment subjects’ cardiovascular endurance levels were similarly tested. The treatment subjects participated in a 12-week aerobic exercise program during their physical education classes. Apo B levels of the treatment group decreased. HDL levels of the control group decreased while the treatment group’s remained unchanged. No significant differences were found between the TC and Apo A-I levels of the two groups. The treatment subjects significantly increased their cardiovascular endurance and decreased percent body fat while control subjects’ percent body fat did not change. No significant relationships were observed between TC, HDL, Apo B, and Apo A-I levels and the age or onset of menopause for any of the subjects. Modification of Apo B and body
Marburger, Lorri K. EFFECTS OF LOW-INTENSITY, PAIN-FREE EXERCISE ON MUSCLE METABOLISM IN PATIENTS WITH PERIPHERAL VASCULAR DISEASE EVALUATED BY $^{31}$P-NMR SPECTROSCOPY, 1992. M.S., University of Florida (Christine Stopka). (113pp 2 f $8.00) PH 1262

The functional capacity of patients with peripheral vascular disease (PVD) is severely limited by exercise-induced muscle ischemia and the resultant pain of intermittent claudication. To evaluate the effects of low-intensity, pain-free exercise training on muscle metabolism in patients presenting with PVD, seven subjects (mean age 65 ± 2) with PVD participated in a 10 week training program. Data were collected before and after training during graded exercise testing (GXT) to evaluate the physiological response to a exercise (N=7). Doppler Ultrasound techniques were used to evaluate the site and severity of the disease (N=7), and $^{31}$P-NMR spectroscopy was used to evaluate the metabolic state of the calf muscle at rest and in response to exercise (N=5). The data collected using $^{31}$P-NMR spectroscopy was also compared to five age and sex matched normal controls (mean age 64 ± 10). After 10 weeks of training, the subjects improved (p<0.05) duration from 23 to 52 min, rate from 1.3 to 2.0 mph, and total distance walked from 0.5 to 1.8 miles. The time to claudication pain onset (CPO) and maximum walking time (MWT) during the GXT improved from 2.67 to 6.93 min and 10.23 to 12.49 min respectively (p<0.05), while the rating of perceived exertion (RPE) decreased at CPO from 11 to 8 (p<0.05). The physiological response to the GXT remained constant, while CPO and MWT improved significantly, indicating improvements in the efficiency of the working muscle. The ankle/brachial index (ABI) revealed a trend toward a significant improvement in blood flow (p<0.07). Data collected by $^{31}$P-NMR spectroscopy showed no significant differences between controls and claudicants nor between claudicants before and after and training at rest; a significant exercise main effects in pH levels in claudicants; a significant interaction between controls and claudicants in PCR recovery levels; and a significant recovery main effect in PCR and pH levels in claudicants. The 10 week low-intensity, pain-free training program was successful in improving the functional capacity of PVD patients, and GXT response indicated an improved efficiency in the muscle tissue, however any specific exercise responses may have returned to baseline prior to post-exercise NMR evaluation which made it impossible to identify the exact mechanism responsible for this improvement.

Marsh, Gregory D. 31-PHOSPHOROUS, NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY STUDIES OF EXERCISING HUMAN MUSCLE, 1992. Ph.D., University of Western Ontario (A. W. Taylor). (111pp 2 f $8.00) PH 1327

Phosphorous 31, nuclear magnetic resonance spectroscopy ($^{31}$PNMR) was used as a non-invasive probe of forearm muscle metabolism in three studies of healthy men and women. Specific objectives of the studies were to: 1) observe the changes in high energy phosphates and intracellular pH in muscle, during a ramp exercise protocol, 2) study the effect of endurance training on muscle metabolism and evaluate the utility of the forearm ramp test as a means to assess muscle oxidative capacity, and 3) describe the kinetics of phosphocreatine (PCr) and inorganic phosphate (Pi) metabolism during the on and off transient response to moderate exercise. In the first study, 18 subjects performed a forearm ramp exercise to fatigue. Exercise caused a biphasic increase in the Pi/PCr ratio of the muscle. Change in Pi/PCr was initially slow, followed by a rapid phase. The transition or threshold between the two rates corresponded to the onset of intracellular acidosis. Repeated testing of 6 subjects showed that this threshold was reproducible. These findings demonstrated the existence of a threshold in intracellular metabolism (IT), which was related to aerobic capacity. In the second study, 4 older subjects trained the dominant forearm daily for 12 weeks, using a light weight. Muscle metabolism was evaluated using the ramp protocol and $^{31}$P NMR spectroscopy before training and after 6 and 12 weeks of training. The onset of the IT was delayed 14%, and submaximal exercise endurance time was increased 58% by training. Muscle blood flow was not altered by training. The results indicated that endurance training improved forearm muscle oxidative capacity, and that the IT could be used to assess this change. Finally, the kinetics of forearm muscle PCr metabolism were studied during the transition to, and the recovery from, moderate intensity work. Five young men completed 6 square wave exercise tests each. The results of these tests were combined and the changes in PCr and Pi modeled using an exponential growth or decay function. The time constants (T) calculated for both metabolites were about 30 s, which is similar to the T reported for oxygen uptake during whole body exercise. These data suggest a first-order relationship between muscle oxygen consumption and substrate utilization during exercise transition states.


Comparisons were made of excess postexercise oxygen consumption (EPOC) between endurance trained (n=9) and untrained (n=9) women following similar relative intensity (70% VO$_{2}$_max) exercise for 30 min. Additionally, the postexercise fuel use and the relationship between lactate removal and EPOC were examined. Subjects were between the ages of 19-29 years old and of low to average body composition (%BF). The total exercise energy expenditure (kcal/s) of the submaximal exercise bout was 23% higher for the endurance trained group than the untrained group. No differences were found in EPOC duration, volume, and magnitude between the two groups. Postexercise VO2 returned to resting baseline level by 36.0 ± 16.2 min for the endurance trained and 37.2 ± 12.4 min for the untrained group and consisted of 13.8 ± 6.2 and 12.4 ± 4.2 kcsals, respectively. The mean RER value at 30 min postexercise was significantly lower than the mean resting value. No relationship was found between lactate removal and EPOC. The present study suggests that EPOC is a factor of the relative exercise intensity, and mechanisms other than lactate removal are responsible for EPOC.

Martin, David E. THE EFFECT OF HEAT STRESS ON EXCESS POST EXERCISE OXYGEN CONSUMPTION, 1992. M.S., Ball State University (Leonard A. Kaminsky). (64pp 1 f $4.00) PH 1351

While a great deal of research has been directed towards the phenomena of excess post exercise oxygen consumption (EPOC), the effect of thermal stress on EPOC is not well defined. To assess the effect of heat stress on EPOC, seven healthy, active subjects (4
used for analysis. Results of a 2 × 2 repeated measures ANOVA
tolerance. The first 5 min of the 15 min passive stand test were
chloride tablets and water were orally administered separately (1 g
isotonic saline solution to every 70 kg of body weight. Sodium
week waiting period between each test. Fluid ratio was 1 L of
tested for aerobic fitness using the Bruce protocol. Orthostatic
expression appears to be altered. Therefore, the purpose of this
spontaneously hypertensive rat (SHR), proenkephalin gene
demonstrated that during the development of hypertension in the
involved in cardiovascular regulation. Recently, it has been
ALTERED DURING THE DEVELOPMENT OF HYPERTENSION,
individuals when compared to non-trained individuals and also
and CM with respect to CID was observed. It was concluded that
present data indicate that heat stress does not have a significant
effect on the magnitude or duration of EPOC.

Mauro, Barbara A. A COMPARISON OF ORTHOSTATIC
TOLERANCE AND FLUID LOADING IN TRAINED AND NON-
TRAINED SUBJECTS DURING SIMULATED WEIGHTLESSNESS,
1992. M.S., Springfield College (Vincent Paolone). (144pp 2 f $8.00)
PH 1234

The researcher examined the effect of a fluid countermeasure (CM)
and no CM on the orthostatic response of 9 trained (T)
(mean=62.72 ml/kg/min) and 9 non-trained (NT) (mean=43.47
ml/kg/min) subjects during a 15 min passive stand after 60 min of
-6° head down tilt (simulated weightlessness). Subjects were first
tested for aerobic fitness using the Bruce protocol. Orthostatic
response was tested twice, with CM and without CM, with a one
week waiting period between each test. Fluid ratio was 1 L of
isotonic saline solution to every 70 kg of body weight. Sodium
chloride tablets and water were orally administered separately (1 g
tablet: 114 ml of water) to mimic a 87% isotonic solution. No
attempt was made to determine the sodium content of the blood
and fluid in the stomach before fluid loading. The Cardiovascular
Index of Deconditioning (CID) was used to determine orthostatic
tolerance. The first 5 min of the 15 min passive stand test were
used for analysis. Results of a 2 × 2 repeated measures ANOVA
indicated no significant (p>.05) interaction between fitness level
and CM with respect to CID was observed. It was concluded that
no difference exists in orthostatic response in aerobically trained
individuals when compared to non-trained individuals and also
that no positive effect of a fluid CM was present in either group.

McMillen, David. PROENKEPHALIN GENE EXPRESSION IS
ALTERED DURING THE DEVELOPMENT OF HYPERTENSION,
1993. M.A., University of North Carolina at Chapel Hill (Robert G.
McMurray). (60pp 1 f $4.00) PH 1352

Enkephalins have been discovered in various regions of the brain
involved in cardiovascular regulation. Recently, it has been
demonstrated that during the development of hypertension in the
spontaneously hypertensive rat (SHR), proenkephalin gene
expression appears to be altered. Therefore, the purpose of this
investigation was to precisely identify the regions of the brain,
utilizing in-situ hybridization, that are involved in cardiovascular
regulation, where proenkephalin gene expression is altered during
the development of hypertension. Proenkephalin gene expression
was compared in 13-14 wk SHR and Wistar-Kyoto rats. In the
nucleus tractus solitarius, caudal and rostral ventrolateral medulla
proenkephalin gene expression was decreased in the SHR. In
summary, the data provides evidence that alterations in the
transcription of proenkephalin mRNA are involved in the
development and/or maintenance of hypertension in the SHR.

McNamara, Michael J. VALIDATION OF A CYCLE ERGOMETER
VO2MAX PREDICTION EQUATION FOR NONSEDENTARY
COLLEGE-AGE WOMEN, 1992. M.S., University of Wisconsin-La
Crosse (Lawrence A. Terry). (64pp 1 f $4.00) PH 1329

Twenty-one nonsedentary college women volunteered to perform
a maximal exercise test on a Monark stationary cycle ergometer.
The S’s ranged in age from 18-25 years. Each S’s maximal work
load (watts), wt (kg), and age were utilized to estimate VO2max
in relative (ml·kg·min-1) and absolute (l·min-1) terms, using the
VO2max prediction equation developed by Storer, Davis, and
Caozzo (1990). Pearson’s product moment correlation coefficients
were computed to measure the strength of the relationship
between the actual VO2max obtained through direct gas analysis
and the predicted VO2max using the Storer et al. (1990) equation
in relative and absolute terms. Relatively high correlations between
the actual and predicted values were revealed (r=.88 and r=.92).
Although a t-test revealed a significant difference at the .05
confidence level between the actual and predicted VO2max values,
the majority of the estimations were within 10% of the actual
VO2max which agrees with the results published by Storer et al. in
1990. It can be concluded that the VO2max prediction equation
developed by Storer et al. (1990) can be used to predict VO2max
in healthy, nonsedentary college age women.

Meeuwisse, Willem H. THE EFFECT OF SALBUTAMOL ON
PERFORMANCE IN ELITE NON-ASTHMATIC ATHLETES, 1990.
M.P.E., University of British Columbia (Donald C. McKenzie).
(74pp 1 f $4.00) PH 1292

The effect of salbutamol on performance was studied in 7 male
non-asthmatic elite (VO2max ≥ 60 ml/kg/min) athletes. The subjects
entered the study just prior to their competitive season.
Salbutamol (2 puffs=200 µg) or placebo was administered by
metered-dose inhaler, through a spacer device, 20 minutes prior to
testing in a double-blind, randomized cross-over design. Pulmo-
mary functions including maximum flow volume curves were
performed on the first two visits, at 5 intervals (pre-medication, 20
minutes post-medication, and 5, 10, and 20 minutes post-exercise).
The first two sessions combined these pulmonary function
measures with an exercise bout consisting of a continuously
ramped cycle ergometer ride to exhaustion to determine maximal
oxygen uptake (VO2max), peak power, and maximal heart rate.
Pulse oximetry was used to measure the oxygen saturation of
hemoglobin. The next sessions involved performing a 45 minute
ride at 70% of VO2max, followed by a timed sprint to exhaustion.
Lastly, a Wingate anaerobic test was used to measure total work
and peak power. There was a non-significant decrease in VO2max
from a mean of 63.5 ml/kg/min (±3.2) for the placebo (P) trial, to a
mean of 62.6 (±3.3) with salbutamol (S). No difference was found
in peak power (P=438 Watts ± 26.3, S= 438 ±27.9) or maximum

female, 3 male; 23.9 ± 2.0 years of age) performed 4 trials: one
control (quiet rest) and one exercise (45 minutes of cycling at 65%
VO2max workload) trial in moderate (23° C, 50% humidity) and hot
(35° C, 50% humidity) environments. Oxygen consumption (VO2),
heart rate (HR) and rectal temperature (RT) were assessed pre,
during and post control or exercise. Subjects were monitored until
post exercise VO2 had returned to within ±2% of baseline. EPOC
was determined by subtracting baseline VO2 from total VO2
during the post exercise period. During the first 15 minutes (acute)
post exercise, a significant EPOC (p=.0019) was seen in both
exercise conditions over both control conditions. During the slow
phase (>15 minutes post exercise to baseline), there was no
significant difference between the hot control (HC), moderate
exercise (ME), or hot exercise (HE) EPOC. Total time post exercise
until baseline was achieved was 35, 44, and 51 minutes for HC,
ME, and HE respectively. HR was significantly elevated in both
exercise conditions. During the acute post exercise period, HR in
HC was elevated above MC, ME and HC (p<0.05). RT was
elevated in both exercise conditions during and post exercise. The
present data indicate that heat stress does not have a significant
effect on peak power (P=438 Watts ± 26.3, S= 438 ±27.9) or maximum
heart rate (P=191 beats/min ±5.4, S=191 ± 6.0). The performance related variables of endurance sprint time (P=104 seconds ±22.8, S= 97 ±21.4), and Wingate peak power (P= 10.12 Watts/kg ±0.57, S= 9.97 ±0.60) showed a non-significant decrease, while the total work performed on the Wingate test (P= 19.30 J ±2.09, S= 19.61 ±1.54) displayed a non-significant increase. The data failed to show significance despite using statistical analysis with a level of significance of p<0.20 to maximize the power of the tests. There was a statistically significant (p<0.05 increase in post medication (pre-exercise) forced expiratory volume (FEV1) of 4.5% with salbutamol. This baseline increase persisted post-exercise, but there was no interaction effect of salbutamol and placebo over time. This represents an expected effect in non-asthmatic individuals, and although statistical significance was achieved, the magnitude of difference is not considered to be clinically significant. It was concluded that a therapeutic dose of aerosol salbutamol does not have an ergogenic effect in elite non-asthmatic athletes and it is therefore recommended that inhaled salbutamol continue to be permitted in international competition for individuals with exercise induced asthma.

Melton, Christine A. THE EFFECT OF EXERCISE INTENSITY ON EXCESS POST-EXERCISE OXYGEN CONSUMPTION (EPOC) IN NORMAL FAT AND OBESE WOMEN, 1993. M.A., Ball State University (Leonard A. Kaminsky), (55pp 1 f $4.00) PH 1353

To determine the magnitude and duration of the excess post-exercise oxygen consumption (EPOC), five obese (OB) and five normal weight (NW) women were studied following steady state and interval type exercise. Each subject completed a maximal treadmill test followed by 2-36 minute exercise trials, one at 60% VO2 maximum and one interval type trial alternating 30% and 90% VO2 maximum. Open-circuit spirometry was used to measure VO2 before, during and after exercise. There was no significant difference in exercise energy expenditure between groups or between the two exercise trials. Oxygen consumption remained elevated longer (p<0.05) following the 30/90% trial (37.5 ± 21.5 minutes) than the 60% trial (16.5 ± 4.7) for both groups and was almost twice as long for the OB group vs. the NW group (48 vs 27 minutes). VO2 measures during the first 15 minutes after the 30/90% trial were significantly elevated (p<0.05) above those for the 60% trial. When expressed in kcsals this amounted to 17.4 ± 6.3 for the 30/90% trial and 9.0 ± 1.9 kcsals for the 60% trial. The magnitude of the EPOC did not vary significantly between the 2 groups. The EPOC/ exercise oxygen consumption ratio was greater for the 30/90% trial (7.4% ± 2.3) compared to the 60% trial (3.9% ± 2.7). These finding suggest a larger EPOC may be created by doing interval type exercise compared to steady state exercise of similar energy expenditure. Although the EPOC was of longer duration for the OB group there was no difference in the magnitude of the EPOC between the groups.


This thesis examined the location, somatotopical organization and connections of a possible cingulate motor area in the cerebral cortex of the rhesus monkey. First the topography of afferent and efferent connections between the cingulate cortex and the face, forelimb and hindlimb representations of M1 and M2 were studied. The results indicate that connections between the various representations and areas 24c and 23c of the cingulate are organized topographically. In area 24c, cortex connected with the face representations were located rostrally, hindlimb caudally, and forelimb between, suggesting that the anterior cingulate cortex contains a somatotopically organized motor area. In area 23c, cortex connected with the forelimb representations was located rostrally and hindlimb caudally. The face representation of M1 and M2 was not connected with area 23c. These results do not support the hypothesis that area 23c contains a somatotopically-organized motor area. Second the afferent and efferent cortical and subcortical connections of areas 24c and 23c were studied. Several common cortical areas and subcortical nuclei were connected with both areas 24c and 23c, however major differences were found which underscore the structural diversity among these cortices. Cortically, areas 13, 25, 6Vb, 38, 22 and 28 were only connected to area 24c while areas 1, 2, 5, 10a and 8 were only connected with area 23c. Subcortically, only the accessory basal and the cortical amygdaloid nuclei, AD, VA, and LD thalamic nuclei, dorsal medial hypothalamic nuclei and red nucleus were connected with area 24c whereas only AV, VLc, 1P and Pul thalamic nuclei were connected to area 23c. Widespread limbic, prefrontal and entorhinal input and localized cortical output suggest that area 24c is a highly-specialized motor area that is a direct link between the limbic and motor systems. From the viewpoint of cortical and subcortical connections, it is hypothesized that the cingulate motor area is directly involved in somatic and autonomic motor activity, emotional expression, behavior, attentional direction and motor memory. Extensive connections with cortical and subcortical sensory associated targets suggest that area 23c is more related to sensory mechanisms than is area 24c.

Morris, David M. THE EFFECT OF BICYCLE CRANK ARM LENGTH ON OXYGEN CONSUMPTION AT A CONSTANT WORKLOAD AND CADENCE, 1992. M.A., University of Missouri-Columbia (Ben R. Londere). (79pp 1 f $4.00) PH 1235

The purpose of this investigation was to determine the effects of various crank lengths on oxygen consumption for trained cyclists exercising at a constant workload and cadence. Secondary purposes were, if individual optimal crank lengths existed, to determine if they could be predicted based on an individual's anthropometrical or isokinetic knee extension strengths. Six trained cyclists completed four 105 minute experimental protocols riding at a workload of approximately 68% of VO2max and a cadence of 90 rpm using three crank lengths of 165, 170, and 175 mm assigned in random order. Two days following the third experimental protocol, the third crank length was retested to establish reliability. During each protocol cadence, oxygen consumption, and distance traveled were determined. Oxygen consumption and distance traveled data were combined to give an oxygen consumption per meter per minute value. The values of each subject’s three protocols were placed in either a high, medium, or low efficiency category. Significant differences in oxygen consumption per meter per minute were found among the three protocols. No significant correlations were found between each subject’s most efficient crank length and any of the...
anthropometrical or isokinetic strength variables. The results of the study suggest that each subject has an optimal crank length which produces the lowest oxygen consumption per unit of work. However, it does not appear that the optimal crank length can be predicted by leg lengths, or various leg isokinetic strengths.

Moser, C. Daniel. METABOLIC RESPONSE TO ACUTE COLD AIR EXPOSURE AND TWO LEVELS OF BETA BLOCKADE IN MALES AND FEMALES, 1991. Ph.D., Temple University (Albert M. Paolone). (156pp 2 f $8.00) PH 1264

To evaluate the metabolic responses to 2 levels of beta blockade during cold air stress, 6 males (28.5±6.3 yrs, 77.5±11.67 kg, 16.7±2.3% fat) and 5 females (27.0±6.0 yrs, 66.6±13.2 kg, 25.1±6.3% fat) were randomly administered propranolol or placebo and were exposed for 60 minutes to 2 environments: 5 and 25 °C (40 to 60% relative humidity). Propranolol treatments were 0.75 mg/kg and 1.25 mg/kg. Propranolol and placebo were administered every 8 hours during the first day and a single dose at the beginning of the second day, 120 minutes before each chamber exposure. Core temperature in the cold (37.5 ± 0.41 °C) was higher (p<0.05) than in the neutral (37.2 ± 0.24 °C) with no gender effect. With environment x drug interaction, mean skin temperature was lower (p<0.01) in the cold (27.2 ± 1.25 °C) than in the neutral (32.8 ± 0.74 °C) across gender. Across gender in the cold environment, mean skin temperature was lower (p<0.05) on the low dose of propranolol (27.24 ± 1.30 °C) than on the placebo (28.00 ± 1.20 °C), and lower (p<0.05) on the high dose (26.49 ± 1.69 °C) than on the low dose. Percents blockade during treadmill exercise were 24.2 ± 6.5 on the low dose and 28.8 ± 5.2 on the high dose (p<0.001) with no gender effect. Thermoregulatory oxygen consumption (TVO2) was taken as the difference between the 25 °C pre-exposure oxygen consumption (VO2) and the mean cold exposure VO2. Across gender, TVO2 was lower (p<0.05) for the low dose (0.114 ± 0.086 L/min) than for the placebo (0.236 ± 0.101 L/min), but the high dose (0.170 ± 0.101 L/min) was not significantly lower than the placebo. Surface electromyogram (amplitude density coefficients of variation) for the high dose (16.2 ± 7.2) was greater (p<0.05) than the placebo (12.4 ± 4.6), but not significantly greater than the low dose (12.9 ± 5.8). In conclusion, the low dose of propranolol reduces the adult human metabolic thermoregulatory response to cold air stress with no change in shivering as compared to the placebo. Second, the adult human shivering response to cold air stress is greater on the high dose of propranolol than on a placebo, without a significant reduction in the metabolic thermoregulatory response. Finally, the metabolic and thermoregulatory responses of males and of females to the low and high doses of propranolol in neutral and cold environments do not differ from each other.

Murr, M. Scott. EFFECTS OF CONTINUOUS HEART RATE MONITORING ON CYCLING TIME TRIAL PERFORMANCE TIMES, 1993. M.S., Slippery Rock University (Frances J. Brannon). (73pp 1 f $4.00) PH 1354

The purpose of this study was to investigate the effects of continuous heart rate monitoring on 40 kilometer cycling time trial performance times. Because endurance athletes are beginning to use heart rate monitors during competition, it was important to determine their value in endurance performance. Ten subjects completed a 40 kilometer time trial (40K TT) for time on a stationary mag turbo trainer. Subjects used interval times, rate of perceived exertion, fatigue, and ventilatory rate as feedback cues for pacing. Subjects repeated the 40K TT 7 to 10 days later. In addition to the traditional cues for pacing, subjects were able to monitor performance intensity with the feedback of a heart rate monitor. Data obtained from the pre test time trials and post test time trials were statistically analyzed utilizing a t-test for dependent samples. The results of this investigation indicated that continuous heart rate monitoring did not improve 40K cycling TT performance times.

Naftzger, Lisa A. A COMPARATIVE STUDY OF EXERCISE BLOOD PRESSURE USING THE BRUCE TREADMILL TEST AND THE 3-3-3 EXERCISE TEST, 1992. M.S., Ball State University (Leonard A. Kaminsky). (89pp 1 f $4.00) PH 1355

The purpose of this study was to compare the exercise blood pressure response of subjects with a history of exercise induced hypertension between the submaximal 3-3-3 exercise test and a maximal Bruce treadmill protocol. Seven male and four female subjects with a mean age of 49 ± 2 years were recruited for the study. All subjects were selected based on a previous elevation of exercise diastolic blood pressure ≥10 mmHg during maximal exercise. The 3-3-3 test is a short, standardized treadmill test protocol that consists of one stage of treadmill walking at a 3% grade, at 3 miles per hour, for 3 minutes. Subjects completed the 3-3-3 test on one day and the Bruce protocol on a different day with 24-48 hours between tests. Test administration order was randomized and all tests were done at the same time of the morning with all blood pressures taken by the same technician with a mercury manometer. The increase in diastolic pressure from rest was significantly lower (p<0.004) during the 3-3-3 protocol compared to the peak of the Bruce protocol. There were no statistical differences between the change in diastolic pressure from rest to peak exercise when the 3-3-3 protocol was compared to the Bruce Stage I or when the Bruce Stage I was compared to the peak Bruce diastolic measurement. The mean change in diastolic pressure from rest to peak exercise in the 3-3-3 protocol was 3.4 ± 2.6 mmHg as compared to 9.9 ± 2.0 mmHg for the Bruce Stage I, and 15.4 ± 2.4 mmHg from rest to peak exercise with the peak Bruce. There were no differences in resting or standing systolic or diastolic blood pressure values between protocols done on separate trial days. The change in systolic response from rest to peak exercise and the peak systolic pressures were significantly different (p<0.001) between the Bruce Stage I and peak Bruce and between the 3-3-3 and peak Bruce. There were no significant differences in the heart rate and rate pressure product between the third minute of the 3-3-3 protocol and the third minute of the Bruce Stage I (p<0.001). The 3-3-3 test was not able to elicit the same rise in diastolic blood pressure as the Bruce treadmill test in this population, although the Bruce Stage I was able to elicit a response that was not statistically different than the response of the peak Bruce protocol. This implies that submaximal treadmill testing may be a feasible method to screen for the presence of an exaggerated diastolic blood pressure response to exercise.

Nichols, David L. THE EFFECTS OF ATHLETIC TRAINING ON BONE MINERAL DENSITY IN FEMALE COLLEGIATE GYMNASTS, 1992. M.S., Texas Woman’s University (Charlotte F. Sanborn). (134pp 2 f $8.00) PH 1330
The primary purpose of this study was to determine the accuracy of the assumptions on which the FITNESSGRAM mile run/walk criterion-referenced standards (CRS), for young adults were based and to partially validate the standards. An additional purpose was to determine if a significant predictor existed for BMD. Physiological characteristics were similar between the gymnasts (n=15) and controls (n=12) except mean weight which was significantly higher in the controls. Bone mineral density of the lumbar spine and femoral neck were determined using dual energy x-ray absorptiometry (DEXA) (Lunar DPX). Initially gymnasts had significantly higher BMD compared to controls at both sites measured. After 27 weeks of training by the gymnasts, no significant increase in BMD was seen at either site. However, when the negative effects of amenorrhea were accounted for, a significant increase in lumbar was seen. Arm muscle mass was found to be the only significant predictor of bone mineral density at either site. Based on these results, it was concluded that this group of gymnasts has BMD values greater than normal but 27 weeks of training did not increase BMD.

Niederpruem, Michael G. DIETARY FAT AND CARBOHYDRATE IN RELATION TO BODY FATNESS IN LEAN AND OBESE MEN AND WOMEN, 1992. M.S., Indiana University (Wayne C. Miller). (83pp 1 f $4.00) PH 1293

Lean (n=23, 11.1 ± 0.6% fat) and obese males (n=23, 29.2 ± 0.8% fat), along with lean (n=17, 16.7 ± 0.8% fat) and obese (n=15, 42.7 ± 1.0% fat) females were hydrostatic weighed to determine body composition. Dietary intake was collected with a 3-day food diary and a food frequency questionnaire. Dietary data was analyzed with the Nutritionist III software program (N-Squared Computing). Group comparisons were made with a MANOVA and significance was accepted at p<.05. Total sugar as well as fructose, sucrose, and glucose intake was not different between groups. Lean males consumed more natural fructose (22.2 ± 2.3 vs. 14.6 ± 1.6 gm), natural sucrose (12.7 ± 1.2 vs. 8.0 ± 0.9 gm), and natural glucose (18.0 ± 1.9 vs. 12.1 ± 1.5 gm) than their obese counterparts. When expressed as a percentage of sugar calories, the obese consumed more added sugar (males, 38.0 ± 3.5 vs. 25.2 ± 2.0% females, 47.9 ± 8.0 vs. 31.4 ± 3.4%) than their lean counterparts. The obese subjects also consumed less dietary fiber than their lean counterparts (males, 20.9 ± 1.8 vs. 27.0 ± 1.8 gm; females, 15.7 ± 1.1 vs. 22.7 ± 2.1 gm). When expressed as gram/100 kcal, the obese females still consumed less dietary fiber (8.0 ± 0.8 vs. 11.4 ± 0.9) than the lean females. These data suggest that additional characteristics of obesity include a high intake of added sugars and a reduced intake of dietary fiber.

O’Bannon, Jane P. VALIDATION OF FITNESSGRAM ONE-MILE RUN/WALK CRITERION-REFERENCED STANDARDS IN MEN AND WOMEN 18 TO 25 YEARS OF AGE, 1992. M.A., University of Georgia (Kirk J. Cureton). (73pp 1 f $4.00) PH 1265

The primary purpose of this study was to determine the accuracy of the assumptions on which the FITNESSGRAM mile run/walk criterion-referenced standards (CRS), for young adults were based and to partially validate the standards. An additional purpose of the study was to determine the relative importance of maximal oxygen uptake, running economy, and percent of VO2max utilized during a mile run/walk in accounting for variation in mile run/walk performance. One-mile run/walk performance, VO2max, running economy, and percent of VO2max used at the average one-mile run/walk speed were measured in 57 men and women, 18 to 25 years of age. It was assumed that young adults, 18 to 25 years of age, would utilize 100% of VO2max during a one-mile run/walk test. Results from this study indicate that males, females, and the total group utilized significantly less than 100% with values of 97%, 96%, and 96% of VO2max, respectively. Running economy (VO2 at 8.1 km/hr) values in young adults were significantly less than the assumed running economy values of Astrand (1952). An acceptable validity coefficient of 0.98 for the FITNESSGRAM mile run/walk CRS was found in young adults. Results from this study indicate that VO2max was the most important factor in determining variation in mile run/walk performance in young adults. The second most important factor was percent of VO2max utilized and least important factor was running economy.

INDEX WORDS: FITNESSGRAM, Criterion-referenced standards, maximal oxygen uptake, running economy, percent VO2max, average mile run/walk speed


Ss for this study were 26 female college students randomly assigned to either the control group or the experimental group. The E group completed a 6-week strengthening program using rubber tubing as resistance, while the C group did no strength training. Dominant upper extremities, with no recent history of injuries were assessed on the Kin-Com computerized dynamometer. The mean concentric and eccentric torque values for the posterior rotator cuff muscles at velocities of 60 deg/s and 180 deg/s were measured prior to the training program, at the third week, and at the conclusion of the training program. A 4-way factorial with one independent groups and three repeated measures factors was used to analyze the differences in torque production. The mean torque value for the E group was significantly (p<.001) greater than the mean torque value for the C group. The eccentric contractions were significantly (p<.000) greater than the concentric contractions with respect to mean torque. The mean torque values for test velocity were significantly (p<.000) greater at 60 deg/s than at 180 deg/s. The mean torque value at the third test administration was significantly (p<.05) greater than the mean torque value at the second test administration; which, in turn, was significantly (p<.05) greater than the first test administration. The mean torque value for the E group was significantly (p<.000) greater than the C group for the concentric and eccentric modes of contraction at the second and third test administrations. College women completing a 6-week training program, using rubber tubing as resistance, are able to increase concentric and eccentric torque production of the shoulder external rotators throughout the training program in comparison to a control group.

O’Connor, MaryLou. CAFFEINE, CARBOHYDRATE LOADING, AND PHYSICAL PERFORMANCE, 1992. M.A., University of North Carolina at Chapel Hill (Robert G. McMurray). (77pp 1 f $4.00) PH 1294

The effects of caffeine ingestion and carbohydrate loading were examined on seven trained male cyclists during 90 minutes of cycle ergometry. The workload was set at 75% VO2max in all four trials. Subjects carbohydrate loaded for 3 days prior to the CHO and CAF/CHO trials. Subjects ingested 5 mg/kg body weight
The computed tomography scans used in the second study indicated that CP elicited a significantly greater VO2 in the elderly men, quadriceps and knee flexors; and 4) identify determinants of CP and anerobic work capacity (AWC) in young and elderly men; 1b) determine if CP does represent a true maximal rate of non fatiguing work; 2) determine if CP does represent non fatiguing, VO2max in the elderly men, quadriceps and knee flexors; and 4) identify determinants of CP; and AWC in young and elderly men; 1b) determine if CP does represent a true maximal rate of non fatiguing work; 2) determine thigh component cross-sectional areas (CSA) and volumes; 3) determine the strength and strength/CSA ratios of the knee extensors and knee flexors; and 4) identify determinants of CP and AWC. The first study showed that CP (115 vs 177 watts) and AWC (8.1 vs 13.6 kJ) were significantly reduced in elderly men. Temporal profiles of cardiorespiratory and metabolic variables monitored during prolonged (24 minutes) cycle exercise at CP indicated that CP elicited a significantly greater VO2 in the elderly men (91.5% vs 85.2% of VO2max) and that CP did not represent a true rate of non-fatiguing work in either young or elderly men. The computed tomography scans used in the second study indicated that subcutaneous and intramuscular fat in the thigh were significantly increased in the elderly men, quadriceps and hamstring muscle CSA and volumes were decreased in comparison to the young men. The third study showed that elderly men were weaker (22-32%) in both concentric isometric and isokinetic (120°/s) knee flexion and extension. Isometric strength: CSA ratios were not different between the two groups, but the isokinetic ratios of the elderly men were significantly decreased, suggesting that their decline in isokinetic strength was greater than could be accounted for by their decrease in muscle CSA. Finally, the fourth study indicated that while CP was correlated with measures of muscle CSA and volume, it was most strongly related to VO2max and maximal power output in both young and elderly men. These studies have identified determinants of CP and AWC and suggest a possible age-related effect on muscle strength and size, but not on the ability of elderly men to perform high intensity exercise for prolonged durations.


Heat related illnesses continue to occur when athletes exercise in hot, humid environments. Because of this, health care professional have attempted to invent practical body cooling techniques and devices to prevent these athletes’ body core temperatures from reaching potentially dangerous levels. The purpose of this study was to assess the effectiveness of one newly invented body cooling device, the Cool Cape, in the rapid reduction of exercise-induced elevated body core temperature. Ten male subjects received three recovery conditions (Cool Cape, Fan and Control) in random order, following forty-five minutes of submaximal cycle ergometer exercise performed on non-consecutive days. Skin and rectal temperatures were measured during both the exercise bouts and the recovery conditions. A two-factor repeated measures analysis of variance was performed on the pre and post recovery temperatures for the three dependent variables (chest, back and rectal temperature). There were no significant effects found between the three recovery conditions at the p<.05 level of significance. Therefore, this study concluded that the use of the Cool Cape in the rapid reduction of exercise-induced, elevated body core temperature in male subjects is no more effective than fan or passive cooling. However, the study recommends highly that further research be conducted on the Cool Cape, particularly in an outdoor environment, to accurately assess its effectiveness.

Poe, Margaret P. MATERNAL AND FETAL RESPONSES TO LOW IMPACT AEROBIC DANCE, 1993. M.A., University of North Carolina at Chapel Hill (Robert G. McMurray). (82pp 1 $4.00) PH 1356

To examine the effects of low impact aerobic dance on pregnancy, ten low-risk pregnant women during the 20th to 30th weeks of gestation completed forty minutes of low impact aerobic dance (AD) and forty minutes of treadmill walking (TM). Similar levels of exertion were sustained by maintaining similar maternal heart rates (MHR) between trials. When comparing the two trials at the highest cardiovascular intensities, subjects had significantly lower oxygen uptake (1.1 ± 0.3 vs 1.4 ± 0.2/l/min), carbon dioxide production (1.1 ± 0.2 vs 1.4 ± 0.2/l/min), caloric costs (5.3 ± 1.2 vs 6.6 ± 1.4 kcal/min) and minute ventilation (26.0 ± 4.5 vs 38.0 ± 5.2 l/min) during AD (p<.05). Respiratory equivalents, respiratory exchange ratio, and blood glucose concentrations were not significantly different between trials. Fetal heart rates varied significantly (171.8 ± 15.2 vs 147.6 ± 7.6 bpm) with values being higher during the AD trial (p<.05). Intensity and duration of the two exercise bouts exceeded the ACOG guidelines for exercise during pregnancy with no adverse effects occurring. Low impact aerobic dance and treadmill exercise were both well tolerated and are suggested forms of exercise during pregnancy.

This study compared the cardio-respiratory responses of 24 subjects during an incremental exercise test to exhaustion on a cycle ergometer in the upright (UC) and the aero-cycling postures (AC). Participants were moderately-trained males 21-42 years of age and free of drugs and medication. None had a history of cardiovascular disease. Exercise began at a power output of 300 kp-min^-1. Power output was increased 300 kp-min^-1 every three minutes until volitional exhaustion. Ventilatory, oxygen consumption, heart rate and blood pressure responses were averaged each minute. Analysis of variance for repeated measures revealed no significant differences in ventilatory pattern or timing, cardiovascular responses, and metabolic requirements between the UC and the AC during maximal and submaximal exercise.

Overend, Thomas J. DETERMINANTS OF CRITICAL POWER AND ANAEROBIC WORK CAPACITY IN YOUNG AND ELDERLY MEN, 1992. Ph.D., University of Western Ontario (David Cunningham). (150pp 2 $8.00) PH 1237

Determinants of critical power (CP, the theoretical maximal rate of non-fatiguing work) and anaerobic work capacity (AWC, a finite energetic reserve from intra-muscular sources) were determined in young (n=13, 24.5 y) and elderly men (n=12, 70.7 y). The purposes of the four studies were to: 1a) determine and compare CP and AWC in young and elderly men; 1b) determine if CP does represent a true maximal rate of non fatiguing work; 2) determine thigh component cross-sectional areas (CSA) and volumes; 3) determine the strength and strength/CSA ratios of the knee extensors and knee flexors; and 4) identify determinants of CP and AWC. The first study showed that CP (115 vs 177 watts) and AWC (8.1 vs 13.6 kJ) were significantly reduced in elderly men. Temporal profiles of cardiorespiratory and metabolic variables monitored during prolonged (24 minutes) cycle exercise at CP indicated that CP elicited a significantly greater VO2 in the elderly men (91.5% vs 85.2% of VO2max) and that CP did not represent a true rate of non-fatiguing work in either young or elderly men. The computed tomography scans used in the second study indicated that subcutaneous and intramuscular fat in the thigh were significantly increased in the elderly men, quadriceps and hamstring muscle CSA and volumes were decreased in comparison to the young men. The third study showed that elderly men were weaker (22-32%) in both concentric isometric and isokinetic (120°/s) knee flexion and extension. Isometric strength: CSA ratios were not different between the two groups, but the isokinetic ratios of the elderly men were significantly decreased, suggesting that their decline in isokinetic strength was greater than could be accounted for by their decrease in muscle CSA. Finally, the fourth study indicated that while CP was correlated with measures of muscle CSA and volume, it was most strongly related to VO2max and maximal power output in both young and elderly men. These studies have identified determinants of CP and AWC and suggest a possible age-related effect on muscle strength and size, but not on the ability of elderly men to perform high intensity exercise for prolonged durations.

Oregenes, Mauricio M., IV. CARDIO-RESPIRATORY RESPONSE TO UPRIGHT AND AERO-POSTURE CYCLING, 1991. M.S., Washington State University (Sally E. Blank). (82pp 1 $4.00) PH 1236

Overend, Thomas J. DETERMINANTS OF CRITICAL POWER AND ANAEROBIC WORK CAPACITY IN YOUNG AND ELDERLY MEN, 1992. Ph.D., University of Western Ontario (David Cunningham). (150pp 2 $8.00) PH 1237

Determinants of critical power (CP, the theoretical maximal rate of non-fatiguing work) and anaerobic work capacity (AWC, a finite energetic reserve from intra-muscular sources) were determined in young (n=13, 24.5 y) and elderly men (n=12, 70.7 y). The purposes of the four studies were to: 1a) determine and compare CP and AWC in young and elderly men; 1b) determine if CP does represent a true maximal rate of non fatiguing work; 2) determine thigh component cross-sectional areas (CSA) and volumes; 3) determine the strength and strength/CSA ratios of the knee extensors and knee flexors; and 4) identify determinants of CP and AWC. The first study showed that CP (115 vs 177 watts) and AWC (8.1 vs 13.6 kJ) were significantly reduced in elderly men. Temporal profiles of cardiorespiratory and metabolic variables monitored during prolonged (24 minutes) cycle exercise at CP indicated that CP elicited a significantly greater VO2 in the elderly men (91.5% vs 85.2% of VO2max) and that CP did not represent a true rate of non-fatiguing work in either young or elderly men. The computed tomography scans used in the second study indicated that subcutaneous and intramuscular fat in the thigh were significantly increased in the elderly men, quadriceps and hamstring muscle CSA and volumes were decreased in comparison to the young men. The third study showed that elderly men were weaker (22-32%) in both concentric isometric and isokinetic (120°/s) knee flexion and extension. Isometric strength: CSA ratios were not different between the two groups, but the isokinetic ratios of the elderly men were significantly decreased, suggesting that their decline in isokinetic strength was greater than could be accounted for by their decrease in muscle CSA. Finally, the fourth study indicated that while CP was correlated with measures of muscle CSA and volume, it was most strongly related to VO2max and maximal power output in both young and elderly men. These studies have identified determinants of CP and AWC and suggest a possible age-related effect on muscle strength and size, but not on the ability of elderly men to perform high intensity exercise for prolonged durations.
The purpose of this study was to analyze selective regulatory hormonal responses [testosterone (T), luteinizing hormone (LH), prolactin (PRL), and cortisol (Co)] within the hypothalamic-pituitary gonadal axis in moderately trained males over an 8 hour recovery period following anaerobic (ANA) and aerobic (AER) exercise sessions of equal total work output. Subjects (n=9) initially performed a maximal aerobic capacity (VO_{max}) test to determine an overall workload for experimental exercise sessions. On subsequent testing days, subjects were randomly assigned to one of the following experimental sessions: (a) rest for 60 minutes (CON), (b) cycle at 60% VO_{max} for 60 minutes (AER), or (c) 2 minute alternate cycling intervals at 110% and 40% VO_{max} (ANA). Blood samples were obtained just prior to the experimental session, immediately following, and every hour for 8 hours into the recovery. Statistical analysis revealed significant increases in PRL and Co only due to exercise. The area under the 8 hour response curve (AUC) was calculated for all hormones. Correlations between the hormonal AUC results revealed a significant inter-relationship between T and LH during CON and AER (p<0.05), but not so for ANA (p>0.05). These findings suggest the relationship between T and LH, as measured by the AUC, seems to be disrupted by the ANA but not the AER exercise.

Prior, Barry M. POSITIVE WORK DONE BY CONTINUED CROSSBRIDGE CYCLING AND THE SERIES ELASTIC COMPONENT IN MUSCLE DURING INACTIVE SHORTENING PRECEDED BY ACTIVE LENGTHENING, 1992. M.A., University of Georgia (Robert B. Armstrong). (60pp 1 f $4.00) PH 1357

The primary purpose of this study was to determine the quantity of positive work done by the series elastic element and continued crossbridge cycling under the conditions when muscle is passively shortened after being actively lengthened. A secondary purpose of this study was to examine the relationship of positive work to negative work (PW/NW ratio) after positive work done by continued crossbridge cycling was excluded. Measurements were made on 14 rat soleus muscles. Measured and calculated variables were positive work, negative work, and the ratio of PW/NW. Protocols selected for this study were those previously found to elicit different ratios of PW/NW in passively shortened muscle when preceded by active lengthening (Prior et al. Medicine and Science in Sports and Exercise, 24 Supplement, S116, 1992). To exclude the effect of continued crossbridge cycling during passive shortening, muscles were shortened at VO, the maximal unloaded shortening velocity of the muscle. Four protocols were used: lengthened and shortened at 0.5 L_o/s over 0.30 L_o (L_o=average of the two muscle length values during maximal dorsi- and plantar-flexion of the ankle) (0530), lengthened at 0.5 L_o/s and shortened at V_o over 0.30 L_o (0350V_o), lengthened and shortened at 1.5 L_o/s over 0.10 L_o (1510), and lengthened at 1.5 L_o/s and shortened at V_o over 1.0 L_o (1510V_o). Results showed that continued crossbridge cycling contributed between 15–17% of the positive work done during passive shortening and that the PW/NW ratio decreased from 0.58 in the 1510 protocol to 0.48 in the 1510V_o protocol, and from 0.21 in the 0530 protocol to 0.18 in the 0530V_o protocol.


Puckree, Threethambal. DOES INTERCOSTAL STRETCH AFFECT RESPIRATORY MUSCLE ACTIVITIES, 1992. M.S., State University of New York at Buffalo (Frank J. Cerny). (76pp 1 f $4.00) PH 1238

The physiological responses produced by intercostal stretch, as applied by physical therapists to improve ventilatory function, on ventilatory muscle activity are unknown. The responses to intercostal stretch in different body positions has not been quantified. The purpose of this study was to determine the responses of the diaphragm, parasternal intercostals and the external oblique abdominal muscles to intercostal stretch when the subject was supine and 60 degrees semi-recumbent. Stretch was applied to the 3rd and 8th intercostal spaces in-phase with either inspiration or expiration. Six healthy female and three male volunteers with a mean age of 25 years, participated in this study. Surface EMG’s were recorded from the diaphragm, parasternal intercostals and the external oblique abdominal muscles. Subjects breathed through a mouthpiece attached to a breathing valve and a pneumotachometer. The pneumotach flow signals served as a guideline to differentiate between inspiratory and expiratory phasic activity, in the analysis of the EMG signals. Stretch was applied 10 times with a 2 minute interval between each condition. Stretch was quantified as a pressure change in a water filled tube under the finger. The results demonstrated a significant increase in the mean peak amplitude and mean burst duration of the diaphragm EMGs when stretch was applied in-phase with inspiration. The parasternal intercostals showed similar but non-significant increases in mean peak amplitude and a significant increase in mean burst duration of phasic inspiratory activity in response to inspiratory stretches. The external abdominal oblique showed no detectable response to stretch. Body position had no detectable effect on the responses of any of the three muscles studied. We conclude that intercostal stretch facilitates diaphragm and parasternal intercostal muscle inspiratory activity but evokes no detectable change in external abdominal oblique EMG.


Twenty NZW rabbits were randomly assigned to exercise and sedentary groups. During a twelve week treatment period the subjects were fed a 0.5% cholesterol diet and exercise subjects were trained on a small animal treadmill. Low-density-lipoprotein (LDL) fractional catabolic rate (FCR) was determined by radiolabelling native and methylated samples. Atherosclerosis was determined as a percentage of lipid stainable area on the intima of the thoracic aorta. T-tests indicated no significant difference between exercise and sedentary groups FCR for the first twelve hour samples. The FCR for the sedentary group was significantly (p<0.05) higher over the final twelve hours. The exercise group had significantly (p<0.05) lower atherosclerotic involvement in the thoracic aorta. The results indicate that exercise does not increase LDL-receptor activity but does attenuate atherosclerotic development. This indicates that exercise has an effect on atherosclerotic development beyond the control of plasma lipoprotein levels.
Quinn, Laura C. EFFECT OF A COMBINED AEROBIC-WEIGHT TRAINING PROGRAM ON RESTING METABOLIC RATE IN PREVIOUSLY SEDENTARY WOMEN, 1993. M.S., Purdue University (Roseann M. Lyle). (68pp 1 f $4.00) PH 1358

The purpose of this study was to examine the effects of six months of participation in a combined aerobic-weight lifting intervention on the resting metabolic rate of healthy, sedentary women aged 18-30, while controlling for day of menstrual cycle and the timing of the previous bout of exercise. The intervention consisted of performing the Super-circuit, in which Nautilus-type machines are interspersed with bicycle ergometers, three times a week. Additionally, subjects were asked to jump rope for a total of one hour/week. Subjects were volunteers who were also participating in a randomized study examining the relationship between exercise and bone health. Baseline and post-test included resting metabolic rate (RMR), maximum aerobic capacity (max VO2), body composition performed on a dual-energy x-ray absorptiometry machine, and an estimate of one-repetition maximum lifts on the Super-circuit machines. A one-way ANOVA demonstrated that the RMR of the exercisers expressed relative to body weight and adjusted for FFM were significantly higher than the control group at baseline (p = 0.03 and p = 0.002, respectively). At post-test, no significant differences were found for RMR between groups by ANCOVA analysis with baseline RMR as the covariate. However, a paired t-test showed significant decreases occurred within the exercise group for absolute and adjusted RMR, and RMR relative to bodyweight (p<0.002), while no significant change occurred within the control group. Overall strength increased 17% in the exercise group (p = 0.02), although compliance with the exercise protocol averaged only 1.7 x/wk for the Super-circuit and 33.8 min/wk of jumping rope. A repeated measures ANOVA demonstrated a time by group interaction for FFM (p = 0.0005). A paired t-test showed that the exercise group increased FFM 3.6% (p = 0.0001), while the control group did not change. Max VO2 and percent body fat remained unchanged following the exercise protocol. The 13.8% decrease in absolute RMR within the exercise group in this study is similar to the results of an aerobic intervention by Poehlman et. al (1996), in which an 8% decrease in absolute RMR was observed. However, others have reported either no change or an increase in RMR following an exercise intervention. Thus, further research is necessary to continue to address the relationship between exercise and RMR.

Redford, Nicolette L. THE EFFECT OF TWO DIFFERENT RESISTANCE EXERCISE BOUTS OF EQUAL WORK ON POST-EXERCISE OXYGEN CONSUMPTION, 1993. M.S., Purdue University (Darlene A. Sedlock). (72pp 1 f $4.00) PH 1399

The purpose of this study was to investigate the effects of two bouts of resistance exercise, equal in work but differing in intensity, on post-exercise oxygen consumption. Eighteen subjects (age = 22.6 ± 3.4 years; height = 164.0 ± 4.6 cm; weight = 59.7 ± 9.0 kg) exercised against resistance on two separate occasions. The exercise consisted of 2 sets of 20 repetitions at 50% and 3 sets of 8 repetitions at 85% of each subject’s own eight repetition maximum (8-RM). There were two exercise routines, each subject being assigned to one; one routine ended with lower body exercises while the other ended with upper body exercises. The exercise bouts were completed on separate days in a counterbalanced order. All subjects fasted for at least 10 hours prior to each session, and remained fasted during the recovery period. Baseline oxygen consumption (VO2) and respiratory exchange ratio (RER) were measured for 10 min following a 20 min rest period. Post-exercise VO2 and RER were measured until the average of 5 consecutive minute VO2 values were at or below baseline values. Results of a 2 way analysis of variance (ANOVA) indicated that the intensity of exercise had no significant effect on the magnitude of EPOC. The magnitude of EPOC was, however, significantly influenced (F (1,16) = 17.8, p < .001) by which muscle group was used at the completion of the test. The subjects ending with the lower body exercises (routine 1) demonstrated a significantly greater EPOC magnitude (x = 12.76 ± 4.96 Kcal) when compared with the subjects ending with the upper body (x = 6.53 ± 3.87 Kcal) exercises (routine 2). There was no significant difference in EPOC duration between either exercise intensities. However, the present study did reveal a trend within EPOC duration such that values representing the effects of muscle group used at the completion of the test were approaching statistical significance (F (1,16) = 4.34, p = .06). Mean ± SD EPOC duration was 35 (± 17.2) minutes for routine 1 and 23 (± 16.4) minutes for routine 2. There was no significant difference in baseline variables between any of the testing conditions. End EPOC heart rate was significantly greater than baseline heart rate while end EPOC RER was significantly less than baseline RER. Based on these findings, it would appear as though the muscle group(s) used to complete a resistance exercise session may have a greater effect of post-exercise caloric expenditure than would the intensity of exercise.

Reimer, Brad W. THE EFFECT OF CADENCE ON AEROBIC AND ANAEROBIC CONTRIBUTIONS TO THE TOTAL ENERGY REQUIREMENTS OF CYCLING AT CONSTANT POWER OUTPUT, 1991. M.P.E., University of British Columbia (David Sanderson). (108pp 2 f $8.00) PH 1296

Steady-state cycling at constant power output can be achieved at any one of a number of cadences. Data have been published (Coast and Welch, 1985) that suggest riding at a particular cadence which minimizes oxygen uptake (VO2) aids in achieving optimal performance. This cadence has been referred to as optimal. However, optimal cadences based solely on an indicator of aerobic metabolism (e.g., VO2) fail to recognize any contributions made by an anaerobic metabolism to the total energy costs of performing the work. The anaerobic contribution becomes particularly important at power outputs greater than a rider’s anaerobic threshold. This study was designed to evaluate the effect of cadence on a) the contributions of the aerobic and anaerobic energy pools to the total energy cost of cycling and b) the EMG activity of five major leg muscles at constant power outputs below and above the anaerobic threshold. Male cyclists (n=4) completed progressive, incremental maximal exercise tests at cadences of 60 and 120 rpm to determine the ventilatory threshold (Tvent) for each cadence. Six minute steady-state rides at power outputs 20% below and 20% above Tvent were subsequently performed at both experimental cadences on separate days. VO2 and excess CO2 data were collected throughout the steady-state rides and presented as the mean value over the final three minutes of each ride. EMG data were collected during the final 10 seconds of each six minute ride and averaged to represent one mean cycle of normalized EMG activity. Both VO2 and excess CO2 were found to be significantly greater (p<0.05) at 120 rpm than at 60 rpm. However, when these data were corrected to account for the zero-load costs of cycling at each cadence, no significant differences were found in either variable. Only one of the five muscles studied (rectus muscle, ...
Reynolds, Hedy. INFLUENCE OF POST-EXERCISE GLUCOSE INGESTION ON PLASMA POTASSIUM LEVELS AND ECG MEASUREMENTS. 1991. M.S., Colorado State University (Loren Cordain). (77pp 1 f $4.00) PH 1239

A common glycerol supercompensation technique currently in use is the post-exercise ingestion of a glucose polymer solution. Previous studies have revealed electrocardiographic (ECG) abnormalities in association with glucose ingestion, and several studies have demonstrated the rapid decrease in plasma potassium concentration in the immediate post-exercise recovery period. The intent of this study was to determine whether post-exercise ingestion of glucose causes hypokalemia and its associated electrocardiographic changes. Eleven trained healthy, male and female runners between the ages of 28 and 42 years were selected as subjects for this investigation. Each subject participated in two trials, during which baseline ECG and plasma potassium and glucose measurements were taken, followed by a 90-minute run. A 100-gram glucose polymer drink (Exceed®), either with or without the addition of three grams of potassium chloride, was ingested by the subjects in a single-blind random fashion within 15 minutes of the cessation of exercise. ECG parameters and plasma potassium and glucose concentrations were again measured immediately and at 25 and 60 minutes following the cessation of exercise. The results indicated that plasma potassium concentrations dropped immediately post-exercise and that there was a significant (p<0.05) difference in plasma potassium levels at 60 minutes post-exercise between the two drinks. The addition of potassium chloride to Exceed® caused plasma potassium levels to rise well above the mean baseline value, while with Exceed® alone, the plasma potassium levels did not increase or return to baseline levels. There were no significant (p>0.05) differences in plasma glucose levels between the two drinks as well as no significant differences in hematocrit and heart rate. Significant (p≤0.05) ST segment depression was demonstrated in Lead I of the ECG following ingestion of Exceed®. Ingestion of Exceed® alone caused T wave amplitude to be significantly (p≤0.05) lowered in eight leads of the ECG and caused U wave amplitude to be significantly (p≤0.05) elevated in four leads. There were no significant differences in QT interval length between the two treatments. These data suggest that ingestion of glucose in the post-exercise recovery period suppresses the return of potassium to the extracellular fluid from the muscle cell, and that this tendency for decreased plasma potassium concentration leads to electrocardiographic changes; specifically, significantly (p≤0.05) diminished T wave amplitude and increased U wave amplitude. The addition of potassium chloride to the glucose polymer drink possibly facilitates the movement of glucose into the muscle cell post-exercise, which is desirable for glycerol supercompensation. It is also likely, however, that the potassium chloride causes increased osmolarity which slows the rate of gastric emptying and delays absorption. Of primary importance is the observation that the additional potassium chloride provides an adequate level of extracellular potassium to prevent electrocardiographic changes associated with rapid decrease in plasma potassium levels immediately post-exercise.

Riggs, Donna M. THE BODY COMPOSITION OF MASTERS WOMEN ENDURANCE ATHLETES FROM 35 TO 74 YEARS OF AGE, 1990. M.S., Arizona State University (Christine L. Wells). (129pp 2 f $8.00) PH 1268

Seventy-three endurance trained masters women athletes (35-74 years of age) were divided into five age groups (35-39 yrs., 40-44 yrs., 45-49 yrs., 50-54 yrs., 55+ yrs.) and assessed for body composition (hydrostatic weighing) and fat distribution. A comparison was made between the runners (n=50) and swimmers (n=23). Analyses on the effects of menopause and aging on body composition and fat distribution were performed on the runners alone. Significant differences between runners and swimmers were detected on measures of total body mass, body mass index (BMI), body density, lean body mass (LBM), and percent body fat (%BF) (p<.05). When age and training were held constant, pre-menopausal, transitional, and post-menopausal groups were not significantly different (p>.05) on any body composition or fat distribution variable, except BMI. When training levels were held constant across the five age groups, the youngest age group (35-39 yrs.) had lower %BF (21.4%) and higher lean/fat ratio (4.13) than the older athletes (p<.05). LBM was maintained across age groups. No differences across age groups were noted in any of the indices of fat distribution (p>.05). It was concluded that (1) the runners represented a leaner, smaller boned, and lighter group of athletes than the swimmers but did not differ on most indices of fat distribution (p>.05) which serve as health risk indicators; (2) menopausal states did not have an effect on body composition or fat distribution; and (3) when training was held constant, these masters runners did not differ in LBM, %BF or fast distribution across age. The runners had a low level of peripheral fat relative to central fat, and a low level of upper body fat relative to lower body fat. Regular endurance training seems to prevent the loss of LBM and increase in %BF associated with aging in the sedentary female population.

Roberts, Gregory A. A METABOLIC COMPARISON OF ISOKINETIC AND FREE SPRINGING, 1993. M.S., University of British Columbia (E.C. Rhodes). (71pp 1 f $4.00) PH 1360

The purpose of this study was to examine the Excess Post-Exercise Oxygen Consumption (EPOC) and peak blood lactate responses of sprinters to exhaustive treadmill running and maximal isokinetic and free sprinting. Eight university sprinters (mean: age=24.8 yrs.,
child with the procedures. On the second visit, each child was familiarized with the procedures. Tukey’s post hoc comparisons determined significantly different corrected EPOC (HSD=2.04, α=0.05) and peak blood lactate (HSD=1.72, α=0.05) cell means between the 2 minute AST (15.16 Litres) 2.59; 14.83 mmol/L 1.21) and the other three protocols: the 5 repetition anaerobic power master (APM) (11.38 Litres) 2.72; 12.77 mmol/L 1.97), the 10 repetition free sprint (9.88 Litres) 2.80; 11.25 mmol/L 2.15) and the 5 repetition free sprint (9.09 Litres) 2.51; 9.83 mmol/L 3.09). Additionally, significance was met between the 5 repetition APM condition and the 5 repetition free sprint condition. These findings suggest that five, 5 second isokinetic sprinting repetitions demand more work in less time and produce a metabolic demand equivalent to ten, 5 second free sprinting repetitions.

Rowe, David A. HEALTH-RELATED FITNESS LEVELS IN BAHAMIAN ELEMENTARY SCHOOL AGE CHILDREN, 1992. M.S., Springfield College (Matthew T. Mahar). (202pp $12.00) PH 1332

Ss were 929 Bahamian elementary school age children who were tested for cardiovascular fitness (CV), upper body strength and endurance (PU), body composition (SF), abdominal strength and endurance (SU), and flexibility (FL) according to protocols used in the National Children and Youth Fitness Study and the National Children and Youth Fitness Study II (United States Department of Health and Human Services, 1985, 1987). Comparisons were made between Bahamian Ss and Ss tested in the two United States (U.S.) studies using one sample t-tests. Patterns of development of the Bahamian sample were also analyzed with 2 x 6 ANOVAs to determine the influence of sex and age on health related fitness (HRF), and norms were developed for use in Bahamian schools. Bahamian children were found to be generally fitter than U.S. children in CV, PU, and SF (boys only). Bahamian and U.S. girls had similar SF. U.S. children were generally fitter than Bahamian children in FL. SU performance was better for Bahamian children at the early ages, but U.S. children were better at the later ages. Within the Bahamian sample, boys were fitter than girls in CV, PU, SU, and SF, while girls were fitter in FL. Fitness scores improved with age for CV, PU, and SU, but not SF or FL. Norms were developed for every 5th percentile and recommendations were made for improvement of HRF through physical education.

Salcedo, Pedro del C. SERUM AND SALIVARY CORTISOL RESPONSES DURING AEROBIC EXERCISE IN CHILDREN, 1993. M.S., Ball State University (Anthony D. Mahon). (80pp $4.00) PH 1361

In adults, serum and salivary cortisol increase during aerobic exercise. There is little data on serum and no data on salivary cortisol responses during aerobic exercise in children. The purpose of this study was to examine serum and salivary cortisol during and after aerobic exercise. Ten male children with a mean age of 10.6 ± 0.6 years were subjects in this study. Each child came to the laboratory on three occasions. The first visit was to familiarize the child with the procedures. On the second visit, each child performed a maximal exercise test on a cycle ergometer (mean VO₂, 49.5 ± 3.6 ml·kg⁻¹·min⁻¹). On the third visit, an indwelling catheter was placed in a forearm vein. Thirty minutes later baseline blood and saliva samples were obtained followed by 30 minutes of exercise on a cycle ergometer at 69.5 ± 3.0% of VO₂max. Blood and saliva samples were obtained at mid-exercise, end exercise and 15 minutes post-exercise. Serum and salivary cortisol were analyzed using RIA kit. Serum samples were corrected for changes in plasma volume. A repeated measures ANOVA revealed that exercise significantly increased serum, but not salivary cortisol. Mean salivary cortisol (ug·dl⁻¹) at baseline was 0.079 ± 0.042, at mid-exercise 0.099 ± 0.070, at end-exercise 0.133 ± 0.112, and at 15 minutes post-exercise was 0.143 ± 0.140. Post-hoc analyzes indicated that mean serum cortisol at mid exercise (7.94 ± 4.53 ug·dl⁻¹), end-exercise (8.72 ± 5.61) and 15 minute post-exercise (8.21 ± 5.03 ug·dl⁻¹) were significantly greater than baseline (5.54 ± 2.73 ug·dl⁻¹). The ratio of mean salivary to mean serum cortisol ranged from 1.3% to 1.7%. Serum and salivary cortisol were significantly correlated at mid-exercise (r=0.77), post-exercise (r=0.90) and 15 minutes post-exercise (r=0.84), but not at baseline. It is concluded that: (1) as a result of children show adrenocortical activation as measured by serum cortisol; and, (2) salivary and serum cortisol are strongly correlated during and after exercise in children.

Sanders, Mary E. SELECTED PHYSIOLOGICAL TRAINING ADAPTATIONS DURING A WATER FITNESS PROGRAM CALLED WAVE AEROBICS, 1993. M.S., University of Nevada, Reno (Nicki E. Rippe). (122pp $8.00) PH 1362

A study was conducted to quantify physiological changes in cardiovascular endurance, muscular endurance, body composition and flexibility during participation in the Wave Aerobics water fitness program. Twenty women, each age 40 years, recruited from the community, participated in an 8 week program. Workouts included shallow and deep water sessions using water exercise equipment. Pre- and post-fitness tests determined physiological changes. During the program, periodic use of wireless heart rate monitors measured mean aerobic intensity at 74-84% Heart Rate Maximum. Results of this study reported significant improvements (p<.05) in cardiovascular endurance, muscular endurance and body composition with no significant changes in flexibility. Further analysis allowed the combined group to be divided to determine significant contributions by age. Both groups 1 x age = 28 and 2 x age = 52 demonstrated significant improvements in muscular endurance and body composition. Group 1 showed significant improvement in cardiovascular endurance while Group 2 did not.

Schlabach, Gretchen A. THE EFFECTS OF TRAINING AND DETERMINATION ON CORTICOSTERONE RHYTHMS AND DIETARY FAT SELECTION IN THE OSBORNE-MENDEL RAT, 1991. Ph.D., University of Maryland (Damaso Laine Santa Maria). (181pp $8.00) PH 1240

The central focus of this study was to examine the effects of 6 weeks of treadmill running and 2 weeks of detraining on corticosterone rhythms and dietary fat intake in the Osborne-Mendel rat. Thirty-two rats were divided into an experimental group and control group. During training and detraining the animals were given the opportunity to self select their own diet. Body weight and food intake (carbohydrate, protein and fat) were measured daily. At the end of the 6th and 8th week corticosterone...
rhythms and citrate synthase were analyzed. Exercise training had no effect on absolute nor relative carbohydrate and protein food intake. However, exercise training resulted in significantly elevated fat intake (grams) in the experimental group during the course of the 6 week training program. Also, the experimental group consumed more total calories than the sedentary controls and at the end of the 8 week training program were considerably heavier in body weight. The exercise training program had a notable effect on the pattern of the 24 hour corticosterone rhythm. The experimental group exhibited a 12 hour elevated plateau, which resulted in a higher corticosterone production levels at the end of the 6th week. An important finding of this study was the significant correlation \((r=.715)\) obtained between 24 hour corticosterone production level and 24 hour intake (grams) at the end of the 6th week. Citrate synthase, which has been reported as a marker of fitness in the rat, was not effected by exercise training. During detraining, the experimental animals consumed significantly more Calories and were considerably heavier than the than the sedentary controls. By the end of the 8th week, the corticosterone rhythms in the formerly exercised rats approximated the normal rhythms of the sedentary controls. Consequently, there was no difference in corticosterone rhythm between the groups.


The purpose of the present investigation was to determine the effects of endurance exercise training on adrenal morphology and epinephrine content in young and old Fischer 344 rats. Animals from each group underwent 8 weeks of treadmill running (60 minutes per day, 6 days per week), 72 hours following the last training session animals were killed and the adrenals removed for subsequent analysis. A training effect was demonstrated by the increases in left ventricular weight (19%-young; 8%-old) in the trained animals as compared to untrained controls. Trained animals had larger total adrenal volumes (nl / g body weight) than untrained controls (p<0.001) (Young Control (YC)= 59.4 ± 7; Young Exercise (YE)=81.9 ± 7; Old Control (OC)= 47.2 ± 3; Old Exercise (OE)=58.0 ± 7). Trained animals had larger cortical volumes (nl / g body controls) compared to untrained controls (p<0.001) (YC= 54.8 ± 7; YE= 75.7 ± 6; OC= 43.1 ± 4; OE= 52.8 ± 7). Trained animals had larger medullary volumes (nl / g body controls) than untrained controls (p<0.005) (YC= 4.6 ± 0.5; YE= 6.3 ± 0.3; OC= 4.1 ± 0.5; OE= 5.2 ± 0.9). Trained animals had higher medullary epinephrine content (ug) than untrained controls (p<0.005) (YC= 44.0 ± 9.6; YE= 53.1 ± 21.7; OC= 64.5 ± 2.3; OE= 80.1 ± 11.9). Young animals had larger total adrenal and cortical volumes (nl / g body controls) than old animals (p<0.001). The medulla accounted for a greater proportion of the total volume in the old as compared to the young animals (p<0.005) (YC= 7.82 ± 0.87%; YE= 7.52 ± 2.88%; OC=8.82 ± 1.62%; OE= 9.11 ± 1.96%). Old animals had higher levels of adrenal epinephrine and norepinephrine (ug / gland) than young animals. There were no differences in epinephrine or norepinephrine concentration (ug / ul medulla) based on either age or training. It was concluded that the training-induced increase in adren medullary epinephrine content is due to an increase in the size of the medulla, and not to a greater medullary epinephrine concentration. Further, that adrenal medullary volume and epinephrine content both increase with age. Similar responses to training occur in old as compared to young animals, but to a lesser extent.


The purpose of this study was to examine the interrelationships between Lactate Threshold (LT), Ventilatory Threshold (VT), and Heart Rate threshold (HRT) in children to determine if HRT can be used to identify VT and LT. Fifteen male children, 10-14 years of age served as subjects. Laboratory testing consisted of an incremental exercise test performed on a motor driven treadmill, designed to determine ventilatory threshold, lactate threshold, and heart rate threshold. A randomized three-way ANOVA was used to analyze whether the time or VO2 at which ventilatory, lactate, and heart rate thresholds occurred were significantly different. A Pearson product moment coefficient of correlation was also applied to determine the degree of relationship between the time and VO2 at LT, VT, and HRT. Results show that there were no significant differences between the time and VO2 at which HRT, LT, and VT were determined (p=.05). Correlational analyses revealed significant correlations between the time at which LT occurred and that at which VT occurred (r=.82), the time that LT occurred and that at which HRT occurred (r=.67), and the time at which VT occurred and that at which HRT occurred (r=.64). The correlations for the relative VO2 at which LT, VT, and HRT occurred were also significant, VO2 at LT and VO2 at VT (r=.94), VO2 at LT and VO2 at HRT (r=.95). VO2 at VT and VO2 at HRT (r=.93). On the basis of this data, it appears that HRT can be used as a means of estimating both VT and LT.

Sheehan, Laurieanne ACCURACY OF A TREADMILL SCORING SYSTEM FOR PREDICTION OF CORONARY ARTERY DISEASE IN FEMALE SUBJECTS, 1991. M.S., Texas Woman’s University (Charlotte F. Sanborn). (85pp 1 f $4.00) PH 1270

This study investigated the application of the Wasir et al. (1988) treadmill scoring system to predict coronary artery disease in a female population. Data was reviewed from RHD Memorial Medical Center. All subjects completed an exercise stress test and a coronary angiogram. A treadmill score was computed for each subject using the Wasir et al. (1988) equation. The statistical results revealed no significant relationship (p<0.05) between the treadmill scoring system and the presence and extent of coronary artery disease. By discriminant analysis, the only predictors of coronary artery disease in females were a history of myocardial infarction and the subjects age, which correctly classified 60% of the population. In conclusion, the Wasir et al. (1988) treadmill scoring system cannot be used to predict the presence or extent of coronary artery disease in women.

Shi, Xiaocai EFFECT OF SODIUM AND WATER INTAKE ON PLASMA ALDOSTERONE DURING PROLONGED EXERCISE IN WARM ENVIRONMENT, 1990. M.A., Ball State University (David L. Costill). (65pp 1 f $4.00) PH 1271

Eight well-trained male and female cyclists were studied to determine the effect of sodium and/or water intake on plasma aldosterone during six hours of cycling (55% VO2max) in a warm
Shuleva, Kathleen M. EXERCISE OXYGEN UPTAKE IN 3-THROUGH 6-YEAR-OLD CHILDREN, 1989. M.A., University of Alabama at Birmingham (Gary Hunter). (56pp 1 f $4.00) PH 1242

The purpose of this study was to compare submaximal and maximal oxygen uptake (VO_{max}) in children ages 3-4 and 5-6 years. Methods appropriate for this age group were developed to elicit maximal performances on the exercise tests. Subjects (N=22) performed progressive treadmill walking tests. The criteria used to determine whether VO_{max} was reached were a plateauing of oxygen uptake, HR>195 and an R>1.00. The VO_{max} for the 3- and 4-year-olds (44.5 ml·kg^{-1}·min^{-1}) was not significantly different from the 5- and 6-year olds (44.1 ml·kg^{-1}·min^{-1}). At submaximal levels 5- and 6-year olds had significantly lower relative oxygen uptake, indicating better economy in walking. A large proportion of children met testing criteria for VO_{max}. Test retest results indicated the tests were reliable.

Siemers, Beverly J. BONE DENSITY PATTERNS IN ADULT FEMALES WITH A HISTORY OF ANOREXIA NERVOSA, 1992. Ph.D., Texas Woman’s University (Barbara E. Gench). (207pp 3 f $12.00) PH 1333

The purpose of this study was to determine bone mineral density patterns in premenopausal adult females with a history of anorexia nervosa (n=20) and age-matched control females (n=20). Each subject was evaluated by dual energy x-ray absorptiometry (DEXA) to determine bone mineral density for the lumbar spine and whole body. Density data for specific subregions were derived from whole body data for descriptive purposes. Statistical analysis revealed significant differences between groups for lumbar (p<.001) and whole body (p<.001) density. Correlation analysis revealed a significant relationship between total body density and both body mass index (r=.512, p=.004) and lean body weight (r=.444, p=.004). Lumbar density was poorly correlated on the same two variables. Dietary variables failed to correlate significantly with either lumbar total body bone density.

Silvey, Carolyn M. INFLUENCE OF MENSTRUAL CYCLE PHASE AND ORAL CONTRACEPTIVE USE ON CARDIOVASCULAR REACTIVITY IN WOMEN WITH A PARENTAL HISTORY OF HYPERTENSION, 1991. M.S., Purdue University (Roseann M. Lyle). (85pp 1 f $4.00) PH 1243

The purpose of this study was to compare cardiovascular reactivity across the follicular and luteal phase of a regular menstrual cycle in oral contraceptive users (OC) and non oral contraceptive users (NOC) with a parental history of hypertension. In a subset of the sample, 24 hour ambulatory blood pressure and heart rate were compared to baseline blood pressure and heart rate, as well as cardiovascular reactivity to laboratory stressors. Twenty regularly cycling, normotensive women (18-41 years) with at least one hypertensive parent reported to the laboratory two times per phase for BP and HR measurements (once for baseline and once for the stress protocol in each phase). Trait anxiety was measured with a Cognitive and Somatic Anxiety Questionnaire during the first session, and State Anxiety was measured prior to each experimental session with a Subjective Units of Distress Scale. There were no differences between groups with respect to age, height, weight, trait or state anxiety. Although the NOC had lower BP and ER than OC during baseline measurements in both phases, differences did not reach significance. A repeated analysis of
variance revealed that systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) increased from baseline to stress conditions. Blood pressure response to isometric handgrip was greater than blood pressure response to the mental arithmetic task. There was no difference in heart rate response to the stress conditions. There were no differences in cardiovascular reactivity between or within groups across phases of the menstrual cycle. Both 24 hour average systolic and diastolic blood pressure were less than blood pressure during the isometric handgrip task, but only 24 hour average systolic blood pressure different than baseline. This study supports the hypothesis that cardiovascular reactivity does not vary across phases of the menstrual cycle in non oral contraceptive users and oral contraceptive users. Thus, it may be unnecessary to control for this factor in future psychophysiological investigations involving women.

Sim, James D. ALTERATIONS IN 72 KILODALTON STRESS PROTEIN LEVELS FOLLOWING ECCENTRICALLY BIASED EXERCISE, 1992 M.A., University of Western Ontario (Earl G. Noble). (157pp 2 f $8.00) PH 1334

A highly conserved group of stress inducible molecules, called stress proteins (sps) appears to be involved in many protein interactions within cells. Exercise stress can lead to an induction of the 72 kilodalton stress protein (sp72). This study was designed to determine the following during the post exercise period in rat skeletal muscle 1) the time of peak sp72 accumulation, 2) whether sp72 induction is greater following damaging eccentrically biased exercise, and 3) whether dantrolene sodium, a calcium antagonist, is capable of diminishing sp72 accumulation. Thirty-four male Sprague-Dawley rats were randomly allocated to one of five groups: sedentary (S), drug injected (D), sham injected (I), triceps medialis (TM) and tibialis anterior (TA) muscles were removed. Plasma was isolated and assayed for creatine kinase (CK) activity. Portions of Sol and TA were embedded and cross sectioned, then stained with hematoxylin and eosin and assessed for indices of muscle damage. All four muscles were homogenized, then proteins were separated by I-D SDS-PAGE, transferred to nitrocellulose membranes, and probed with an anti-sp72 monoclonal antibody. Elevations in CK activity were only evident in the E group (p<0.05), but values were not different from those of the L group. Histochemically observed damage was noted in Sol sections from E and L animals. Increased levels of sp72 were observed in Sol and VI of E and L animals, and in the TM of E animals only (p<0.05). Drug effects were unclear since the injection carrier alone appeared to attenuate measures of damage, and sp72 accumulation in one muscle. It is concluded that 1) sp72 accumulation peaks 48 hours after eccentrically biased exercise. This time course may be associated with muscle damage, 2) Damaging eccentrically biased exercise does produce greater sp72 accumulation than non biased exercise in certain muscles (TM). In general, sp72 induction correlated well with muscle damage 3) Any effects of the drug are unclear as it appears that the carrier interfered with the measures in this study. The carrier may have played a protective role in skeletal muscle.

Sipp, Tina L. EFFECT OF CHRONIC ETHANOL CONSUMPTION AND MODERATE INTENSITY ENDURANCE TRAINING ON MURINE PLASMA CORTICOSTERONE CONCENTRATION, 1992. M.S., Washington State University (Sally E. Blank). (87pp 1 f $4.00) PH 1244

Stress, manifested physiologically by increased plasma glucocorticoid concentration, is a known modulator of the immune response. Physical exercise and ethanol consumption are known physiological stressors and have been associated with immunosuppression in mice. To investigate the effects of chronic ethanol (20% w/v) consumption and moderate intensity endurance training on the physiological stress response, plasma corticosterone concentration (PC), the primary glucocorticoid in mice, was monitored in the present study. Female C57BL/6j mice (n=120) were assigned to one of four groups: sedentary, water drinking (SED-H2O, n=40); sedentary, ethanol-consuming (SED ETOH, n=40); trained, water-drinking (TR-H2O, n=20); and trained, ethanol-consuming (TR-ETOH, n=20). Mice ran on a treadmill at 12m/min, 8° incline, 60 min/day, 5 days/week for 10 weeks. The lights were on a 12 hour photo cycle going on at noon and off at midnight. Diurnal PC and blood ethanol concentration (BEC) were determined at weeks 1, 2, 6, and 10 from retro-orbital blood samples taken at 7 pm, 1 am, 7 am, 1 pm (pre-exercise), and 2:30 pm (post-exercise). Plasma corticosterone concentration was not chronically elevated in SED-ETOH, TR-ETOH or TR-H2O groups as compared to SED-H2O mice. However, PC was significantly increased immediately following exercise. Compared to pre-exercise values (451 ± 26 nM, x ± SEM) PC was four to five-fold greater immediately after exercise (1439 ± 93 nM) but similar to SED mice at recovery from exercise (697 ± 13 nM) PC was not correlated with BEC. These results indicate that over a 10 week period, chronic exercise and continuous ethanol intake did not impose a chronic stress effect and that training did not dampen exercise-induced increases in PC in previously sedentary mice.

Skroog, Ingrid A. EFFECTS OF VITAMIN B-6 SUPPLEMENTATION AND EXERCISE TO EXHAUSTION ON NITROGEN BALANCE, TOTAL URINARY NITROGEN & URINARY UREA IN TRAINED MALE CYCLISTS, 1994. M.S., Oregon State University (Anthony Wilcox). (147pp 2 f $8.00) PH 1363

The role of protein (amino acids) as a fuel substrate during prolonged activity has been actively debated for the last 100 years. More recently, the study of gluconeogenesis during endurance exercise has shed more light on alternative glucose or energy production pathways. The athlete who is better able to postpone glycogen depletion may have a competitive edge over his/her competitors. Conversely the individual who quickly becomes glycoligen depleted may fatigue, and terminate activity more rapidly. Our present investigation sought to explore three questions: 1) Will supplementation with vitamin B-6, in the form of pyridoxal 5'-phosphate (PLP), lead to a greater breakdown of muscle glycogen due to its role as a part of the glycogen phosphorylase enzyme; 2) will a more rapid time to exercise induced exhaustion be observed due to supplementation and exhaustive cycle ergometer testing; and 3) if the above two hypotheses are met, will we observe a corresponding increase in urea production by a product of gluconeogenesis as evaluated through nitrogen balance assessments? To test these hypotheses, six moderately trained adult male subjects were first tested maximally, using cycle ergometry. Two exhaustive exercise tests
were performed separated by 3 weeks; workloads were set to elicit heart rates of 64-75% of each subject’s maximal heart rate. The first (Test-1) exhaustive test was performed without supplementation with vitamin B-6 (Phase-1, US), the second (Test-2) following a 27 day supplementation with 20 mg/day oral vitamin B-6 capsules (Phase-3, S). All subjects followed a strictly controlled isocaloric metabolic diet that provided 62% carbohydrate, 17% protein and 21% fat. Journals included records of dietary compliance, activity level and general feelings of wellness were kept by the subjects and reviewed daily by the researchers. Subjects collected all urine in 24-hour time periods. Food composites and urine were analyzed in duplicate for urea nitrogen content. Total urinary and urinary urea nitrogen were obtained for each 8-day collection period surrounding each exhaustive exercise test, Days 1-6, prior to exercise testing and Day 7 and 8, post-exhaustive exercise testing. Based upon food composite analysis and nitrogen excretion, nitrogen balance was determined with estimates made for the lost plasma, sweat urea data, and other miscellaneous losses. No statistically significant differences were observed in time to exercise-induced exhaustion between Test-1 (US) and Test-2 (S). Mean time to exhaustion for Test-1 was 121.25 min. and Test-2 was 124.80 min. Dietary intake of protein was 1.88 gm/kg body weight/day, which is 235% of the current RDA. Therefore it was of no surprise that all subjects were in positive nitrogen balance (NBAL) during all days of both Diet Phase 1 (US) and 3 (S). There were no statistically significant differences observed between Dietary Phases 1 and 3 for days 3-8 pre-exercise collections for Urinary Urea Nitrogen (UUN) or Total Urinary Nitrogen (TUN). Additionally, no statistically significant changes in UUN excretion during the 24 or 48 hours post-exercise (Days 7 and 8) were observed between each treatment, however, a tendency towards an increased UUN excretion was observed for both days. Nitrogen balance did shift towards a less positive NBAL state during the 24 and 48 hour periods of recovery. We observed a statistically significant decrease in NBAL during Day 7 (US) (x=+2.27 gm/24hrs) and Day 7 (S) (x=+1.28 gmN/24hrs) (p<.005). Additionally, a statistically significant decrease in NBAL was observed between Day 8 (US): (+2.08 gmN/24hrs) and Day 8 (S): (+1.72 gmN/24hrs) (p<.005), equating a 188% decrease in positive nitrogen balance status (see Table 7a). Based upon these findings, there appears to be an increased UUN elimination post-exercise while supplemented with vitamin B-6. Additionally, as observed through changes in NBAL status, the most significant changes were those observed in the 48 hours post-exhaustive exercise. It is suggested that vitamin B-6, despite no significant changes in subject’s exercise duration, did perhaps increase the rate of muscle glycogen breakdown, therefore leading to a greater reliance on gluconeogenic production of glucose form amino acids. Furthermore, the observed NBAL changes were more pronounced during recovery due possibly to a depression in kidney function during Day 7, as glucose production from amino acids continued during initial recovery, and, an increased rate of glycogen re-synthesis post-exercise, Day 7 and 8. These findings concur with those researchers who have observed an increase in UUN following long duration exercise. Additionally, they are in agreement with data that indicate a high protein intake will result in positive nitrogen balance despite long duration exercise. Future research in this area may need to reduce total dietary protein intake and successfully analyze sweat and plasma as well as urinary urea concentration prior to, during, and after exercise. Employing more aggressive research methods, such as muscle biopsy for muscle glycogen content, utilizing amino acid tracers, monitoring plasma amino acid changes, and identifying tissue level shifts in amino acid concentration will help add vital information for elucidating the role of amino acids as an energy source for long duration activity.


The purpose of this study was to determine the effects of varying levels of muscular fatigue on absolute and relative leg power, and if level of leg strength differentially affected this response. Twelve college males were tested for maximum strength (1-repetition maximum [RM]) on the leg press station of the Universal Gym, for absolute power with the Modified Vertical Power Jump, and for relative power by the vertical jump. Subjects were separated into a high strength group (n=6) and into a low strength group (n=6) based on the 1-RM leg press. Fatigue levels were induced by lifting loads of 50, 70 or 90% of the 1-RM repeatedly until exhaustion followed immediately by a power test. The effect was to produce strength decrements of 50, 30, and 10% respectively. Both levels of power were also measured without fatigue preceding a test. Data were analyzed in terms of relative power (distance jumped in cm) and absolute power (work produced in the jump in Joules) by a 2 x 4 analysis of variance with two levels of strength and four levels of fatigue. Leg power decreased inversely to increases in fatigue. A 10% fatigue level decreased absolute power 22% and relative power 21%, a 30% fatigue level decreased absolute power 33% and relative power 32%, and a 50% fatigue level decreased absolute power 41% and relative power 39%. All fatigue levels differed significantly (p<.05) from the resting condition, the 50% from the 10% fatigue level but only for the absolute power. No differences (p>.05) in power were found between the two strength groups under all conditions. It was concluded that power is inversely and increasingly affected by fatigue regardless of initial strength level.

Starkey, David. THE EFFECT OF TRAINING VOLUME ON STRENGTH AND HYPERTROPHY OF THE QUADRICEPS AND HAMSTRING MUSCLES. 1994. M.S., University of Florida (Michael Pollock). (166pp 2 f $8.00) PH 1364

This study was conducted to determine the effects of high intensity resistance training on isometric torque, muscle thickness (MT), and fat thickness (FT) before and after 14 weeks of training 3 days/ wk using 1 set (low volume, G1, n=18) or 3 sets (high volume, G3, n=20) of exercise. Ten subjects acted as non training controls. Bilateral knee extension (KE)/flexion (KF) were performed to fatigue within 8-12 repetitions. Maximal isometric KE/KF torque was tested at 6, 24, 42, 60, 78, 96, and 108° of KE/KF torque was tested at 6, 24, 42, 60, 78, 96, and 108° of flexion and rehabilitation machine. The anterior (ANT), lateral (LAT), and posterior (POST) right thigh, at 20, 40, and 60% of the distance from the greater trochanter to the lateral epicondyle of the tibia were assessed for MT and FT with B-mode ultrasound (ULTRA). The same tester was used for all measurements and was not aware of group assignment or experimental design. Also assessed on the anterior face was the medialis (MDE) muscle (3 cm right of the 60% ANT mark) and the lateralis (LATER) muscle (3 cm left of the 40% ANT mark). Both training groups improved strength full range (p<.01); but there was no difference between G1 and G3 (p>.05). Peak torque increased in KE 15.1% in G1 and 14.8% in G3 (ps<.001), and in KE 13.9% in G1 and 16.2% in G3 (ps<.001). ULTRA detected increases (p<.01) in MT for G1 at 60% LAT, 40 and 60% POST. No significant decreases in fat were noted.
for Gl, G3 increased MT at the MED (p<.05), 40 and 60% POST (p<.01); increasing trends at 20 (p=.06), 40 (p=.08), and 60% (p<.10) LAT were noted. G3 decreased fat at 60% ANT (p<.05). When separated by gender, G3 females (n=9) decreased FT at 20% ANT (p<.01), and 60% ANT (p<.01), and increased MT at 40% ANT, MED, and 40% POST (p=.05). In conclusion, 1 set of high intensity resistance training is as effective as 3 sets for increasing KE/KF isotropic torque and MT and represents a more efficient use of training time.

Stopford, Jane L. EFFECTS OF CALORIC RESTRICTION AND RESISTIVE EXERCISE ON THE RESTING ENERGY EXPENDITURE OF WEIGHT-REDUCED OBESE WOMEN, 1992. Ph.D., Temple University (Zebulon V. Kendrick). (129pp 2 f $8.00) PH 1272

The purpose of this study was to investigate the effect of a six-week regimen of low caloric restriction and resistive exercise on the body composition and resting energy expenditure of obese women. Twenty-four subjects were randomly assigned to one of four groups: control, diet, exercise, and diet plus exercise. Prior to, after three weeks, and after six weeks of intervention, body composition and resting energy expenditure were measured by body density and oxygen consumption, respectively. Differences between groups for the dependent variables were analyzed by analysis of variance. The level of statistical significance was set at p<0.05. Body mass decreased significantly for the diet group (-4.0 kg) and the diet plus exercise group (-4.9 kg) compared with the control group (-2.2 kg) and the exercise group (2.4 kg). Percent body fat decreased significantly for the diet group (2.7%) and for the diet plus exercise group (4.0%) compared with the control group (-0.5%) and the exercise group (0.6%). Lean body mass increased for the exercise group (1.0 kg) and the control group (0.3 kg) compared with the diet group (-0.2 kg) and the diet plus exercise group (-0.3 kg). Resting energy expenditure significantly decreased in the diet group (-193 kcal/day) compared to the diet plus exercise group (-52 kcal/day), the control group (-8 kcal/day), and the exercise group (6 kcal/day). Significant increases in strength were found in both the exercise group and the diet plus exercise group for all exercises. The control group and the diet group had essentially no changes in strength for all exercises. There was no advantage to adding resistive exercise to a low calorie diet for either body mass loss or body composition changes. Adding resistive exercise to a low calorie diet prevented the decrease in resting energy expenditure associated with caloric restriction. A low calorie diet did not affect the strengthening response of muscle to resistive exercise.

Sun, Darlene O. OROCEAL TRANSIT DURING PROLONGED CALORIC RESTRICTION AND REFEEDING, 1993. Ph.D., Indiana University (Janet P. Wallace, Bruce J. Martin). (169pp 2 f $8.00) PH 1365

Eleven obese men and women who were free of gastrointestinal (GI) disease in the Bloomington Hospital Optifast Program served as subjects. All data was collected during Week Eight (7 weeks fasted), and Week 24 (6 weeks refed) of the Optifast Program. On each testing day following a eight hour fast, subjects ingested 30 gms of lactulose combined with the Optifast supplement. The hydrogen breath test (Bond and Levitt, 1975) was used to determine orocecal transit. B-hydroxybutyrate (B-HBA), free fatty acids (FFA), free tetradethylthorazine (T4), thyroid stimulating hormone (TSH), and cortisol were measured during the sample week. Caloric intake and exercise were monitored with 7-day food diaries and exercise logs. Subjects rated their perception of hunger using a rating scale of hunger intensity. A control group consisted of 11 obese subjects not enrolled in a weight loss program and variables were measured at similar intervals. The related hypotheses of this study were tested using a nonequivalent control group design with independent t-tests on gain scores (p<.05). No significant difference in orocecal transit (102 ± 68 min fasted, 82 ± 22 min refed) was found despite a 65% reduction in caloric intake of fasted Optifast patients (465 ± 85 vs. 1302 ± 251 kcal/day refed) with an associated ketosis (β-hBA=0.78 ± 0.57 Nm/l fasted, 0.23 ± 0.12 Nm/l refed) and similar energy expenditures. FFA, T4, TSH, cortisol and perception of hunger were not different between fasted and refed patients. Orocecal transit was not affected by caloric or nutrient intake. This suggests that functional GI adaptations are stimulated by other factors, which possibly include chronic exercise.

Van Duser, Bruce L. THE EFFECT OF ORAL SMOKELESS TOBACCO ON THE CARDIOVASCULAR AND METABOLIC RESPONSES IN HUMANS DURING REST AND EXERCISE, 1991. Ph.D., Texas A&M University (John M. Chevrette). (118pp 2 f $8.00) PH 1298

The purpose of this study was to examine the effects of oral smokeless tobacco (OST) usage on the cardiovascular and metabolic responses in young men during rest, moderate steady state, high intensity, and maximal exercise. Fifteen asymptomatic subjects were recruited from 18 to 33 year old male users of OST. Comparisons of the response of oxygen uptake (VO2), cardiac output (Q), heart rate (HR), stroke volume (SV), and blood lactate concentration (Lc) were made between a 2.5gm OST experimental condition and a placebo (P) condition during rest, 60% and 85% VO2 maximal treadmill exercise. Plasma nicotine (Nc) levels were determined by radioimmunoassay. Mean differences (±SD) between OST and P conditions are summarized on the following page.

<table>
<thead>
<tr>
<th>VO2</th>
<th>Q</th>
<th>HR</th>
<th>SV</th>
<th>Lc</th>
<th>Nc</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ml/kg/min)</td>
<td>(l/min)</td>
<td>(l/min)</td>
<td>(ml/beat)</td>
<td>(mmol/l)</td>
<td>(ng/ml)</td>
</tr>
<tr>
<td>60% %OST</td>
<td>35±4.9</td>
<td>14.4±2.4</td>
<td>164±14</td>
<td>118±13</td>
<td>2.6±0.8</td>
</tr>
<tr>
<td>60% P</td>
<td>35.7±3.2</td>
<td>18.6±1.4</td>
<td>154±13*</td>
<td>122±12</td>
<td>2.1±0.7*</td>
</tr>
<tr>
<td>85% %OST</td>
<td>42±5.6</td>
<td>21.0±2.1</td>
<td>177±12</td>
<td>129±15</td>
<td>2.8±0.9</td>
</tr>
<tr>
<td>85% P</td>
<td>42.1±5.7</td>
<td>21.5±2.0</td>
<td>171±14*</td>
<td>126±17</td>
<td>2.4±0.7*</td>
</tr>
</tbody>
</table>

* Indicates a significant difference between treatments with a P<0.05

Furthermore, there were no significant differences in maximal HR, Lc, and VO2 (p>0.05). In conclusion, these data indicate that the increased Nc levels incurred by OST usage increases anaerobic energy production and produces an increased tachycardic response to a given relative submaximal workload.

Veazey, Susan K. THE VALIDITY OF FIELD TESTS OF PHYSICAL WORK CAPACITY IN OLDER ADULTS, 1993. M.A., University of North Carolina at Chapel Hill (Barbara E. Ainsworth). (112pp 2 f $8.00) PH 1366

The purposes of this study were to measure the energy costs of the Sitting-Chair Step Test and the Modified Step Test in senior citizens and to develop prediction equations to estimate peak oxygen uptake (VO2 peak) using HR and RPE data from the submaximal tests. Data were analyzed in 28 subjects with a mean age of 70.1±6.1 years old. VO2 peak was measured by indirect
calorimetry using the Modified Balke Maximal Treadmill GXT. Among this sample, n=22 had complete data for the Modified Step Test and n=23 had complete data for the Sitting-Chair Step Test. Data were analyzed using linear regression and t-test analyses. In the Modified Step Test and in the Sitting-Chair Step Test, respectively, all four models with age, sex, and HR variables (R=0.54 to 0.59, p<.001) and (R=0.80 to 0.82, p<.001) and all four models with age, sex, and RPE variables (R=0.52 to 0.57, p<.001) and (R=0.58 to 0.65, p<.001) accounted for a significant amount of the variance in VO₂max. Regression formulas were developed in each subject to predict VO₂max from submaximal HR and RPE values predicted within 3 ml/kg/min of measured VO₂max values. These results suggest that the submaximal exercise tests are effective in predicting maximal PWC in older adults.

Veldhuis, Robert J. A FIVE-MILE MOUNTAIN BICYCLE TEST TO PREDICT VO₂MAX, 1993. M.S., University of Wisconsin-La Crosse (Nancy Kay Butts). (107pp 2 f $8.00) PH 1335

Although the sport of mountain biking has escalated dramatically in recent years, there is a dearth of research investigating the physiological demands of the sport. The purpose of this investigation was to establish a prediction equation to estimate VO₂max values using a 5-mile mountain bike time trial. VO₂max was determined in 33 healthy males (18-37 yrs), using an incremental cycle ergometer protocol (53.0 ml·kg⁻¹·min⁻¹). Throughout the VO₂max test, HR’s were recorded and expired air was analyzed using an automated open-circuit gas system each min. Each S performed a 5-mile time trial using their own bicycles on an Action 400, Polyurethane outdoor quarter mile track (average ride time=16.26). HR’s were monitored throughout the time trials. The independent variables entered into the regression analysis were: age, height, weight, body mass index (BMI), wind speed, yrs of riding experience, weekly mileage, HR during the last minute of the time trial, and ride time (RT). Using a standard stepwise regression analysis the following equation was developed:

\[ VO₂_{\text{max}} (\text{ml·kg}^{-1}·\text{min}^{-1}) = 122.05 - 0.7902 (\text{BMI}) - 3.05 (\text{RT}) \]

\( r=0.74; \text{SEE}=4.59 \)

The resulting equation provides a simple (time for 5-mile cycling test and Body Mass Index) field test for estimating VO₂max in male mountain bikers.

Wade, Michael E. EXERCISE AND BETA ADRENERGIC MODULATION OF CARDIAC MYOSIN ISOFORMS IN THE RAT HEART, 1993. M.S., University of Florida (Scott K. Powers). (40pp 1 f $4.00) PH 1367

Exercise-induced sympathetic stimulation and beta blockade are used to examine the role of sympathetic stimulation in regulating cardiac isomyosin shifts. Specifically, two hypotheses are tested: 1) exercise facilitates a V3 to V1 cardiac ventricular isoform shift in rats and beta blockade will retard this V3 to V1 isoform shift; and 2) sedentary rats treated with a beta blocking agent demonstrate an increase in V3 cardiac isoforms at the expense of V1. Male rats were divided into four groups: exercise-sham (ES), exercise-propranolol (EP), sedentary-sham (SS), and sedentary-propranolol (SP). EP animals received daily propranolol injections (IP, 30 mg propranolol/kg body wt) 30 minutes prior to exercise; SP rats also received daily propranolol injections. Both ES and SS receive daily sham injections (IP) of an isotonic saline solution. Exercise-trained animals performed treadmill running (5 days/wk) for six weeks. Analysis of native myosins using gel electrophoresis did not support the notion that exercise promotes a shift toward V1, however, beta blockade in both sedentary and exercise-trained rats did increase the V3 isoform. These experiments clearly demonstrate that beta stimulation plays a significant role in modulating cardiac myosin isoform expression.


The purpose of this study was to examine the differences in the physiological response of trained cyclists to three different cycling handlebar postures, where aero-dynamics was not a factor. The variables examined were oxygen consumption (VO₂), oxygen consumption per kg of body weight (VO₂/KG), metabolic rate (METS), respiratory exchange ratio (RER), tidal volume (VT), breathing frequency (f), pulmonary ventilation (VE), carbon dioxide production (VCO₂), heart rate (HR), blood pressure (BP), and rate of perceived exertion (RPE). The experimental population consisted of 7 male, well trained, competitive cyclists. The handlebar postures tested had the subjects (a) ride in a semi-erect position with hands on the top of traditional handlebars (tops), (b) ride with hands on the downturned portion of traditional handlebars in a deep forward lean position with upper body weight supported by the hands (drops), and (c) ride with elbows rested on aero handlebars in a deep forward lean position with upper body weight supported by the elbows (aero). With the order of testing postures randomly selected, subjects completed the same submaximal test in each of the experimental positions. Subjects rode their own bicycles on a wind load simulator. The test consisted of a 5 minute rest period, 5 minute warm-up, 20 minute work bout, and 5 minute cool-down. Data were analyzed for the 20 minute work bout, during which the subjects rode a 78.0 inch gear (53 x 18) at 90 rpm. A one-way analysis of variance (ANOVA) for repeated measures showed no significant difference among the three experimental handlebar positions. It was concluded that altering the upper body position of a cyclist does not significantly affect the metabolic requirements of cycling in an environment where wind is not a factor.

Wallick, Mark E. THE PHYSIOLOGIC RESPONSES TO IN-LINE ROLLER SKATING COMPARED TO TREADMILL RUNNING, 1991. M.S., University of Wisconsin-La Crosse (John P. Porcari). (58pp 1 f $4.00) PH 1336

The physiologic responses to in-line roller skating were compared to those during treadmill running in 16 males (18-37 yr) who actively participate in recreational aerobic activity. Each subject performed a VO₂max test during in line roller skating and treadmill running. Rollerblade® Lightning™ in-line roller skates were used during the in-line skating test. The results showed that VO₂max (L/min) and HRmax were significantly (p<0.05) different between modalities. VO₂max (L/min) was 26 L/min (5.7%) lower during in-line skating compared to treadmill running. No other maximal physiologic values were significantly (p>0.05) different. Linear regression was used to determine the VO₂/HR relationship for both modalities. Paired t-tests failed to show significant (p>0.05) differences in the slope and y-intercept between the lines. Skating between 11-13 mph corresponded to 60-75% VO₂max or 75-90% HRmax which are common training intensities and within the guidelines recommended by the American College of Sports Medicine. Across the speeds investigated, caloric expenditure was
9.5 19.0 kcal/min. Thus, in-line skating would appear to be another exercise alternative for improving aerobic capacity or maintaining body weight in most individuals.

Ward, Jeffrey J. EVALUATION OF THE SET-POINT AND PROPORTIONAL CONTROL MODELS OF HUMAN THERMOREGULATION DURING EXERCISE, 1990. Ph.D., University of Queensland (Brian Quigley). (261pp 3 f $12.00) PH 1274

Two experiments were undertaken. The first examined the Set-Point Model of thermoregulation which describes thermal control as analogous to a heating/cooling unit with a thermostat which is reset during exercise based on the relative exercise intensity. Eight male cyclists served as subjects. Oesophageal temperature (T_e) was monitored while subjects completed two workloads (50% 70% VO_2max) in air and then in water where the skin temperature (Tsk) and VO_2's from the air trials were produced. The tests were then repeated in reverse sequence to balance any ordering effect. Analysis of variance showed significant differences with T_e 0.63°C higher in air than in water at the 50% VO_2max workload and 1.15°C higher in air than in water at the 70% VO_2max workload. The data did not support the model of core temperature being regulated to an elevated level relative to exercise intensity. The second experiment investigated a Proportional Control Model by examining the relationship between the temperatures at the core and skin and the effector response of skin blood flow during exercise in water. Blood flow was calculated for 11 subjects from total body conductance using a regression formula developed for each subject from 3 or 4 different workloads in water. There was not a significant correlation between core temperature nor skin temperature and the change in total body conductance. Therefore the effector response of skin blood flow could not be described by a model where effector response is proportional to temperature elevation.

Warren, John R. EFFECTS OF NUTRITIONAL INTERVENTION ON BLOOD GLUCOSE LEVELS IN WOMEN (AGE 73-85), 1992. Ph.D., Indiana University (Robert B. Armstrong). (242pp 3 f $12.00) PH 1299

Twelve women in the age range of 73 to 85 (mean age 80.3) participated in the study. Data were collected over a three month period, using procedures that had been approved by the Indiana University Committee for the Protection of Human Subjects. Experimental design was based upon current knowledge of glycemic indices and the glycosylation theory of aging. The study applied the concept of glycemic indices to reduce the area under the glucose response curve by dietary modification. Each subject served as their own control. Subjects were asked to fast for 12 hours on two separate days. Early morning Fasting Blood Sugars were obtained. On the first morning, subjects were given a 50g loading dose of carbohydrates in the form of white bread, which was considered the standard or control. On the subsequent morning, subjects were given a 50g loading dose of carbohydrates in the form of fresh orange slices (experimental variable). Blood specimens were analyzed on 0.5 hr intervals for the first hour and on 1 hour intervals for the next 2 hours. Results indicate that the area under the glucose response curve for elderly women can be cut in half by using a low-glycemic index food such as orange (P<0.001 using the paired t-test). These results indicate that dietary intervention can help to normalize the age-related elevated glucose tolerance curve seen in older women.

Warren, Julie A. DOES VITAMIN E SUPPLEMENTATION ATTENUATE EXERCISE-INDUCED SKELETAL MUSCLE INJURY, 1991. M.A., University of Georgia (Nathan W. Shier). (97pp 1 f $4.00) PH 1245

The purpose of this study was to evaluate the effect of vitamin E on the attenuation of in situ muscle force and other indicators of skeletal muscle damage from exercise. Fifty Sprague-Dawley rats weighing an average of 100 grams were put on a normal (40 IU vitamin E/kg food) or supplemented (10,000 IU vitamin E/kg food) diet for a period of 5 weeks. Animals were then tested for loss of muscle function either immediately or 48 hours after a downhill walking protocol; sedentary animals were also tested, but did not exercise. Vitamin E levels were significantly elevated following supplementation, but the antioxidant was not able to prevent a loss of maximal isometric muscle force at 0 or 48 hours. Other results, including histology and quantification of phagocytic cell influx or CK efflux, also indicated that, although injury to muscle was occurring both immediately and 2 days after exercise, vitamin E was unable to lessen the effects of damaging eccentric contractions. KEY WORDS: Antioxidant, Eccentric Exercise, Peroxidation, Skeletal Muscle Damage, Tetanic Force, Vitamin E

Weyand, Peter G. PEAK OXYGEN DEFICIT AS A PREDICTOR OF SPRINT AND MIDDLE-DISTANCE TRACK PERFORMANCE, 1992. Ph.D., University of Georgia (Kirk J. Cureton). (136pp 2 f $8.00) PH 1275

The primary purpose of this study was to determine the value of the peak oxygen deficit as a predictor of sprint and middle-distance track performance. A secondary purpose was to determine the relative importance of the peak oxygen deficit, maximal oxygen uptake, running economy at 215 m·min⁻¹, and lactate threshold in predicting sprint and middle-distance track performance. Forty-one competitive runners, 22 males and 19 females, of different event specialities were tested for peak oxygen deficit, maximal oxygen uptake, lactate threshold (% of VO_2max), and running economy at 215 m·min⁻¹, during horizontal treadmill running. Subjects also completed performance trials at 100, 200, 400, 800, 1500, and 5000 meters. Zero-order correlations of the peak oxygen deficit with respective event performances of -0.66, -0.71, -0.71, -0.62, -0.52, and -0.40 were all statistically significant (p<0.05). First-order partial correlations, holding the effect of sex constant, were slightly lower and not statistically significant for the 1500 or 5000 meter trials. The distance-equivalent of the peak oxygen deficit, which incorporates the estimated transport cost of high speed running, was a significantly better predictor of 100, 200, and 400 meter performance than the peak oxygen deficit. Three multiple regression analyses were used to predict track event performance from metabolic variables (peak oxygen deficit, maximal oxygen uptake, lactate threshold, and running economy at 215 m·min⁻¹) alone, and in combination with sex and event specialty (sprinters vs. distance runners). In these analyses the peak oxygen deficit was the most important metabolic predictor of 100, 200, and 400 meter performance, and a significant predictor of 800 and 1500 meter performance. The strongest metabolic predictor of 800, 1500, and 5000 meter performance was maximal oxygen uptake. It was concluded that among a heterogeneous group of competitive runners: 1) the peak oxygen deficit is a moderately strong predictor of sprint and middle-distance track performance, 2) the peak oxygen deficit is the best metabolic predictor of sprint and middle-distance track performance.
days, trials and exercise level, 95% confidence intervals ranged from 1.91±1/min to 5.41±1/min. It may be concluded that assessment of Q via CO2 rebreathing is not valid at rest, however, during exercise, Q can be estimated when the protocol includes a sufficient number of days and trials.

Zhang, Qiang. GENDER DIFFERENCES IN PEAK BLOOD LACTATE CONCENTRATION AND BLOOD LACTATE REMOVAL FOLLOWING STRENUEOUS EXERCISE, 1991. M.S., Springfield College (Jacqueline L. Puhl). (178pp 2 f $8.00) PH 1246

The purpose of this study was to determine gender differences in peak blood lactate concentration and blood lactate removal rate following strenuous exercise. Seventeen untrained physically active male and 17 female college students aged 19 to 28 yrs participated in this investigation. The mean value of VO2max (ml·kg⁻¹·min⁻¹) in men was significantly (p<0.05) higher than in women (50.9 vs. 44.6). The estimated percent body fat in women was significantly (p<0.05) higher than in men (22.3% vs. 10.5%). After performing a VO2max test on a treadmill, the subjects sat on a chair for 5 min. The peak blood lactate sample was taken at the end of the 5th min. Thereafter, subjects performed an active recovery test at an intensity of 40% VO2max for 30 min. Blood samples were taken at the 5th, 10th, 15th, 20th, and 30th min. Two two-way (gender x sample times) analyses of variance (ANOVA) with repeated measures on one factor (lactate concentration, and removal rate) were used to analyze the data. There were no significant (p>0.05) differences in resting or peak blood lactate concentrations between men and women. The rate of blood lactate removal of the men and women was not significantly (p>0.05) different during the active recovery period. The fastest and the slowest lactate removal rates were observed between 5 to 10 min and 20 to 30 min respectively. At the end of the recovery period, almost 100% of lactate was removed from the blood. The average recovery heart rate was 73.5% of the subjects' maximal heart rate.

Zinker, Bradley A. MILDE IRON DEFICIENCY AND HORMONAL ALTERATIONS DURING REST AND EXHAUSTIVE EXERCISE, 1990. Ph.D., University of California at Berkeley (George A. Brooks). (189pp 2 f $8.00) PH 1247

Female weanling rats were placed on a mildly iron-deficient (15 mg Fe/kg diet; -Fe), or iron sufficient (50 mg Fe/kg diet; +Fe) diet and studied at rest and during exhaustive treadmill exercise. Plasma epinephrine (E), norepinephrine (NE), ACTH, corticosterone, insulin, and glucagon levels were similar in both groups. Succinate oxidase activity was decreased in all muscles by ~30-50%. Maximum oxygen consumption (VO2max) was decreased (22%).Time to exhaustion was decreased 45% (63 ± 5 vs. 116 ± 10 min). During exercise, euglycemia was maintained in both groups but blood lactate was elevated in -Fe. The glycogen utilization rate during exercise was increased in the liver (39%), soleus (100%), and superficial vastus medialis (100%) in -Fe. Liver and kidney PEPCK activities were increased similarly in both groups at exhaustion. There was a greater rate of rise in E (210%) and NE (290%) in -Fe during exercise, however, at exhaustion all hormones measured were similar. In conclusion, mild iron deficiency results in elevated gluconeogenic precursor (lactate) supply and normal PEPCK activity, and is associated with an augmented sympathetic response. These adaptations in mild iron deficiency are associated with a shift toward carbohydrate metabolism with accelerated muscle glycogenolysis and hepatic gluconeogenesis.
Sixteen female Ss (30-59) volunteered to walk at 3.0 mph, normal walk (NW), while performing arm movements to the shoulder level of excursion (SLE) and head level of excursion (HLE), with no weight (0-), 1 lb (1-), and 2 lb (2-) hand weights: 0-SLE, 1-SLE, 2-SLE, 0-HLE, 1-HLE, and 2-HLE, respectively. After successfully completing a practice session, the Ss randomly performed the exercises on 3 separate days with no more than 3 exercises per session. Exercise variables measured were HR, \( V_{o2} \), \( V_{c02} \) (L·min\(^{-1}\), ml·kg\(^{-1}\)·min\(^{-1}\)), METS, RER, RPE general, and RPE arms A one-way and two-way ANOVA with a Scheffe post hoc analysis indicated that walking with HEAVY HANDS (HH) sig (p<.05) increased HR, \( V_{o2} \), \( V_{c02} \) (L·min\(^{-1}\), ml·kg·min\(^{-1}\)), RPEg, RER and MET responses over the NW. HR responses sig (p<.05) increased from 86.5 NW to 119.3 (2-HLE), respectively. Sig (p<.05) RER values were found between weight and level of excursion for all variables except RPEg and RPEa. Sig (p<.05) increases were observed in VO2 for 0-lbs to 1-lb, and from 1-lb to 2-lbs. RPEg and RPEa responses did not sig (p<.05) differ from each other and accurately assessed increased workload. The findings indicate that hand weighted exercises could be used to assist in weight reduction programs. The MET levels obtained in this study were appropriate for persons with a 10 MET capacity or below. The HR response in 2-SLE, 1-HLE, and 2-HLE were sufficient to produce a training effect at or above 60% in the Ss tested using the age prediction formula: 220-age.

**RECREATION AND LEISURE**


The purpose of this study was to develop an interpretive program of nineteenth century American children's games and to examine the participants' knowledge and satisfaction attained as a result of participation in the program. The rationale for the development of this program was to allay the misconception that nineteenth century Americans had no time to involve themselves in leisure activities. A one and one-half hour program was developed and presented to elementary students, university students, and senior adults. The program consisted of three major components: 1) presentation of events which affected urban, rural, and native American nineteenth century games; 2) a demonstration of four games which were played by rural, urban, and native Americans' and 3) an opportunity for participants to play three of the games which were presented. Prior to implementation of the program, a pre-test was given to evaluate the participants' knowledge of nineteenth century children's games. A post presentation knowledge test was given to determine the amount of change in knowledge level. These two knowledge tests consisted of 11, true/false questions developed from the presentation material. After the presentation, each participant was asked to complete a revised version of the Physical Activity Satisfaction Scale (Hupp, in press), regarding their satisfaction with the interpretive program. This instrument was composed of 18 items which the participant rated on a five point Likert-type scale. The results of the study indicate the interpretive games program had a significant effect on knowledge gain of the participants in the elementary group. The college group knowledge scores approached significance at the .05 level. All groups evaluated in the interpretive program reported the experience was satisfying. Elementary females scored significantly higher satisfaction levels than did elementary males. Finally, there was a low, positive association found between program satisfaction and change in knowledge scores for the elementary subject group.


The problem was to identify and compare opinions concerning the computer competency skills graduates should possess upon completion of their baccalaureate degrees. Data were collected through the circulation of a mailed questionnaire. An overall response rate of 39.8% (n=342) was obtained. The analysis of variance (ANOVA) and t-TEST analyses were conducted to determine whether faculty and practitioners were statistically significant in agreement on the specific computer competency skills. Frequency data were obtained as to the brands of computer, types of computer software and types of instructional components.
available to baccalaureate students and public sector employees. Conclusions were that practitioner respondents are less in agreement than faculty respondents that specific computer competency skills are needed by baccalaureate students, practitioner respondent agencies have available IBM/IBM compatible computers more than Macintosh computers, and three fourths of NRPA/AALR COA accredited program faculty respondents indicated that their departments have an instructional component in general computing for baccalaureate students.


The purpose is to examine the theoretical relationship between visitors’ queuing time, crowding perception, and satisfaction. Based on this relationship, a computer simulation written with the simulation software SIMAN was used as a practical tool to make recommendations to park planners. The simulation model was used on the Yangmingshan National Park in Taiwan as a case study to provide recommendations for park managers. The findings of the case study showed a statistically significant relationship between crowding perception and queuing time. The relationship between queuing time and satisfaction is not clear. Visitors’ crowding perception and their satisfaction were statistically significant when the other variables were held constant. Visitors’ preference and personal demographics were found to be unrelated to their crowding perception or their satisfaction when controlling travel time. Five proposed projects were simulated to develop recommendations for park managers. A comparison of the results suggested decreasing the number of visitors on weekends by methods like limiting the number of visitors or distributing the visitors to weekdays would relieve the crowding perception of visitors. Other projects like decreasing the parking time, changing the location of one of the parking lots, increasing the number of parking lots and increasing the number of parking spaces had a simulated effect of causing increased road queues.


The relationships between recreational use level, user contacts, various impacts to the experience, and behavioral pattern adjustments are neither simple nor uniform. Understanding these relationships is fundamental, however, for managing the recreation experience. This study focused on peak boat use patterns and their effects on boating quality at Berlin Lake, Ohio during the summer of 1989. Emphasis was placed on indicators of boat use levels, contacts between users, boaters’ perceptions of and reactions to the boat densities they encountered, and general satisfaction with the boating experience. Operationalization of the displacement construct was additionally conducted toward this end. Further, the primary activity in which subjects were engaged was investigated for its potential influence on the relationships between variables. Boating activity on Berlin Lake was examined through periodic counts of vehicles and boat trailers parked at major access points on selected weekend days. Personal exit interviews were conducted with 642 boaters sampled at major boat ramps, campgrounds, marinas, and selected boat clubs on the lake to obtain user perceptions of their experience. In addition, mail questionnaires were completed by 224 private dock permit holders. Hypothesized direct and indirect relationships between study variables were tested utilizing the path analytic technique. Specifically, zero-order correlations were calculated, as were a series of linear regression equations representing the respective model paths. To address potential differences among primary activity subgroups for key study variables, one-way analyses of variance with post-hoc Scheffe tests were employed. Further, regression analyses and correlation coefficients were repeated for specific sub-groups based on primary boating activity. Results were consistent with principles established in previous research. First, the regression models lent support to the notion that overall satisfaction can be understood in terms of user evaluations of specific elements of the recreation experience. Secondly, the results echo findings of other studies showing that relationships between visitor density and satisfaction are mediated by a variety of factors. Thirdly, the strong intercorrelation of satisfaction with total displacement reflects the strong interaction of experiential affect and outcome measures. The actual behavioral modification may be judged as the stronger experiential indicator. While generally satisfied with conditions on Berlin Lake regardless of the number of boats at the lake, the subjects do indicate some dissatisfaction and behavioral modifications. Analyses revealed that boating quality, as measured by overall satisfaction, is to a large extent a function of various perceived impacts to the boating experience. In fact, within this study the pool of experiential impacts and measures of displacement accounted for 61 percent of the variance in satisfaction. Likewise, satisfaction was found to be highly and reciprocally impact measures of displacement. Total displacement may, in fact, serve as a more discriminating measure and managerial tool for understanding and evaluating recreational experiences. While previous research has focused upon determining experiential quality for a single user group, this effort clearly indicated that personal, situational and activity variables mediate the relationships between use level and indicators of a quality recreational experience.


This study examines both the historical relationship between religion and leisure as well as the current role of the church as a provider of recreation. The historical description was accomplished primarily by using secondary sources. Specific information was gathered in regard to the provision of recreation activities by churches in small Ontario communities. The data concerning the current role of churches in regard to leisure were collected through the use of a questionnaire which was mailed to 214 church leaders in 30 randomly selected towns (having a population between 2,000 and 15,000) throughout the province of Ontario. Religion and leisure have had a long standing relationship throughout the ages. The role of the church vis-a-vis recreation has, for the most part, been one of regulating leisure patterns and lifestyles. By the nineteenth century, the church began to realize that its attempts at curtailing society from engaging in recreation diversions were futile. It is at this time that religious denominations attempted to re-evaluate their attitudes and beliefs toward leisure. By the end of
the nineteenth century, the more liberal churches started to perceive themselves as providers of “wholesome” recreation pursuits for their church members. The twentieth century witnessed a proliferation of church recreation programs. However, faced with increased involvement of the public and commercial sectors in the provision of recreation and the decline of church attendance, leisure activities offered by the church decreased. Recently, there has been a resurgence of churches becoming actively involved in providing a variety of recreation activities for their church members, and when appropriate, for the whole community. Congregation members play a significant role in the provision of church recreation by offering most of the activities. Furthermore, churches seem to consciously plan and program their activities. The majority of churches co-operate with other organizations in providing their recreation programs, however, few have established formal and/or informal agreements with the recreation department of the community. It appears that church leaders view recreation in a positive manner and favour the church’s involvement in such activities. Several church leaders, however, did not necessarily view themselves as providers of recreation opportunities.


Ecotourism, as an alternative type of tourism, is seen as an effective manner with which to maintain natural areas and contribute economically at national and community levels. Little research is available concerning ecotourists and the characteristics/benefits associated with such travellers. This is an exploratory study that seeks to identify an ecotourist profile. In addition, benefits sought by ecotourists are uncovered through an analysis of both the natural resource base and the tour or service industry. Costa Rica, a small South American country, is known to possess a dynamic and growing ecotourism industry, and because of its benefits sought by ecotourists are uncovered through an analysis of the environment; session one: introduction to water safety and rafting equipment; session two: introduction to the strokes used in paddling, a review of water safety, and introduction to the environment of white water rafting; session three: review of water safety, review of the forward strokes, introduction to the backward stroke, and introduction to commands; session four: the environment; session five: practice of all skills and commands and a review of the environment. The river experience was a one-hour rafting trip on a class I to II rapids. There were two eight-person rafts in which the eight participants, six non-disabled adult volunteers, and two river guides were seated. Three types of data were collected: 1) performance of the skills involved in white water rafting, 2) assessment of decision-making capability, and 3) participant understanding of the risks involved. The instruments were specifically developed for this study. The performance of the eight participants as a group was analyzed by descriptive statistics, specifically percentages. Further, individual profiles of each of subject described their performance on each of the three assessments. It was found that adults with developmental disabilities can perform the skills involved in white water rafting, make many of the needed judgment decisions, and understand some of the risks involved in white water rafting.


The researcher’s theoretical model of the leisure activity selection process, incorporating “shapers,” “tuners,” and “attractors,” was preliminarily tested. The “attractor” effects of activity were operationalized through the development of an inventory based on activity analysis theory. This instrument (LCPI) was pilot tested for reliability and subsequent revisions made. Two samples were drawn for the study: one (N=83) was comprised of institutionalized persons undergoing psychiatric treatment; the other (N=95) was comprised of College students. To each sample, the LCPI and the Mirenda Leisure Interest Finder (MLIF) were coadministered. Interscale correlations between the inventories were computed across both samples. Subsequently, composite independent variables were built from item clusters across the LCPI sub-scales; Mirenda’s activity categories were considered the dependent variables. Stepwise multiple regression analyses were conducted to investigate the comparative predictive effects of the LCPI (representing interest in activity components) on the MLIF (representing interest in activity types) across the samples. Further

Gargasz, Kimberly L. PARTICIPATION IN WHITE WATER RAFTING INSTRUCTION BY ADULTS WITH DEVELOPMENTAL DISABILITIES, 1990. M.Ed., Bowling Green State University (Betty van der Smissen). (132pp 2 f $8.00) RC 473

Activities are often denied persons with disabilities alleging that they do not have the capacity to learn the necessary skills, make the needed judgment decisions, or understand the risks involved. This study was conducted to determine the capacity of adults who are developmentally disabled to participate in adventure activities, particularly white water rafting. The purpose of this study was to determine 1) the ability of adults who are developmentally disabled to develop and demonstrate the skills involved; 2) their capability to make needed judgment decisions; and 3) their understanding of the risks involved in white water rafting. The study was divided into two experiences, an instructional experience in the pool and a river experience. The instructional sessions were based on a five-step model of sequential activities. A panel of experts assisted in developing the specifics of each step and the development of the assessment instruments through analysis of a white water film and their experiential-wisdom. There were five sessions — session one: introduction to water safety and rafting equipment; session two: introduction to the strokes used in paddling, a review of water safety, and introduction to the environment of white water rafting; session three: review of water safety, review of the forward strokes, introduction to the backward stroke, and introduction to commands; session four: the environment; session five: practice of all skills and commands and a review of the environment. The river experience was a one-hour rafting trip on a class I to II rapids. There were two eight-person rafts in which the eight participants, six non-disabled adult volunteers, and two river guides were seated. Three types of data were collected: 1) performance of the skills involved in white water rafting, 2) assessment of decision-making capability, and 3) participant understanding of the risks involved. The instruments were specifically developed for this study. The performance of the eight participants as a group was analyzed by descriptive statistics, specifically percentages. Further, individual profiles of each of subject described their performance on each of the three assessments. It was found that adults with developmental disabilities can perform the skills involved in white water rafting, make many of the needed judgment decisions, and understand some of the risks involved in white water rafting.
regression analyses were conducted where the effects of gender, experience and the composite variables from the LCPI on MLIP outcome were examined. The two samples were found to act differently with respect to demonstrated predictive ability; data from the College sample were most predictive of activity interest. The LCPI composite variables, representing the “attractors” in the conceptual model, held up well against the “shaper” and “tuner” variables. Major conclusions were that 1) qualities or components of leisure activities are dynamically related to interests in activity types; 2) to a considerable extent, activity interests can be predicted by first knowing those activity components that are of interest; 3) this predictive ability differs across two samples where one represents persons with special needs.

Gruver, Bonita M. THE SOCIAL CONSTRUCTION OF LEISURE FOR WOMEN IN ACADEME: A GROUNDED THEORY OF MEANING; 1991. Re.D., Indiana University (David R. Austin). (145pp 2 f $8.00) RC 450

Event-diaries and multiple collaborative interviews were the techniques used to collect data for a purposive sample of nine women professors. Consistent with a contextual analytic framework, the event was the unit of analysis. A total of 491 events were qualitatively analyzed in accordance with the techniques recommended by Strauss (1987) for grounded theory studies. Of the 491 total events, 205 were classified as work, 170 as leisure, and 116 as either a combination or other. The grounded theory data analysis techniques included: open, axial, and selective coding; categorical construction; and theoretical memo writing. A constant comparative method of analysis was the technique used to construct the substantive theory. The concept consistently used to define leisure was, a priori choice. However, this concept was also describe autonomous work. The distinguishing factor was job-relationship, as low job relationship coupled with a priori choice facilitated the perception of leisure. A paradigm of leisure and work was constructed based on a perceived freedom of choice and constrained choice dichotomy, with low and high job-relationship being important factors. The paradigm depicts a model of how social contexts may facilitate the perception of a certain type of experience.

Gunning, Mary Jo. SURVEY OF AQUATIC PROGRAMS AND AQUATIC FACILITY ACCESSIBILITY FEATURES AVAILABLE TO AND UTILIZED BY PHYSICALLY HANDICAPPED STUDENTS AT FOUR-YEAR PENNSYLVANIA COLLEGES AND UNIVERSITIES, 1991. Ed.D., Temple University (Michael W. Jackson). (121pp 2 f $8.00) RC 459

The purpose of this study was to identify and examine aquatic programs and aquatic facility accessibility features available to and utilized by physically handicapped students at four-year Pennsylvania colleges and universities. Utilizing a self-designed questionnaire, the investigator surveyed aquatic administrators from 100 four-year Pennsylvania colleges and universities. Validity for the instrument was established via an acknowledged panel of six experts. Reliability was established via random selection with replacement of a sample of 10 institutions followed by an item analysis measure of agreement measure. Findings indicated that physically handicapped student enrollment represented less than 2% of the total institution enrollment. Less than 1% of physically handicapped students at public institutions and less than 10% at private institutions were participating in aquatic programs. In addition, none of the respondents met or exceeded the minimum requirements for aquatic accessibility. Conclusions of this study included: 1. Enrollment size was related to aquatic entry accessibility features available, physically handicapped participation in recreational aquatic programs, and adjunct areas accessibility features available. 2. Enrollment size was not related to aquatic programs available, physically handicapped participation in instructional aquatic programs, adaptive aquatic instructor’s qualifications, and aquatic depth, aquatic deck, and aquatic safety accessibility features available. 3. Institution type was related to aquatic programs available, entry aquatic accessibility features available, adaptive aquatic instructors qualifications, and adjunct area accessibility features available. 4. Institution type was not related to physically handicapped participation in recreational and instructional programs, and aquatic depth, aquatic deck, and aquatic safety accessibility features available.


The purpose of this study was to investigate the role marine debris, wind and wave conditions and unexpected events play in determining the satisfaction of recreational boaters in an estuarine environment. This study is based on the Expectancy Theory of Satisfaction which postulates that the recreationist enters into an activity with certain expected experiences and outcomes. The level of congruence between the expected experiences and outcomes and the perception of the actual experiences and outcomes determines the level of satisfaction. The study explored a number of potential impacts on recreational boater satisfaction on the Delaware Inland Bays during the summer of 1991. Boaters were surveyed using both on-site and mail surveys. The population studies included a total of 741 seasonal visitors (tourists), seasonal residents, and permanent residents of the Delaware Inland Bays environs. The existence of the marine debris was tested by asking respondents how often they observed various types of debris, while the existence of serendipity was tested by asking the boater if any unexpected events had taken place. Weather conditions were determined using U.S. Coast Guard data. Impacts on satisfaction were measured in two ways: first, on a single item Likert scale for each variable asking boaters how that variable impacted their enjoyment of the day’s trip; and secondly, through the creation of a Satisfaction Index composed of a number of statements concerning the overall boater experience. Additionally, a multiple regression was conducted testing the impacts of the study variables along with those used in other similar studies of boating satisfaction. This methodology is consistent with that of Graefe and Drogin (1989) and Drogin, Graefe and Titre (1990). Results indicated that marine debris, wind and waves and unexpected events did impact satisfaction. Greater amounts of debris observed lowered the overall satisfaction, though the impact varied depending upon resident type and activity participation. Wind and wave conditions impacted boaters in positive and negative ways depending upon the activity. Some boaters experienced unexpected events during their trip and the impact of those experiences tended to reduce satisfaction. In general, these findings tend to support Expectancy Theory, particularly in the case of serendipity. The multiple regression
analysis showed that wind and wave conditions and unexpected events do directly impact overall boater satisfaction, though the beta weights are small (-.27 for wind and waves and -.09 for unexpected events), indicating the impacts are small. Overall, the multiple regression produced an R2 of .40 which compares with R-squares of .44 and .42 in previous boating studies done by Graefe and Drogan and Drogan, Graefe and Titre. This study showed that wind and waves and unexpected events do directly impact boater satisfaction and that the existence of marine debris has a secondary influence. Additional study was recommended, particularly in situations where the same conditions can be perceived as increasing satisfaction for some users and decreasing satisfaction for others. The impacts of debris on tourists was seen to be relatively small.

Isogawa, Hiroaki. THE ECONOMIC EFFECTS OF GOVERNMENT ASSISTANCE IN COMMERCIAL RESORT DEVELOPMENT: A CASE STUDY OF FRENCH LICK, INDIANA, 1990. M.S., Purdue University (William F. Theobald). (116pp 2 f $8.00) RC 460

The economic effects of government assistance to a hotel in French Lick, Indiana, were assessed by a cost-benefit analysis. Four government assistance programs were recognized: the EDA/CDBG loans (financial incentives), the French Lick Municipal Airport (infrastructure provision), the Maple Street project (attraction provision), and the local Chamber’s activities (promotion). Documentary analysis and interviews were employed in order to determine cost and benefit items and the effects of these items. Cost-benefit analysis showed that the effects of the EDA/CDBG loans just reached a break-even point in 1989 though the town could not attain the primary objective (creation of new jobs) of the loan. Another cost-benefit analysis revealed that operation of the airport resulted in net loss in the year 1989. However, these assistance programs were justified in terms of effects when we consider other benefits such as secondary benefits of revolving loan funds (the EDA/CDBG loans) and reduced travel cost/time and emergency/recreation use (the airport). Two local promotional programs (the Maple Street Project and the local Chamber’s promotion) were recognized as potential forms of government assistance to the hotel though these programs did not cause tangible effects on the hotel. These government assistance programs revealed several administrative problems. It is suggested that government should consider four possible solutions of these problems: establishment of goals and objectives, commitment to programs, adoption of monitoring systems, and insertion of periodical reviews, in order to maximize benefit/cost ratios of assistance programs.


316 male recreational basketball players were selected to examine the causal relationships among leisure satisfaction and perceived freedom, intrinsic motivation, stimuli, competence, reciprocity, costs of participation, past participation frequency, and future participation intention. All subjects completed a self-administered questionnaire consisting of 29 statements and questions. Data for the study were collected during the months of August, September, and early October, 1992. Raw data were screened and described by a SAS program. Using LISREL, confirmatory factor analysis was made to test the measurements of latent variables. The proposed model was estimated and tested in LISREL following the design of double cross-validation. Some modifications were made for the proposed model based on analyzed results, theories, and realities. According to the findings, leisure satisfaction was found to be most influenced by immediate leisure experiences, such as perceived reciprocity, competence, and intrinsic motivation. Future participation intention was formed by past participation frequency, leisure satisfaction, and perceived freedom. Perceived competence was found to have significant influences on leisure satisfaction and intrinsic motivation, when both perceived stimuli and competence were above average levels. Long-term leisure styles and immediate leisure experiences may be distinguished in studying leisure behavior. Long-term leisure styles could be strengthened by good immediate leisure experiences.


The purpose of this study was to compare the leisure lifestyles of three developmentally disabled and three non-disabled older adults. Issues such as leisure needs and interests as well as the opportunities and barriers experienced by these participants were examined. This inductive, qualitative, exploratory study examined life satisfaction in relation to these people’s life experiences. As well, the results of this study aid in our understanding of the meaning of leisure through the participants’ experiences and perceptions. Data were collected by use of leisure journals and qualitative interviews with the six participants. Data were analyzed and three common patterns emerged from this analysis. These patterns were associated with the social networks of the participants and how these networks influenced their leisure, types of leisure activities engaged in, and choice and decision-making with respect to leisure. Themes also derived from the data, which aid in our understanding of the participants’ leisure experiences, were related to barriers to leisure and benefits of leisure. This study found that the two groups had differing leisure lifestyles. The differences were found to be influenced by the lack of social networks and lack of choice that the developmentally disabled older adults experience in their leisure. Recommendations resulting from this study include suggestions to encourage linking the developmentally disabled older adults with the community through ‘bridge-building’ efforts. As well, leisure education and the teaching of decision making skills to the developmentally disabled adults would help to enrich their leisure lifestyles.


The purpose of this study was to examine the effects of a four-day residential environmental education camp on the knowledge and attitudes of fifth graders towards the environment. The focus of the residential camp was teaching the participants about the environment through experiential education. The lessons stressed the interrelationships of the environment and adaptations of animals. A questionnaire was designed to measure changes in the