Southeast Chapter of the
AMERICAN COLLEGE
OF SPORTS MEDICINE
annual meeting

January 19-21, 1989
16th Annual Meeting
Atlanta, Georgia

CONFERENCE ABSTRACTS
Sixteenth Annual Meeting
SOUTHEAST REGIONAL CHAPTER
AMERICAN COLLEGE OF SPORTS MEDICINE

Hyatt Regency Ravinia, Atlanta, Georgia
January 19-21, 1989

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CONFERENCE ABSTRACTS
**SOUTHEAST CHAPTER OF THE AMERICAN COLLEGE OF SPORTS MEDICINE**

**1989 Annual Meeting Program**

**Hyatt Regency Ravinia, Atlanta, Georgia**

**Thursday, January 19**

3:00 - 4:30  **EXECUTIVE BOARD MEETING**  
Dogwood

4:30 - 7:00  **SPEAKER READY ROOM**  
Dogwood

4:30 - 7:45  **REGISTRATION**  
Foyer

7:45 - 9:00  **KEYNOTE ADDRESS**  
Barbara L. Drinkwater, Ph.D.  
Pacific Medical Center  
Maximizing Bone Mass In Premenopausal Years  
Regency Ballroom

**BUSINESS MEETING**  
Phil Sparling, President, SEACSM

9:00 -  
**SEACSM SOCIAL**  
Pre-Function

**Friday, January 20**

7:00 - 12:00  **REGISTRATION**  
Foyer

7:30 - 5:30  **SPEAKER READY ROOM**  
Dogwood

8:00 - 12:00  **POSTER PRESENTATIONS, Group 1 (#28 thru 40)**  
Authors present from 11:00 to 12:00  
Ashford

8:00 - 9:00  **TUTORIALS**  
Acute and Chronic Responses of the Denervated Transplanted Human Heart to Exercise. D.T. Badenhop, East Carolina University School of Medicine.  
Regency E -- Chair: Bob McMurray, U.N.C.
Curriculum Development for Corporate Fitness Degree Programs. H.P. DuVal, University of Georgia.

Regency F -- Chair: Don Franks, L.S.U.

Skeletal Muscle as a Site of Lactate Uptake. L.B. Gladden, University of Louisville.

Dunwoody A & B -- Chair: Scott Powers, U.F.

Body Image and "Yo-yo" Dieting. A. Timberlake, Takagi and Martin Women's Healthcare, Riverdale, GA.

Dunwoody C -- Chair: Dianne Ward, U.S.C.

8:00 - 9:00
FREE COMMUNICATIONS - Running
Regency G -- Chair: Steve Dodd, L.S.U.

(8:00-8:15)


(8:15-8:30)

Variations in Stride Length and Running Economy in Male Novice Runners Subsequent to a Seven Week Training Program. S.P. Bailey, University of South Carolina, and S.P. Messier, Wake Forest University.

(8:30-8:45)

Analysis of Ventilatory Anaerobic Threshold as a Limiting Factor in a Five Mile Performance Run. G.W. Miller, R.B. Kreider, M.H. Williams, T. Somma and T. Masser, Old Dominion University, Norfolk, VA.

(8:45-9:00)

Iron Status in Adult Male and Female Distance Runners. L. Klingshirn, R.R. Pate, C. Macera, W. Bartoll and C. Sientz, University of South Carolina.

9:00 - 9:15

BREAK - coffee & Julie

9:00 - 5:00

EXHIBITS: Visit throughout the day!
These exhibitors help support our meeting.

9:15 - 10:45

SYMPOSIAS

Amino Acid Needs In Athletes. R. Carson, S. Gropper, R. Keith, Auburn University.

Regency E -- Chair: Terry Bazzare, U.N.C.G.


Dunwoody A & B -- Chair: Joe Smith, U. Ala.
Affect and Exercise: Theory, Methods and Application. J. Rejeski, Wake Forest University, S. Boutcher, University of Virginia and C.J. Hardy, The University of North Carolina.
Dunwoody C -- Chair: Jerry Brandon, Ga. State

Regency F -- Chair: Jackie Hudson, UNC-G


10:45 - 11:00 BREAK - walk time/visit exhibits

11:00 - 12:00 TUTORIALS

Bone Mineral Content and Athletic Amenorrhea in Women Runners. E. Dowling, D.B. Snead and A. Weltman, University of Virginia.
Regency E -- Chair: Kirk Cureton, U. Tenn.


Ergogenic Aid Update: The Effects of Sodium Phosphate Supplementation on Performance. R.B. Kreider and G.W. Miller, Old Dominion University, Norfolk, VA.
Dunwoody C -- Chair: Mark Davis, U.S.C.

11:00 - 12:00 FREE COMMUNICATIONS - Skeletal Muscle
Regency F -- Chair: Allan Goldfarb, UNC-G

(11:00-11:15) Influence of Extracellular Calcium Influx on Skeletal Muscle Excitation-Contraction Coupling. J.H. Williams, Virginia Tech, and W.S. Barnes, Texas A&M University.


11:00 - 12:00 FREE COMMUNICATIONS -- Exercise Evaluation Regency G -- Chair: Jay Graves, U. Fla.


11:15-11:30 Physiological Comparison of a Recently Developed Velodyne Bicycle Ergometer and a Monark Ergometer. W.P. Bartoll, R. Attaway, J.M. Davis and R.R. Pate, University of South Carolina.


11:45-12:00 An Anaerobic Endurance Test for Athletics. K. Stuart, J. Nelson, S. Powers and A. Miller, Baton Rouge General Hospital and Louisiana State University.

12:00 - 1:15 LUNCH

2:15 - 5:30 POSTER PRESENTATIONS, Group 2 (#41 thru 54) Authors present from 3:45 to 4:45 Ashford

1:15 - 2:15 SEACSM SCHOLAR LECTURE

Hugh G. Welch, Ph.D.
University of Tennessee
"Trails and Trials in Hyperoxia"
Regency Ballroom

2:15 - 2:45 STUDENT MEETING Regency Ballroom -- Chair: David Pelzer, Auburn University

BREAK - walk time/visit exhibits

2:45 - 4:15 SYMPOSIA
Lexington Clinic Sports Medicine Center.
Regency F -- Chair: Dennis Wilson, Auburn

Substrate Utilization During Exercise
J.L. Durstine and J.M. Davis, the University of South Carolina and G.J. Kasperek, Ph.D.,
East Carolina University.
Regency E -- Chair: Janet Walberg, Va. Tech

Hand and Wrist Weights—Exercise Use and
Research Design Considerations. P.A. Bishop
and J.F. Smith, University of Alabama and
J.G. Graves, University of Florida.
Regency G -- Chair: Bob Moffatt, F.S.U.

Public Health Approaches for the Promotion
of Physical Activity in the United States.
C.J. Caspersen, Ph.D., M.P.H., G.W. Heath,
Dr. Sc., M.P.H. and E.L. Jones, Centers for
Disease Control, Atlanta, Georgia.
Dunwoody A & B -- Chair: Gay Israel, E.C.U.

4:15 - 4:30 BREAK - beverages/last chance to visit
exhibits.

4:30 - 5:30 SPECIAL TOPICS LECTURE
Lester Packer, Ph.D.
University of California, Berkeley
Oxidants and Antioxidants in Exercise
Regency Ballroom

5:30 - EXERCISE, DINNER, REUNIONS!
SEE AND ENJOY ATLANTA

Saturday, January 21
7:30 - 9:30 REGISTRATION
Foyer

7:30 - 11:00 SPEAKER READY ROOM
Dogwood

8:00 - 12:00 POSTER PRESENTATIONS, Group 3 (#55 thru 66)
Authors present from 11:00 to 12:00
Ashford

8:00 - 9:00 TUTORIALS
Application of Rehabilitative Videotapes in Outpatient Cardiac Programs. H.S. Miller and J.A. Te Winkle, Wake Forest University.

Dunwoody A & B - Chair: Dalyn Badenhop, ECU


Regency E - Chair: Robert Shapiro, U. Ky.

Fundamentals of Computerized Data Acquisition in the Human Performance Laboratory. B.A. McClenaghan, B. Bartoli and S. Bailey, University of South Carolina.

Dunwoody C - Chair: Richard Godsen, College of Charleston

8:00 - 9:00 FREE COMMUNICATIONS - Strength Training

Regency F - Chair: Mike Stone, A.S.U.


8:15 - 8:30


8:30 - 8:45


8:45 - 9:00

Ventricular Functional Dynamics Consequent to a Strength Training Program in Pre-pubescent Boys. F.J. Servedio and W.R. Thompson, University of Southern Mississippi.

8:00 - 9:00 FREE COMMUNICATIONS - Nutrition

Regency G - Chair: Bob Keith, Auburn

(8:00-8:15)


(8:15-8:30)

Carolina-Chapel Hill and Iowa State University.

**19**

(8:30-8:45)

(8:45-9:00)

**20**

9:00 - 9:15
BREAK - coffee & juice

9:15 - 10:45
SEACSM STUDENT SYMPOSIUM

Employment Possibilities Overseas,
G. Dennis Wilson, Ph.D., Auburn University

Regency EFG - Chair: David Pelzer, Auburn University

SYMPOSIA

Current and Future Trends in Cardiac Rehabilitation, W. Wheeler, C. Mayo and D. Badenhop, East Carolina University School of Medicine

Dunwoody C - Chair: Walter Thompson, U.S.M.

Sports Medicine: Past, Present, Future
K. Jago, Nichols Clinic; B. Woodfin, Atlanta Sports Medicine Clinic; G. Fletcher, Emory University; W. Taylor, Gulf Breeze, FL

Dunwoody A & B - Chair: Ken Jago, Atlanta

10:45 - 11:00
BREAK - walk time

11:00 - 12:00
TUTORIALS

Evaluating Patella Pain in Women Athletes.
L. Hunter-Griffin, Peachtree Orthopedic Clinic, Atlanta.

Dunwoody A & B - Chair: Mindy Millard-Stafford, Ga. Tech

Use of Ratings of Perceived Exertion in Research and Clinical Settings. D.S. Ward, University of South Carolina.

Regency E - Chair: Ron Bos, Va. Tech

Sexual Activity and Counseling in Cardiac Patients: A Review and Reassessment of the
11:00 - 12:00 FREE COMMUNICATIONS - Cardiovascular
Regency F - Chair: Lucille Smith, E.C.U.

11:00-11:15 Hemodynamics of Pregnant Women During
Immersion and Exercise. R.G. McMurray, M.J.
Berry and V.L. Katz, University of North
Carolina-Chapel Hill.

11:15-11:30 Central and Peripheral Circulatory Responses
During Four Different Recovery Positions. D.
Redondo, T. Boone, A. Donner and C.W. Cortes,
University of Southern Mississippi.

11:30-11:45 Central Circulatory and Thermoregulatory
Responses to Moderate Exercise During Heat
Stress. D.T. Lee and D.L. Spitzer, University
of North Carolina at Greensboro.

11:45-12:00 Effect of Mode of Training on Ankle
Peripheral Resistance Recovery Following
Submaximal Supine Exercise. P.D. Swan,
University of Tennessee, D.L. Spitzer,
University of Florida, P.M. Harragh and
M.K. Todd, University of North Carolina at
Greensboro.

11:00 - 12:00 FREE COMMUNICATIONS - Health and Fitness

11:00-11:15 Health-Related Behaviors as Predictors for
Future Health Status. L. Szymanski, M. Dowda,
R.R. Pate, S.N. Blair and H. Howe, University
of South Carolina.

11:15-11:30 Effects of an Eight Week Low Impact Aerobic
Dance Class on Adult Women. M. Barrett-Friend
and R.B. Kreider, Old Dominion University.

11:30-11:45 Effects of a 12 Wk Walking Program on
Selected Health Risk Factors in Mildly
Overweight Sedentary Females. D.F. Jarrell,
W. Bartoli and D.S. Ward, University of South
Carolina.

12:00 - 2:00 SEACSM LUNCHEON
Regency Ballroom

SEACSM LUNCHEON SPEAKER

Charles J. Dillman, Ph.D
2:00 - SEACSM EXECUTIVE BOARD MEETING
2:00 - HAVE A SAFE TRIP HOME
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STRIPE FREQUENCY AS A DETERMINANT OF THE VENTILATORY THRESHOLD
Health and Sport Science, Wake Forest University, Winston-Salem, NC
27109

Stride frequency has been shown to influence the ventilatory patterns of trained runners
when compared to untrained individuals. To examine the effects of these influences on the
ventilatory threshold (VT), fourteen males completed two maximal exercise bouts on a
motor-driven treadmill for the determination of the VT and the lactate threshold (LT). Seven
of the subjects were untrained individuals (UT) whereas the remaining seven were trained
runners (TR). Both exercise bouts consisted of linear increases in stride frequency with the
exception of one stage in each where there was a large non-linear increase. This increase
occurred early in one protocol (ESB), whereas it occurred mid-way to late in the other
protocol (LSB). The VO2 at which the LT occurred was not significantly different when
comparing the two protocols for either group. When comparing the VO2 at which the LT and
the VT occurred, there was a significant difference for the TR subjects when using the LSB
protocol. Correlation analysis revealed the VT during the LSB protocol with the TR subjects to
be tightly linked (r = 0.96) to the large non-linear increase in stride frequency. This
relationship was not present when TR subjects were tested using the ESB protocol, nor was it
present in the UT subjects with either protocol. In addition, no significant differences were
found in the VO2 at which the LT and the VT occurred when using the ESB protocol with the TR
subjects or when using either protocol with the UT subjects. Whereas there were no
significant differences, the correlations between the LT and the VT did not the measure the
use of the VT as a predictor of the LT. Results from this investigation demonstrate the influence of
stride frequency on the determination of the VT in certain subject populations and suggest that
the VT is not an accurate predictor of the LT.

VARIATIONS IN STRIDE LENGTH AND RUNNING ECONOMY IN MALE
NOVICE RUNNERS SUBSEQUENT TO A SEVEN WEEK TRAINING PROGRAM
S.P. Bailey, University of South Carolina, Columbia, SC
S. Messier, Wake Forest University, Winston-Salem, NC

The purposes of this investigation were to document the changes in stride length in college aged male novice
runners allowed to freely choose (FCSL) their stride length throughout a seven week training period (n=13), and to
capture the subsequent changes in running economy to those observed in a similar group that ran with a constant stride
length (CCL) equivalent to the stride length which they initially chose (n=13). Each subject completed a treadmill
running program consisting of 3 training bouts per week.
Each training bout consisted of a 5 minute warmup (60% iniital VO2 max) and a 15 minute run (80% initial VO2 max).
Absolute stride length (ASL), heart rate (HR), and RPEs were measured during the 12th and 20th minutes of exercise.
Submax VO2 was measured during the 4th and 22nd training bouts. Statistical analysis by way of two-way ANOVA revealed
no significant differences between the groups or across the weeks of training in percent changes in ASL at the 12th and
20th minutes of exercise; however, a significant group by
week interaction at the 20th minute of exercise was
revealed. Specifically, a significant difference (p<.05) was
revealed in the 4th week of training between the FCSL
(2.2%) and the CCL (6.0%) groups. No significant
differences were found between the groups in submax VO2.
Submax VO2 at the 12th minute of exercise was found to
decrease significantly following the training period in both
the FCSL (-2.3%) and CCL (-4.3%) groups. Significant
decrease in VO2 % is also apparent that after seven weeks of training the FCSL group
had yet to select a consistent stride length at which to train. Moreover, it is also apparent that the stride
length variations have little effect on submax VO2, HR, and
RPEs.
Regency G – Chair: Steve Dodd, L.S.U.

ANALYSIS OF VENTILATORY ANAEROBIC THRESHOLD AS A LIMITING FACTOR IN A FIVE MILE PERFORMANCE RUN

G.W. Miller, R.B. Kreider, M.H. Williams, T. Somma, and T. Masser
Human Performance Lab., Old Dominion University, Norfolk, VA 23529

Maximal oxygen uptake (\(\dot{V}O_2\)) and anaerobic threshold have been used as indicators of aerobic and endurance performance capacity. It has also been suggested that optimal aerobic efficiency occurs as an athlete performs slightly beneath anaerobic threshold. The purpose of this study was to determine if anaerobic threshold, as determined by ventilatory anaerobic threshold (VANT), is a limiting factor in 5-mile run performance. Seven male competitive runners (18-28 yrs) performed a maximal running stress test followed by a 5-mile treadmill performance run 3-days later. Respiratory data were collected using a SIM metabolic measurement system. Max data were graphed, coded and subjectively analyzed for VANT by two independent investigators using standard criteria. Results revealed a max \(\dot{V}O_2\) of 4.77±0.3 l/min\(^{-1}\) or 73.94±0.3 ml:kg\(^{-1}\)min\(^{-1}\) while VANT was calculated at 3.74±0.3 l/min\(^{-1}\). VANT represented 78.44±4.3 % of \(\dot{V}O_2\) max. Performance run data were as follows:

<table>
<thead>
<tr>
<th></th>
<th>(\dot{V}O_2) l/min(^{-1})</th>
<th>(\dot{V}O_2/\dot{V}O_2) max</th>
<th>Split Time</th>
<th>% (\dot{V}O_2) max</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.47</td>
<td>0.88</td>
<td>0.29</td>
<td>78.4</td>
</tr>
<tr>
<td>2</td>
<td>3.38</td>
<td>0.88</td>
<td>0.28</td>
<td>78.4</td>
</tr>
<tr>
<td>3</td>
<td>3.47</td>
<td>0.88</td>
<td>0.29</td>
<td>78.4</td>
</tr>
<tr>
<td>4</td>
<td>3.47</td>
<td>0.88</td>
<td>0.29</td>
<td>78.4</td>
</tr>
<tr>
<td>5</td>
<td>3.47</td>
<td>0.88</td>
<td>0.29</td>
<td>78.4</td>
</tr>
</tbody>
</table>

Results demonstrate that the athletes 1-mile \(\dot{V}O_2\) was well below VANT (72.79±6.3 % \(\dot{V}O_2\) max) and observed the fastest split time (5.26±0.23 min). Thereafter, \(\dot{V}O_2\) expressed as a percent of \(\dot{V}O_2\) max rose above calculated VANT (\(X\) +4.85%) suggesting that competitive runners can perform above VANT. However, split time increased during miles 2-4 indicating a decreased performance efficiency. In addition, post-run lactate was 5.34±2.2 mmol:1\(^{-1}\) demonstrating a significant contribution of anaerobic metabolism. These data suggest that in response to the increased anaerobic energy contribution the athletes slowed down in order to remove \(\dot{V}O_2\) and prevent further accumulation of lactate. This resulted in an increased metabolism of free fatty acids, an elevation in \(\dot{V}O_2\), and a decrease in work output during miles 2-4. In conclusion, performance efficiency decrease as VANT was exceeded in competitive runners.

IRON STATUS IN ADULT MALE AND FEMALE DISTANCE RUNNERS

L. Klingh?n, R.R. Pate, C. Macera, W. Bartoli, and C. Slentz. Human Performance Lab., University of South Carolina, Columbia, SC 29208

Adult male (N=119) and female (N=64) endurance runners were studied to examine the relationships among gender, habitual running mileage and iron status. Iron parameters measured included hemoglobin (Hb), hematocrit (Hct), serum iron (SI), total iron binding capacity (TIBC), percent saturation of transferrin (PSAT) and serum ferritin. Subjects were placed in groups according to gender and weekly running mileage (Gp 1: < 20 miles/wk; Gp 2: 21-40 miles/wk; Gp 3: > 40 miles/wk). In all running groups, males were significantly higher than females in Hb concentration and Hct. Within gender, the only difference between subgroups in these two parameters (Hb and Hct) was between Gp 2 and Gp 3 males in Hct (43.53 ± 4.44 vs 45.08 ± 6.92%). No inter-group differences were noted for SI, TIBC or PSAT. Ferritin levels were significantly higher in males than females in mileages 1 and 2. Interestingly, however, serum ferritin was not significantly different between Gp 3 men and women (59.70 ± 10.84 vs 42.13 ± 11.85 \(\mu g/L\)). The Gp 3 males also had a lower ferritin concentration than those in Gp 1 (59.70 ± 10.84 vs 94.04 ± 7.41 \(\mu g/L\)). It was concluded that, in general, adult male and female distance runners manifest normal iron status profiles but that higher mileage male runners show iron storage levels that are either those of lower mileage male runners and comparable to those of female runners.
FREE COMMUNICATIONS — SKELETAL MUSCLE

INFLUENCE OF EXTRACELLULAR CALCIUM INFLUX ON SKELETAL MUSCLE EXCITATION —
CONTRACTION COUPLING

J.H. Williams & W.S. Barnes, Division of HRPE, Virginia Tech
University, Blacksburg, VA 24061 & Human Performance Laboratories,
Texas A&M University, College Station, TX 77843

Recent work has shown that a depolarization-induced, inward calcium
current exists in frog skeletal muscle. The purpose of this investigation
was to determine if this current plays a major role in excitation —
contraction coupling under normal conditions. Sartorius muscles (60–75 mg)
from small male grassfrogs (Rana Pipiens) were mounted vertically, under
tension (2 gm) in a phosphate buffered normal Ringer’s solution (HR, pH
7.4, 25°C). Twitches were evoked every min. via platinum ring electrodes
placed at either end of the muscle. Following an 80 min equilibration
period, muscles were incubated for 20 min in HR. To inhibit the influx of
extracellular calcium, muscles were subsequently incubated for 20 min in
Ringer’s in which calcium was removed and replaced by magnesium and 1 mM
EDTA (Group Ia), calcium was removed with no divalent cation replacement
(Group Ib), or the calcium channel blockers D-600 (Group Ila) or diltiazem
(Group Iib) (SUM) were added. Muscles were then returned to HR for 20 min.
During each incubation period, twitches were again elicited every minute.
For Groups Ia and Ib, removal of extracellular calcium caused a slight
initial twitch potentiation which was followed by a small decline in peak
tension (PT). For Groups Iia and Iib, calcium channel antagonism also
caused a slight increase in PT. However, these small changes in PT were
not significant (p<0.05). Split-plot ANOVA revealed that PT, time to PT,
half-relaxation time and the peak rates of tension increase and decrease
were not significantly different between the three incubation periods
(p>0.05). These results provide indirect evidence supporting the notion
that under normal conditions, extracellular calcium has little if any role
in the excitation-contraction coupling process.

DISTRIBUTION OF MUSCLE BLOOD FLOW IN RATS DURING LADDERMILL CLIMBING.

Laboratory, The University of Georgia, Athens, GA 30602.

The purpose of this study was to assess the distribution of muscle blood flow (BF) in rats,
using radioactive microspheres, during high intensity (10 m.min⁻¹; VO₂=93
ml.kg⁻¹.min⁻¹) laddermill (LM) climbing, and to compare these flows with those
previously reported for rats running at comparable metabolic rates (60 m.min⁻¹) on the
level treadmill (TM; Laughlin & Armstrong, AJP 243: H296,1982). During LM climbing,
HR (b.min⁻¹) was 551±12 (x ± SE) and BP (torr) was 138±10, which corresponded to a
HR of 519±12 and a BP of 126±7 on the TM. These were not significantly different
(p>0.05). BFVs to the 7 thigh muscles and/or parts measured were not different between
the two modes of exercise; however, BFVs to ankle extensors (soleus, gastrocnemius white and
mixed portions) and flexor (tibialis anterior) muscles were higher (p<0.05) while
climbing when compared to BFVs on the TM at the same metabolic intensity. This BF
distribution followed the same pattern as that previously reported during LM climbing at a
moderate intensity (5 m.min⁻¹; Jones et al. MSSE 20(suppl.):512,1988). In the present
study the soleus muscle attained peak flows averaging 27% greater than the highest flows
previously reported during high speed (105 m.min⁻¹; VO₂ =125 ml.kg⁻¹.min⁻¹) TM
running (Armstrong & Laughlin, JAP 59:1322,1985). These results support the
hypothesis that blood flow is preferentially directed to the metabolically active tissues, and
suggest that peak flows measured during one type of exercise may not represent the highest
possible flows that a muscle or muscle part can attain during another type of exercise.

Supported by grants from NIH (BRSGS07RR07025-21) and AHA-GA Affiliate
Electrical activity and soreness in the quadriceps muscles were examined during a 48-hour period following eccentric (EC) and concentric contraction (CC). Electrical activity was determined by computing both root mean square (RMS) and mean power frequency (MPF) of the electrical myographical signal during low level contractions of the muscles. Recordings of muscle activity were made before-exercise (BE); immediate post-exercise (IPE); 1 hour, 12 hours, 24 hours and 48 hours post-exercise (PE) in 12 volunteer subjects, mean age = 28.5 years (range 25-35). Recordings were made with the leg being tested slightly off the ground. The exercise protocol included a step test performed for 15 minutes using a 46 cm step. Subjects were given a Subjective Pain Rating Scale (SPRS). The (BE) values for RMS (EC= 13.3mV; CC=13mV) and MPF (EC=55.3Hz; CC=54.4Hz) were

<table>
<thead>
<tr>
<th></th>
<th>IPE</th>
<th>1HR</th>
<th>12HR</th>
<th>24HR</th>
<th>48HR</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMS EC</td>
<td>17.1</td>
<td>7.3</td>
<td>17.2</td>
<td>7.6</td>
<td>15.0</td>
</tr>
<tr>
<td>MPF EC</td>
<td>55.4</td>
<td>5.8</td>
<td>55.6</td>
<td>5.4</td>
<td>54.4</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

The mean rating of soreness for the eccentrically exercised muscles ranged from slightly uncomfortable at 12 hours post-exercise to sore during the period of 24 to 48 hours PE. The concentrically exercised muscles were reported as possessing soreness ranging from normal to slightly uncomfortable during the whole recording period. Analysis revealed a significant (p<0.05) difference between EC and CC RMS values at 1HR PE and at 12HR PE. The results suggest that changes occur in the electrical activity of muscles following EC. However, muscle soreness did not occur at the time of greatest electrical change. No differences were found for MPF values. Changes due to fatigue and temperature may have masked changes in the MPF.

CREATINE KINASE, CREATINE KINASE-MM, AND THE ISOFORMS OF CREATINE KINASE-MM FOLLOWING A COMPETITIVE SWIMMING WORKOUT

Mark H. Bean, Hugh M. Neisler, Walter R. Thompson, Margot Hall, Tony Young, and John Prittington. Laboratory of Applied Physiology, University of Southern Mississippi, Hattiesburg, Mississippi 39406 and Northeast Louisiana University, Monroe, Louisiana 71209

Serum levels of total creatine kinase (CK), CK isoenzymes and the isoforms of CK-MM were measured in 16 male collegiate swimmers (X age = 19.3 ± 1.36 years). Venous blood samples were taken before and immediately following a 5500 yard competitive swimming workout. The main series in the workout consisted of a 24-minute, minimal rest interval set designed to obtain a moderately heavy effort. Total CK and CK-MM increased but not significantly from pre- to post-exercise. CK-MM3 (skeletal muscle tissue form) increased significantly (p<0.01) following exercise. CK-MM2 (intermediate form) increased but not significantly; CK-MM1 decreased but not significantly, following the swimming workout. Mean data are presented below:

<table>
<thead>
<tr>
<th></th>
<th>CK</th>
<th>CK-MM</th>
<th>CK-MM3</th>
<th>CK-MM2</th>
<th>CK-MM1</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre-exercise</td>
<td>234.94</td>
<td>230.88</td>
<td>23.50</td>
<td>63.75</td>
<td>144.81</td>
</tr>
<tr>
<td>post-exercise</td>
<td>260.13</td>
<td>259.56</td>
<td>43.50*</td>
<td>77.44</td>
<td>130.56</td>
</tr>
</tbody>
</table>

[Data presented in IU/L; * p<0.01]

These results indicate that the isoforms of CK-MM may be a more sensitive indicator of exercise-induced skeletal muscle enzyme release and an earlier detector of skeletal muscle membrane disruption.

This research was supported by Helena Laboratories, Beaumont, Texas.
FREE COMMUNICATIONS — EXERCISE EVALUATION

PREDICTION OF $\dot{V}_O_2$ USING A BICYCLE WIND-LOAD SIMULATOR

A number of devices known as wind-load simulators (WS) have been used to test cyclists in laboratory settings. No differences have been found between maximal $\dot{V}_O_2$ values measured when using a WS or a traditional bicycle ergometer (BE). While $\dot{V}_O_2$ estimation curves have been established and validated for exercise on BEs, equivalent curves have not been established for WS exercise. Forty subjects participated: 10 male trained cyclists, 10 male untrained cyclists, 10 female trained cyclists and 10 female untrained cyclists. A magnetic counter attached to a Findlay Road Machine (FRM) counted flywheel revolutions (FR). Subjects pedalled 3 min at each workrate. Exercise began at 141 FR/min and progressively increased by 50 FR/min until the subjects reached volitional fatigue. Research using a BE has found a linear relationship between workrate and $\dot{V}_O_2$. A curvilinear relationship was found between $\dot{V}_O_2$ and workrates on the WS; $\dot{V}_O_2$ (1/min) = 1.643 – 0.01283x + 0.000065x²; r=0.97; where x=FR). This curvilinear relationship is similar to the relationship observed between speed and $\dot{V}_O_2$ during road cycling. In the curvilinear regression model, FR accounted for 95% of the total variance in $\dot{V}_O_2$. Gender accounted for 2% of the variance beyond FR. However, when body surface area was considered, gender accounted for no additional variance. Significant (P<0.05) differences in $\dot{V}_O_2$ were found when subjects performed the same FR on 2 WSs. However, it was observed that different cyclists on the same WS did not result in different $\dot{V}_O_2$ values at the same FR. In conclusion: 1) $\dot{V}_O_2$ can be accurately estimated from FR; 2) similar $\dot{V}_O_2$ values are obtained at the same FR regardless of gender or state of training; 3) the WS allows subjects to be tested on their own bicycles; however, researchers must be careful when comparing data from different WSs.

PHYSIOLOGICAL COMPARISON OF A RECENTLY DEVELOPED VELODYNE BICYCLE ERGOMETER AND A MONARK ERGOMETER
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Laboratory testing on traditional bicycle ergometers can feel foreign and uncomfortable to trained athletes. In order to provide a more comfortable ergometer that could provide consistent and accurate work rates, the Velodyne ergometer was created. This new state-of-the-art instrument consists of a stand to which the front fork of the subjects own bicycle (minus the front wheel) is attached and an electrically braked roller which provides the resistance on which the rear tire rests. A selected power output is maintained regardless of pedal speed or gear ratio. The purpose of this study was to compare oxygen consumption ($\dot{V}_O_2$), heart rate (HR) and perceived exertion (RPE) during both maximal and submaximal exercise tests on a Velodyne (V) and Monark (M) ergometer. The Monark was modified with a racing saddle, toe clips, and dropped handlebars. METHODS: Six trained male cyclists performed one $\dot{V}_O_2$max test on both ergometers and two submax tests on each of three identical Velodynes and a Monark. During each of the submax tests, subjects rode at 90 rpm's for 10 min at 125, 175, and 225 W. The order of the tests were counterbalanced. Both ergometers were calibrated according to the manufacturers instructions. $\dot{V}_O_2$, HR, and RPE were measured twice (6 and 9 mins) at each workload. Date were analyzed via repeated measures ANOVA. RESULTS: No differences were found in maximal HR (V = 186 ± 2, M = 186 ± 2 b/min²; X ± SEM), $\dot{V}_O_2$(V = 4.35 ± 0.18, M = 4.28 ± 0.18 L/min’) or time to exhaustion (V = 10.6 ± 0.5, M = 10.3 ± 0.4 min). No differences were also found for $\dot{V}_O_2$, HR or RPE between trials or between ergometers at any of the submax workloads. The results indicate that the Velodyne represents a viable alternative to the Monark ergometer for at least short duration (30 mins or less) exercise tests in the laboratory.
Regency G — Chair: Jay Graves, U. Fla.

PHYSIOLOGICAL RESPONSES DURING MAXIMAL TETHERED SWIMMING, CYCLING ERGO-
METRY, AND TREADMILL RUNNING IN MALE TRIATHLETES.
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CA 30332

The purpose of this study was to compare physiological responses of
highly-trained amateur triathletes during maximal swimming, cycling, and
running exercise. Twelve males, aged 25-36, completed maximal tethered
swimming (TS), cycle ergometer (CE), and treadmill (TM) tests. Expired
air was measured continuously during TM, CE and during the last minute of
each workload during TS. Heart rate was measured from EOG tracings during
TM and CE, and from a Uniq CIC 8799 monitor during TS. Blood lactate
concentration (HLa) was determined with a YSI model 23L analyzer. The fol-
lowing mean (±SD) physiological responses were obtained:

<table>
<thead>
<tr>
<th></th>
<th>TM</th>
<th>CE</th>
<th>TS</th>
</tr>
</thead>
<tbody>
<tr>
<td>VE (l/min)</td>
<td>144.2 ± 14.8</td>
<td>148.6 ± 20.7</td>
<td>123.7 ± 22.9*</td>
</tr>
<tr>
<td>VO2max (l/min)</td>
<td>4.9 ± 0.4</td>
<td>4.6 ± 0.4**</td>
<td>4.3 ± 0.5**</td>
</tr>
<tr>
<td>VO2max (ml/kg/min)</td>
<td>67.0 ± 3.8</td>
<td>62.9 ± 3.5**</td>
<td>59.4 ± 4.1*</td>
</tr>
<tr>
<td>HLa max (bts/min)</td>
<td>183.7 ± 9.4</td>
<td>177.1 ± 6.5</td>
<td>162.0 ± 7.5</td>
</tr>
<tr>
<td>HLa max (mmol/L)</td>
<td>6.9 ± 0.9</td>
<td>7.8 ± 1.4</td>
<td>8.0 ± 1.5</td>
</tr>
<tr>
<td>Rmax</td>
<td>1.09 ± 0.4</td>
<td>1.13 ± 0.4</td>
<td>0.96 ± 0.7*</td>
</tr>
</tbody>
</table>

[TS < CE and TS; **CE < TM; ***TS < TM; (significant at p < .05)]

Significant differences were observed in all physiological responses
except HLa. Mean VO2max during CE was 94% of the TM value, which
is greater than values typically found for non-cyclists, but less than that
of elite cyclists. Mean VO2max during TS was 89% of the TM value, which,
again, is greater than recreational swimmers, but less than that of elite
swimmers. These data suggest that amateur triathletes, who are comparably
trained in swimming, cycling, and running, exhibit differences in maximal
physiological responses. Therefore, establishing optimal training inten-
sity based on VO2max or heart rate is dependent on the specific mode.

AN ANAEROBIC ENDURANCE TEST FOR ATHLETICS
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Heretofore, participants in football and other sports which
require energy provision through anaerobic means have often been
evaluated for endurance by field tests that are primarily
aerobic. This study offers a more sport-specific assessment of
anaerobic endurance. Professional football players (N=120; 65
veterans and 67 rookies/free agents) were tested on 10
consecutive 40-yard dashes at maximal effort, with a 20 second
recovery interval between trials. Analysis of the data revealed
a linear decrement over the 10 trials. Velocities of the last 3
trials (X) were divided by first 3 trials (X) and expressed as
percent anaerobic endurance (ZAE). The first Quartile, median
and third quartile values for the total group were 85%, 88% and
91%, respectively. Backs were found to have the highest ZAE.
Maximum speed (4.86 vs 4.96s) and ZAE (89.7% vs 96.9%) of the
veterans were significantly higher than rookies/free agents. The
test protocol was reliable. When systematic trial differences
were excluded, intraclass R=.96; and R=.87 when trials were
included. Data on 39 players were analyzed over a 2 year period.
An R of .83 for the 2 years indicated considerable stability in
the anaerobic endurance measure. These data indicate that the
repeated-dash test is a reliable, functional assessment of
anaerobic endurance in athletics.
EFFECT OF RESISTANCE TRAINING ON LUMBAR EXTENSION STRENGTH

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Development of a new testing machine, which stabilizes the pelvis, allowed us to evaluate the trainability of the lumbar (LB) extensor (EXT) muscles. Fifteen healthy subjects (29.1 ± 8 yr) trained (TR) 1x/wk for 10 wks and 10 healthy subjects (33.7 ± 16 yr) acted as controls (C). Training consisted of 6-15 repetitions of full range of motion variable resistance LB EXT exercise to volitional fatigue. Prior to and after the 10 wk training period, subjects completed a maximal isometric strength test at 7 angles through 72 degrees (0, 12, 24, 36, 48, 60, 72) of LB EXT. The TR group improved in LB EXT strength at all angles (p<0.01) (figure). The result at 0 degrees (EXT) showed an increase from 180.0 ± 25 to 364.1 ± 443 N-m (+102%) and at 72 degrees (FLEX) from 431.4 ± 44.1 to 609.8 ± 68 N-m (+42%). Results from the C group showed no change (p>0.05) (figure). The magnitude of gain shown by the TR group reflects the low initial strength of the LB EXT muscles. These data indicate that when the LB area is isolated through pelvic stabilization the LB EXT muscles show a large potential for strength increase.

EFFECT OF AEROBIC AND VARIABLE RESISTANCE EXERCISE TRAINING ON STRENGTH AND BODY COMPOSITION OF MEN AND WOMEN 70-79 YRS OF AGE

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To evaluate the effect of aerobic and variable resistance exercise training on strength and body composition of the elderly, 49 healthy, untrained men (n=23) and women (n=26), 72.0 (±2.3) yrs of age, were randomly placed into one of three groups; walk/jog (W/J) (n=17), strength (STR) (n=20), or control (n=12). The W/J and STR groups trained 3X/wk for 6 months. The W/J group started training at 59% of maximal heart rate reserve (HRmax) for 40 min and progressed to 75-85% of HRmax by week 15. The STR group completed 1 set of 10 to 12 repetitions to volitional fatigue on 10 Nautilus® F M machines. Measurements included aerobic capacity (VO2max), chest press and knee extension strength, body weight, 7 skinfolds, and 6 girth measures. Analysis of covariance revealed that the control group did not change (p>0.05) for any of the measured variables. The W/J group increased VO2max (22.5 to 27.1 ml/kg/min), reduced predicted % fat (29.0 to 27.5%), sum of 7 skinfolds (152.3 to 139.8 mm), shoulder girth (105.6 to 103.5 cm), and waist girth (93.5 to 91.4 cm), and did not change in strength. The STR group increased chest press strength (38.6 to 46.9 kgs), knee extension strength (52.0 to 59.0 kgs), and biceps girth (31.1 to 31.6 cm), reduced predicted % fat (29.4 to 28.1%), sum of 7 skinfolds (158.4 to 148.2 mm), and waist girth (96.1 to 94.5 cm), and did not change in VO2max. These data support the concept of specificity of training and the need for a well-rounded program to develop strength and aerobic capacity. Both strength and aerobic training can elicit favorable changes in body composition of healthy men and women 70 to 79 yrs of age.
REGENCY F — CHAIR: MIKE STONE, A.S.U. •

DECREASED EFFECTS OF RESISTANCE EXERCISE ON PLASMA VOLUME SHIFTS
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Ten male subjects were studied before and after 90 minutes of resistance exercise to determine the acute and delayed effects of both high volume (HV) and low volume (LV) regimens on alterations in plasma volume (PV). The HV exercise bout involved performance of 8-12 RM loads with 60 second rest intervals between sets, while LV exercise involved the use of 2-5 RM loads with 3-4 minute rest intervals between sets. Fasting blood samples were drawn from an antecubital vein immediately before and after exercise as well as 24, 48, and 72 hours post-exercise. When compared to baseline values, only HV resistance exercise elicited a significant (p < 0.05) decrease in PV (hemocencentration) immediately post-exercise (8.7%) followed by a PV expansion (hemodilution) 24 hours (7.4%) and 48 hours (6.0%) post-exercise. The changes induced by the LV regimen, while in the same direction, were not sufficient magnitude to be significant. These data illustrate the variable influence of resistance exercise on plasma volume and suggest that the immediate hemocencentration accompanying such exercise is followed by a rebound hemodilution which may last up to 48 hours. Consideration of shifts in plasma volume is of particular importance when dissociating the effects induced by exercise on plasma constituents from those induced by changes in relative concentration.

Supported by a grant from the FSU Foundation

VENTRICULAR FUNCTIONAL DYNAMICS CONSEQUENTIAL TO A STRENGTH TRAINING PROGRAM IN PRE-PUBESCENT BOYS
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The purpose of this study was to determine the effects of an eight week strength training program on ventricular dimensions and inotropic state using healthy pre-pubescent boys. Twelve male subjects (age = 11.5±0.4 yr, ht = 148±3.1 cm, wt = 39.8±4.7 kg) participated in this study. Two groups, training and control, were established and subjects were matched for body surface area (1.28±0.07 m²) and Tanner level of sexual maturity (1.5±0.6). All subjects had resting echocardiograms for the determination of baseline data prior to participation in this study. The six subjects assigned to the training group performed six to eight sets of two to four repetitions (Olympic style weightlifting exercises) with weights ranging from 30% to 80% of their one repetition maximum (1RM) for eight weeks. These subjects were members of a local weightlifting club and followed the training protocol designed by their coach. Periodic evaluation of 1RM allowed for increases in the training work level. The remaining six subjects served as a control group and were urged not to deviate from their normal activities of daily living. After completing eight weeks of training, posttest echocardiograms were conducted on both groups. Significant increases (p<0.05) in the internal diameters of both left and right ventricular dimensions at end-diastole but not at end-systole were evident. These dimensional changes increased stroke volume and cardiac output significantly (p<0.05). Measures of the inotropic state, however, demonstrated no significant changes. Results from this study indicate that weight training in children may increase the internal dimension of the left and right ventricles at end-diastole, thereby increasing stroke volume and cardiac output, without altering the inotropic state.
MAINTAINING BLOOD GLUCOSE AND PROTEIN STATUS DURING A THREE DAY, 1500 MILE CYCLING RELAY RACE.

Nine trained male cyclists (x±S.E.: age=27.0±1.7 yr, ht=179.5±2.1 cm, wt=72.1±2.4 kg, and % body fat=11.5±1.6) completed a 1500 mile relay race (300 miles per cyclist; 100 miles per day). The cyclists rode in pairs for approximately one hour then rested in a support vehicle for five hours, while the next pair of riders did the same. A modified liquid diet (76% carb, 10% protein, and 14% fat) was developed for the cyclists in order to 1) prevent dehydration; 2) maintain energy needs; 3) provide a complete/balanced diet; 4) supply optimal amounts of carbohydrate and hence, blood glucose; and, 5) satisfy the cultural food needs of these athletes. This study was designed to examine the effectiveness of the recommended diet in maintaining blood glucose above fasted levels while providing enough kcals and protein for maintaining protein status. Markers of protein status used in this study were 24-hour urine concentrations of hydroxyproline and creatinine. Blood samples were taken after a 12 hr. fast, and at 20, 100, 200, and 300 miles for each cyclist. Mean blood glucose levels never fell below the mean fasted values (3.9±0.1mmol/l), and at 0 and 200 miles of collection periods were significantly higher (p<0.05). Mean urinary hydroxyproline and creatinine values were significantly lower (p<0.05) during the three day event when compared to the three day period before the event. The cyclists in general felt that the modified liquid diet was of benefit, primarily because it was easy to prepare, transport, consume, and was well tolerated. Although blood glucose levels were favorably maintained, the protein status of these cyclists may have been compromised due to inadequate protein intake.

Supported in part by Ross Laboratories.

RESTING HORMONAL CHANGES DURING INTENSIVE TRAINING: EFFECTS OF A DIETARY PROTEIN SUPPLEMENT
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Resting hormonal changes were compared in males using a protein supplement (PS = 0.8 g·kg⁻¹·day⁻¹, n=8) or a comparable amount of carbohydrate supplement (CS; n=7) during intensive training. Both groups trained using interval (4 day·wk⁻¹, 90 min·day⁻¹, 75-200% VO₂max) and continuous (1 day·wk⁻¹, 90 min·day⁻¹, 65% VO₂max) cycle ergometry exercise. Serum was collected at 2 week intervals (following 2 days rest) and analyzed for testosterone (T), luteinizing hormone (LH), follicle stimulating hormone (FSH), growth hormone (GH), prolactin (PRL), and cortisol (C). Both groups had decreased (p<0.05) T at 4 and 6 weeks; however, CS levels (X(SE)) were lower than PS (4 wk, CS=5.0±0.7 vs PS=7.2±1.0 ng·ml⁻¹, p=0.08; 6 wk, CS=5.2±0.5 vs PS=6.5±0.3 ng·ml⁻¹, p=0.04). GH levels gradually increased in both group during the training, with group difference being greatest at week 4 (PS=6.7±2.4, CS=5.7±0.2, ng·ml⁻¹; p=0.07) and week 6 (PS=6.0±0.5, CS=5.5±0.5, ng·ml⁻¹; p=0.05). PRL was increased at weeks 2-6 in both groups (week 4 greater than pre levels for both groups, p=0.01), but no between group differences were observed. C levels were slightly elevated at week 2 in both groups but no between group differences were observed. Each group displayed large variability in LH and FSH throughout the study, but no significant changes occurred.

These findings suggest dietary protein supplementation during intensive training may result in enhanced levels of anabolic hormones, but has little effect on "stress hormone" responses.
Dissociation of the lactate and ventilatory thresholds with caffeine ingestion


Caffeine consumption prior to the start of an exercise bout has been shown to have an effect on both the ventilatory parameters and substrate utilization during the exercise bout. Additionally, changes in either substrate utilization or ventilatory parameters may influence the lactate threshold (LT) and/or the ventilatory threshold (VT). It was the purpose of this investigation to determine the effects of caffeine ingestion on both the LT and the VT. Ten male subjects completed two maximal exercise bouts on the treadmill. A single blind experimental procedure was followed with one trial being performed 30 min after the subject ingested 4.7 mg·kg⁻¹ of caffeine citrate (CC) and the other trial being performed 30 min after the ingestion of a placebo (P). The order of treatments was counterbalanced. Ventilatory parameters were monitored on a breath-by-breath basis and blood for lactate determination was obtained every minute. Maximal oxygen consumption did not differ significantly between the two trials (CC = 60.3±5.1 ml·kg⁻¹·min⁻¹; P = 59.5±5.6 ml·kg⁻¹·min⁻¹). Oxygen consumption (VO₂) during the P trial at the VT (40.2 ml·kg⁻¹·min⁻¹) and at the LT (38.6 ml·kg⁻¹·min⁻¹) were not found to differ significantly. Caffeine ingestion did result in a dissociation between the VT and the LT. During the CC trial, VO₂ at the VT (44.4 ml·kg⁻¹·min⁻¹) and at the LT (39.7 ml·kg⁻¹·min⁻¹) were significantly different. Whereas VO₂ at the LTs during the two trials was not significantly different, there was a significant difference in VO₂ at the VTs during the two trials. These data provide evidence that the LT and the VT do not always occur simultaneously and the VT may not be an accurate predictor of the LT.

Eating disorders in competitive athletes

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Recent evidence has shown that some female runners and ballet dancers manifest disordered eating patterns. To further elucidate the presence of dietary disorders in competitive athletes, 74 female student athletes (SA, x age=20 yrs) representing 7 Division I sports volunteered for the study. Fifty-two college-age females (CF) served as controls. Two standardized eating disorder measures, the Eating Disorder Inventory (EDI) and the Eating Attitudes Test (EAT) were employed. The results indicated that the SA vs CF differences emerged only on the body dissatisfaction (BD) scale with the CF expressing considerably greater BD than SA (F=7.40, p < .05). Scores on drive for thinness, bulimia, and EAT did not differ for SA vs CF. No differences in body mass emerged between SA and CF. These data suggest that SA have eating patterns similar to CF but evidence less body dissatisfaction. When grouped by sport, no significant differences were found among groups for any eating disorder scale. However, when athletes whose body weight was critical to performance (cross country and gymnastics) were compared, gymnasts evidenced greater drive for thinness (F=8.57, p < .05), greater BD (F=5.88, p < .05), and greater tendencies toward anorexia (F=5.04, p < .05) than did runners.
HEMODYNAMICS OF PREGNANT WOMEN DURING IMMERSION AND EXERCISE
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Twelve women, recruited early in their pregnancy, were
studied during 20 min of immersion in 30°C water followed by
20 min of upright cycle ergometry in the water (60% VO2) to
determine the effect of advancing pregnancy on the blood and
plasma volume shifts. Each subject completed the trials
during the 15th, 25th, & 35th week of pregnancy, as well as
10 wks post partum (PP). Compared to PP, resting blood
volume increased 18% during the 15th, 30% during the 25th wk
(p<0.05) with no further increase (p>0.05) during the 35th
wk (35%). Plasma volume (Evans Blue Dye) increased 25% by
the 15th wk, 44% by the 25th wk, with no further increase
the 35th wk (43%). Immersion in the water had no effect on
plasma volume shift PP (±=0.2±4%). Conversely, immersion
plasma volumes during pregnancy (15-35 wks) increased by
5.2±5% (p>0.05 pregnant vs PP). Plasma volumes during
exercise decreased compared to rest, but were only
significantly different from rest PP (15 wk=-3.0, 25th wk=
-4.0, 35th wk=-1.6, PP=-7.0%). Total plasma proteins were
higher PP than during pregnancy (p<0.05). As expected,
plasma proteins, sodium, and potassium were found to dilute
during immersion and concentrate during exercise.
The immersion diuresis during the 15, 25 & 35th wk trials was
greater (p<0.05) than PP (15 wk=326, 25 wk=418, 35 wk=367 ml
vs PP=208 ml). The data suggests that immersion of pregnant
women results in a greater hemodilution than would be
expected causing an enhanced diuresis. The results also
suggest that pregnancy does not significantly effect the
exercise hemodynamics.

CENTRAL AND PERIPHERAL CIRCULATORY RESPONSES DURING FOUR DIFFERENT
RECOVERY POSITIONS
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MS 39406-5034

The purpose of this study was to compare central and peripheral
circulatory responses during four different recovery positions immediately
after 75% heart rate (HR) intensity on the treadmill. Ten male subjects
(ξ = 23 years) were tested using a non-invasive CO2 rebreathing technique
to measure cardiac output (Q). ANOVA with repeated measures was followed
by the Tukey multiple comparison procedure to determine significant
differences between means (p<0.05). When compared to sitting, standing,
and supine 2nd-minute recoveries, walking recovery resulted in significant
increases in HR, stroke volume (SV), Q, oxygen uptake (VO2), double
product (DP), and myocardial oxygen consumption (MVO2). These data
indicate that walking recovery is consistent with an increased cardiac
effort when compared to sitting, standing, and supine recoveries at 2-min
post-exercise. The supine recovery resulted in significantly higher SV
and Q and significantly lower HR, arterial-venous oxygen difference, and
systemic vascular resistance responses than did sitting and standing
recoveries. But, since VO2, DP, and MVO2 were non-significantly different
during sitting, standing, and supine recoveries, it was concluded that
these three recovery positions result in a similar cardiovascular response
and myocardial oxygen consumption. This implies that aside from a walking
recovery, sitting, standing, and supine types of recovery have an equiva-
 lent cardiovascular effect immediately post-exercise.
The purpose of the study was to evaluate the efficacy of impedance cardiography to measure central circulatory responses to moderate exercise and heat stress. Six male subjects completed two submaximal exercise (65% VO2max) tests, consisting of 30 min rest followed by 30 min cycling, either in the normal (22°C, 40% rh) or heat (32°C, 44% rh) environments. Stroke volume (SV), cardiac output (Q), heart rate (HR), blood pressure (BP), rectal temperature (Tre), mean skin temperature (Tsk), mean body temperature (Tb), sweat loss, and plasma volume (PV) changes were measured. Sweat loss, Tsk, and Tb were significantly (P<0.05) higher in the heat during exercise. No differences were noted in HR, BP, SV, Q, Tre, and PV changes during exercise. Mean resting Q was 4.7±1.3 l.min⁻¹ (normal) and 3.1±1.2 l.min⁻¹ (heat) while mean exercise Q was 15.7±1.3 l.min⁻¹ and 15.8±5.7 l.min⁻¹, respectively. These values were similar to reported values measured by other techniques during heat and exercise stress. Tsk was significantly correlated to SV in both conditions (r=0.77 normal, r=0.75 heat). The central circulatory demands were adequately met by maintenance of Q, both during rest and exercise. Impedance cardiography seems to be an appropriate technique to evaluate central circulatory stress responses during submaximal exercise in the heat.

EFFECT OF MODE OF TRAINING ON ANKLE PERIPHERAL RESISTANCE RECOVERY FOLLOWING SUBMAXIMAL SUPINE EXERCISE
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The purpose of the present investigation was to study the effect of swimming (SWM) and cycling (CYL) on ankle peripheral resistance (PR) recovery from exercise stress. Fifteen men and 15 women (mean age 26 ± 5.0 yrs) completed 20 minutes of supine exercise on a cycle ergometer at 60-65% of their supine cycle VO2 max. Subjects were recruited on the basis of regular training of primarily upper body (SWM, n = 10) or lower body (CYL, n = 10), but not both. Ten subjects, considered recreationally active (REC) served as controls. Stroke volume was measured by impedance cardiography and blood pressure was measured by auscultation. PR was calculated from values of mean arterial pressure and cardiac output (Guyton, 1986). During rest SWM PR was significantly (p < 0.05) lower than CYL (SWM = 1141.4 ± 361.8; REC = 1984.9 ± 312.9 dynes.sec.cm⁻⁵). PR decreased immediately following exercise (SWM=47%, CYL = 73%, & REC = 58%). Throughout recovery, SWM PR was significantly (p < 0.05) lower than REC. During recovery, CYL and REC PR returned to 90-95% of rest by minute 5. SWM PR did not reach initial levels until 15 minutes following exercise. Regularly trained swimmers have a lower and slower recovery PR response compared to REC athletes. Possible mechanisms that influence post-exercise ankle PR of swimmers include the effects of prone training in the water, i.e. reduction of lower limb muscular involvement, adaptation of postural reflexes, and acclimatization to reduced heat dissipation.
FREE COMMUNICATIONS — HEALTH AND FITNESS

Employees from Liberty Life Corporation (n=723) were studied to evaluate the ability to determine the value of health-related behavior screening for predicting future health status. All employees completed a questionnaire and a medical exam upon entering the study and were given another medical exam upon leaving the study. Employees were followed from the year they entered the study until the end of the eight-year period, or until they dropped out. Health-related variables evaluated included: 1) not smoking (NMSK), 2) regular physical activity (PA), 3) low alcohol consumption (LAC), 4) not skipping breakfast (BFAST), 5) sleeping 7 to 8 hr/night (SLEEP), 6) not snacking in between meals (SNAK), and 7) average weight status (BMI). Additional independent variables included sex, age, and initial health measures. STEEPWISE regression analyses were performed to determine the predictors for each final health outcome: systolic (SBP) and diastolic blood pressure (DBP), total (CHOL) and HDL cholesterol, triglycerides (TG), pulse, and sick leave hours (SLH). Another analysis was performed including the initial health measure as a possible predictor for each final health outcome. The number of years (TIME) involved in the study was forced into all models. The models for SBP and DBP included TIME, SEX, AGE, BMI (R² = .40 and .27, respectively, P < .0001). The model for CHOL included TIME, AGE, BMI, NMSK (R² = .15, P < .0001). Adding the initial health measure into the model increased R² in all health outcomes. These results support the hypothesis that health-related behavior screening of employees is valuable for the prediction of future health status.

EFFECTS OF AN EIGHT WEEK LOW IMPACT AEROBIC DANCE CLASS ON ADULT WOMEN

M. Barrett-Friend and R.B. Kreider. Human Performance Lab., Dept. of NPER,
Old Dominion University, Norfolk, VA 23529

The purpose of this study was to determine the effects of an 8-week community recreation department low impact aerobic dance course on fitness related measures in 17 adult women (32-69 yrs, X = 51.94±11 yrs). The class consisted of 1-hr of continuous exercise 3-days per week including 10 min of warm-up and stretching, 20-25 min of low impact aerobic dance, 15-20 min of calisthenic exercise, and 5-10 min of stretching and cool-down exercises. Subjects were tested prior to and following the 8-week course for resting mean arterial pressure (MAP), resting heart rate (HR), resting rate pressure product (RPP), sum of 3-site skin fold (SF), hand grip strength (HS), low back flexibility (FL), estimated maximal oxygen uptake (VO₂), total cholesterol (TC), HDL cholesterol (HDL), LDL cholesterol (LDL), glucose (G), and triglycerides (TG). In addition, mid-aerobic exercise HR were recorded throughout the 8-week course. Data were analyzed by dependent t-tests. Results revealed that the subjects' average attendance was 82.41% with mid-aerobic 65.41% of predicted maximal HR (HRmax). Significant decreases (p<.05) were seen in MAP (97.4±90.3 mmHg), RPP (682±22 to 641), and LDL (5.6±15 to 7.9±15 mg/dl; significant increases (p<.05) were indicated in LDL (118±35 to 128±35 mg/dl, G (72±9 to 83±9 mg/dl). No significant differences (p>.05) were observed in HR (77±7 to 71±9 beats/min), SF (99±21 to 105±14 mm), HS (25±10 to 57±10), F (18.24±2.1 to 18.64±2.3 in), estimated VO₂ (20.0±7.1 to 32.6±8.8 ml/kg/min), TC (208±33 to 208±31 mg/dl), and TG (109±59 to 101±55 mg/dl). Results suggest: 1) class participants were low fit, moderate risk individuals who require pre-participation evaluation; 2) mid-aerobic HR intensity was appropriate and within guidelines to promote cardiovascular improvement; 3) non-significant increases were observed in aerobic capacity and health related fitness parameters; 4) resting MAP and RPP were decreased; 5) TC was essentially unchanged while HDL decreased and LDL increased slightly; and 6) the 8-week community recreation department low impact aerobics course was sufficient to maintain and/or promote low level fitness, however, the class should be increased to 12 to 16 weeks to provide further increases in fitness related parameters.

Supported by the Wellness Institute and Research Center, Old Dominion University and Virginia Beach Department of Parks and Recreation, Virginia Beach, Virginia
EFFECTS OF A 12 WK WALKING PROGRAM ON SELECTED HEALTH RISK FACTORS IN MILDLY OVERWEIGHT SEDENTARY FEMALES

Walking is the most commonly prescribed mode of exercise for older men and women. It was the purpose of this project to determine the specific health benefits observed in middle-aged women as a result of a 12 wk monitored treadmill walking program. Thirteen sedentary women (X age = 37.0 yrs) volunteered to train 4 times/wk for 12 wks. Six matched control subjects were also evaluated. Training intensity was 70-75% HR max and progressed from 15 mins during wk 1 to 40 mins during wks 6-12. Training session attendance averaged 91.34%. A repeated measures ANOVA was used to determine within and between group differences. Walk training resulted in an insignificant VO\textsubscript{2} increase of 5% in the experimental (E) group. Es lost 0.82 kg while controls gained 2.60 kg. No significant differences were observed in total cholesterol, HDL-C, LDL-C, HDL2-C, HDL3-C or VLDL for either group. Dietary intake did not change across the 12 wk period. Results indicate that 12 wks are insufficient for substantial changes in health risks. However, trends in fitness measures, body composition and blood lipids indicated that walking, if continued, may have a significant health impact on the middle aged, overweight female.
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POSTER PRESENTATIONS  Times and Locations

**Friday, January 20**

8:00 - 12:00  Group 1 (#28 thru 40)  
Authors present from 11:00 to 12:00  
Ashford

2:15 - 5:30  Group 2 (#41 thru 54)  
Authors present from 3:45 to 4:45  
Ashford

**Saturday, January 21**

8:00 - 12:00  Group 3 (#55 thru 66)  
Authors present from 11:00 to 12:00  
Ashford
The purpose of this study was to determine if there was a difference between the 70% Heart Rate Range (HRR) method and the 4 mM lactate (LT) method of prescribing the average intensity of exercise, taken as a work rate equal to 70% VO2max. Three groups of subjects were tested, each with 4 males and 4 females. The groups differed in the hours of self-reported strenuous physical activity per week: Group 1 = <5 hr; Group 2 = 5-10 hr; Group 3 = >10 hr. A discontinuous, 15 W per stage, incremental exercise test was used; each stage lasted 3 minutes with a 30 second rest between stages for blood sampling. A linear regression equation was used to predict %VO2max from 70% HRR for each subject, and a second degree polynomial regression equation was used to predict %VO2max from LT. Mean (±SE) VO2max values were 35.1±2.5, 34.3±2.7, and 49.7±3.2 ml·kg⁻¹·min⁻¹ for Groups 1, 2, and 3, respectively. The two-way repeated measures analysis of variance indicated that there was a significant difference between the HRR and LT methods for both Group 1 and Group 3. While significant differences existed, the data indicate that with the exception of Group 3, there is little to be gained by prescribing exercise by the HRR method. In order for Group 3 to work at the 4 mM LA level a value of 85% HRR would have to be used.

ABSORBIC TRAINING FOR BRAIN STIMULATION: INITIAL OBSERVATIONS

M. Lommet, J. Buggsy*, J. M. Davis and F. Galileo, Exercise Biochemistry Lab, and School of Medicine, University of South Carolina, Columbia, SC 29206

The purpose of this experiment was to investigate an alternate method for training rats. Six Sprague-Dawley male rats, 4-6 wks of age, were surgically implanted with stainless steel microelectrodes in the ventral tegmental center of the brain. Mild electrical stimulation of this area excites a group of dopaminergic neurons which stimulate a reward center. This stimulus elicits desired self-behaviors in rats, and thus served as the training reinforcer. Rats were conditioned to bar-press for stimulation, and once conditioned averaged 1-1.3 presses/sec, indicating they would perform a physical task for this reward. Using this reinforcer, rats were then aerobically trained on a treadmill. When a photobeam at the front end of the treadmill was interrupted by the rat, it triggered the stimulator to deliver the appropriate microamps (μA). A progressive training protocol was used. Observations at 4 wks of the training period showed that the rats ran as fast and as long as those trained using shock, i.e. 30m/min for 45 min, 5 g/wk. However, the amount μA needed to maintain running speed increased. At 5 wks, the rats became unresponsive to the stimulus, and refused to run for more than 10-15 min. At wk 6, the rats responded to the stimulus only if the voltage was increased from 725 to 1000-3000 μA. However, an awkward running style was noted and running time decreased to 15-17 min. The mechanism(s) for this decreased running time remains to be investigated. Several theories have been postulated, and several parameters still need to be investigated, i.e. optimal electrode site and material, μA, pulse frequency and duration, and general conditions for training while using brain stimulation as the reinforcer. However, this model may provide an alternate method of training rats by positively reinforcing their exertional efforts.
The purpose of this study was to compare the cardiovascular responses to different arm positions during gravity-facilitated inversion. Ten male subjects (X = 25 years) were tested using a non-invasive O2 rebreathing technique to measure cardiac output (Q). ANOVA with repeated measures was followed by the Tukey's HSD to determine significant differences between means (p<0.05). During the 5th-minute of full inversion with the arms in the dependent overhead position, there were significant increases in oxygen uptake (VO2), Q, stroke volume (SV), systolic blood pressure (SBP), and diastolic blood pressure (DBP) from the resting (sitting) measurements. During the 6th-minute of full inversion with the arms alongside the body (in the anatomical position), VO2, Q, and SV continued to be significantly increased from the resting measurements. But, with the arms alongside the body versus the overhead position, there were significant decreases in SBP and DBP. As to this latter finding, these data demonstrate that the higher blood pressure response with the arms in the overhead position reflects the pooling of the blood (due to the increase in hydrostatic pressure) in the dependent regions during gravity-facilitated inversion. The hydrostatic increase is thus reflected in the blood pressure measurement recorded with the arms overhead. The blood pressure recorded at the heart level during inversion should therefore be viewed as a normal cardiodynamic effect (which was unchanged from the upright sitting measurement).

BLOOD LIPID PROFILES OF FEMALE ATHLETES
D. Blessing, R. Keith, H. Williford, R. Warren, M. Stone, L. Stoessel, and J. Barksdale. Health & Human Performance, Auburn University, Auburn, AL 36849

Physically well-trained people generally exhibit more favorable blood lipid profiles than their sedentary counterparts. As limited information is available in this area regarding various groups of exercising females, we studied seven intercollegiate teams (basketball, n=11, cross-country, n=12, golf, n=7, gymnastics, n=12, swimming, n=8, tennis, n=7, and volleyball, n=9). In addition, competitive female cyclists (8), weight lifters (8), aerobic dance instructors (17), and sedentary college females (8) were included in the study. Fasting blood samples were assayed for total cholesterol (TC), triglycerides (TG), high density lipoproteins (HDL), low density lipoproteins (LDL), and LDL/HDL ratio. The results indicated that all blood lipid and lipoprotein values were similar to age-adjusted norms for total serum cholesterol (161), triglycerides (63), HDL (51), LDL (93) and LDL/HDL ratio (1.93). Although the values are well within the accepted limits recommended by the National Cholesterol Education Program, no differences were noted between groups or from normative values for college-age females.
EFFECTS OF HYDRATION AND DEHYDRATION ON BODY COMPOSITION ANALYSIS: A COMPARATIVE STUDY OF BIOELECTRICAL IMPEDANCE AND HYDRODENSITOMETRY

Walter R. Thompson, Deon L. Thompson, T. Joe Prestridge, and Johnny B. McDaniel. Laboratory of Applied Physiology, University of Southern Mississippi and Institute for Wellness and Sports Medicine, Hattiesburg, Mississippi 39406-5034

This study was designed to investigate the relationship between bioelectrical impedance analysis (BIA) and hydrodensitometry (HW) under three conditions: control (after voiding), hydration, and dehydration. Ten caucasian males aged 18 to 44 years (mean = 26.5 ± 8.2 years) volunteered to participate in this study. Body composition was determined by BIA and HW (randomly assigned) before intervention (control), 30 minutes post-hydration (ingestion of 0.5 L distilled water), and dehydration (acute weight loss of two to four percent of body weight by a combination of exercise and steam room). Periodic weighing determined the proper amount of weight loss (mean loss = 2.81% or 2.5 Kg). All subjects attained the goal weight loss within 1½ hours. Upon reaching that goal, body composition was determined by BIA and HW (randomly assigned). Statistical treatment by two-way analysis of variance for repeated measures revealed that no significant difference (p>0.05) existed between the two techniques, BIA and HW in the determination of Z body fat. There was, however, a significant difference (p<0.008) among the three conditions. Post-hoc analysis by the Newman-Keuls procedure revealed that these differences existed only with respect to the values observed in the dehydrated condition. No significant difference existed between the control and hydrated values. Although the hydration state is a confounding variable in the estimation of Z body fat, it appears that BIA compares favorably to HW under these conditions.

RELATIONSHIP OF PERCENT FAT AND PERFORMANCE MEASURES IN ADULT MALES.

Field tests of physical performance are influenced by a number of factors, among which are motivation, heredity, environment, and body dimensions. The purpose of the present study was to determine the relationship between percent fat and performance measures in adult males. The subjects were 66 males 24 to 61 years of age (X = 37.5, SD 8.8) who were heterogeneous in exercise habits. Percent fat was estimated using skinfolds (Jackson and Pollock, 1978). Pearson correlation coefficients (r) and r-square between percent fat and each physical performance measure are listed below:

<table>
<thead>
<tr>
<th>Test</th>
<th>r</th>
<th>r²</th>
<th>p</th>
<th>n</th>
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<tr>
<td>1-mile run time</td>
<td>0.58</td>
<td>.34</td>
<td>0.001</td>
<td>79</td>
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<tr>
<td>1-minute timed sit-ups</td>
<td>-0.41</td>
<td>.17</td>
<td>0.001</td>
<td>81</td>
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<tr>
<td>sit-and-reach</td>
<td>-0.38</td>
<td>.14</td>
<td>0.004</td>
<td>86</td>
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<tr>
<td>leg press</td>
<td>0.40</td>
<td>.16</td>
<td>0.004</td>
<td>75</td>
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<tr>
<td>bench press</td>
<td>0.18</td>
<td>.03</td>
<td>0.119</td>
<td>80</td>
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Since these and similar performance measures are used in pre-employment screening, in employment evaluation (i.e., U.S. military), and in field tests of physical & motor fitness, it is important to recognize the portion of variance in performance accounted for by percent fat.
EFFECTS OF GENDER ON CHANGES IN BODY FAT DISTRIBUTION FOLLOWING WEIGHT LOSS IN OBSESE INDIVIDUALS

R.L. Self and A. Weltman. Exercise Physiology Lab., Univ. of Virginia, Charlottesville, VA 22903

The effects of weight loss on body fat distribution was examined in 13 women (x age = 40.3 ± 11.9 yrs., x weight = 93.6 ± 9.7 kg., x% fat = 45.5 ± 4.1%) and 6 men (x age = 43.2 ± 10.8 yrs., x weight = 114.9 ± 13.7 kg., x% fat = 37.0 ± 4.1%) who participated in a 3 month program of supplemented fasting (Optifast, 420 kcal/day). Hydrostatic weighing at residual volume and chest, abdomen 1, abdomen 2, hip and thigh girth measurements were determined pre and post. Both males and females significantly decreased wt., % fat and girths after weight loss (* = p<.05).

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<th>Females</th>
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<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
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<tr>
<td>BW (Kg)</td>
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<td>90.7*</td>
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<tr>
<td>% Fat</td>
<td>37.0</td>
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<td>Chest Girth (cm)</td>
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<td>Abdomen 1 Girth (cm)</td>
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<td>Hips Girth (cm)</td>
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<tr>
<td>Thigh Girth (cm)</td>
<td>63.1</td>
<td>56.4*</td>
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</table>

Although no significant difference existed between gender for % change (post-pre/pre) at any individual girth, within gender analysis for differences in body fat distribution revealed that women reduced girths uniformly at each site (11-15%, NS) while males showed greater reduction in girth measurements at the abdomen (> 17%) compared to the chest and thigh (< 11%) (p<.05). It can be suggested that males and females have different changes in body fat distribution with weight loss.

THE RELATIONSHIP OF FAT PATTERNING AND RESTING CARDIOVASCULAR PARAMETERS TO MODE OF TRAINING

P.M. Darragh, D.L. Spiteri, P.D. Swan. Human Performance Lab., University of North Carolina Greensboro, Greensboro, NC 27412; University of Florida, Gainesville, FL 32611; University of Tennessee, Knoxville, TN 37996

To investigate the relationship of exercise mode on fat patterns and resting cardiovascular function 5 men and 5 women swimmers (SWM), 5 men and 6 women cyclists (CYC) and 5 men and 5 women non-training recreational athletes (REC) were studied (mean age = 26.0 ± 5.05 yr). Height, weight, skinfold thickness (7 sites), and circumferences (7 sites) were measured. Central fat patterns (adipose distribution on torso) were calculated: CFP1 = subscapular/triceps skinfold ratio and CFP2 = waist/hip circumference ratio. Peripheral fat pattern (adipose distribution of extremities) was calculated: PFP = arm/leg circumference ratio. Supine resting heart rate, stroke volume (SV), and cardiac output (Q) were measured by cardiac impedance, and blood pressure (SBP, DBP) by auscultation. Mode of training and gender did not influence (p < 0.05) fat patterning. Total population mean ratios were PFP = 0.62 ± 0.19, CFP1 = 1.03 ± 0.34, and CFP2 = 0.82 ± 0.09. Resting SV (SWM = 102.1 ± 23.99, CYC = 106.9 ± 24.80, REC = 70.41 ± 19.29 ml.min-1) and Q (SWM = 6.5 ± 1.56, CYC = 7.2 ± 1.84, REC = 5.21 ± 1.65 l.min-1) were significantly higher in both trained groups. No significant correlations between mode of training and fat patterning were noted. Mode of training demonstrated a low significant relationship to SBP (r = .34) and DBP (r = .53). In conclusion, upper (SWM) and lower (CYC) body physical training was associated with higher resting supine stroke volume but appeared to have minimal relationship to subcutaneous fat distribution patterns.
THE RELATIONSHIP OF METABOLIC CONTROL TO LEAN BODY MASS, PERCENT FAT AND MAXIMAL OXYGEN UPTAKE
J. Evans, M. Stone & D. Blessing. Health & Human Performance, Auburn University, Auburn, Al. 36849

The notion that exercise benefits the metabolic control and health of diabetics has received increasing attention in recent years. Physical training has been reported to favorably alter glucose uptake, insulin sensitivity, and cardiovascular function. This study examined the relationship of metabolic control (HbA1c—glycosylated hemoglobin) to lean body mass, percent fat, and maximal oxygen uptake in six type 1 diabetics. Five males and one female, ages 20-29, who had type 1 diabetes volunteered as subjects. Mean values for weight (82.3), percent body fat (17.8), lean body weight (67.3), Max VO2 (40.5) and HbA1c (7.7). Pearson correlation coefficients revealed that no significant correlations existed between percent body fat and HbA1c (r=-.44) or lean body mass and HbA1c (r=.48). However, a significant (p<.05) negative correlation was noted between Max VO2 and HbA1c (r=-.72). Although the sample size was small, the results suggested that as cardiovascular function improved, patient metabolic control also improved (↓in HbA1c). Further investigation with a larger patient sample may elucidate the role of percent body fat and lean body mass on insulin sensitivity in the diabetic population.

EFFECT OF A COMPREHENSIVE HOSPITAL-BASED WELLNESS PROGRAM ON TWELVE MALE SENIORS
P. Krebs, K. Stuart, and S. Dodd. Louisiana State University, and Heart and Fitness Center, Baton Rouge, LA

The purpose of this study was to determine the effect that a comprehensive hospital-based wellness program has on twelve male seniors (♂♂'s age 60.9, height 69.1, weight (WT) 193.4). All subjects participated in a twelve month comprehensive wellness program. Each subject was medically evaluated (pre,post), Pre and Post Tested for all major components of fitness and given individualized supervision and support throughout participation. Dietary evaluations and counseling were incorporated. Significant improvements were observed for percent body fat (SBF) (p < .01) and treadmill performance time (TT) (p < .01).

<table>
<thead>
<tr>
<th>N=12</th>
<th>X</th>
<th>SD</th>
<th>SEM</th>
<th>N=12</th>
<th>X</th>
<th>SD</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP</td>
<td>PRE</td>
<td>143.3</td>
<td>15.8</td>
<td>4.6t</td>
<td>SBF (PRE)</td>
<td>33.1</td>
<td>5.7</td>
</tr>
<tr>
<td>POST</td>
<td>136.5</td>
<td>18.6</td>
<td>2.8</td>
<td>POST</td>
<td>27.2</td>
<td>4.3</td>
<td>1.2</td>
</tr>
<tr>
<td>DBP</td>
<td>PRE</td>
<td>88.0</td>
<td>10.7</td>
<td>3.1t</td>
<td>WT (PRE)</td>
<td>193.4</td>
<td>31.4</td>
</tr>
<tr>
<td>POST</td>
<td>80.8</td>
<td>9.8</td>
<td>2.8</td>
<td>POST</td>
<td>181.8</td>
<td>26.7</td>
<td>7.7</td>
</tr>
<tr>
<td>MABF</td>
<td>PRE</td>
<td>105.1</td>
<td>10.8</td>
<td>3.1t</td>
<td>TT (PRE)</td>
<td>17.9</td>
<td>3.6</td>
</tr>
<tr>
<td>POST</td>
<td>99.3</td>
<td>10.3</td>
<td>2.9</td>
<td>POST</td>
<td>167.7</td>
<td>4.9</td>
<td>1.4</td>
</tr>
<tr>
<td>Total Cholesterol</td>
<td>PRE</td>
<td>236.2</td>
<td>35.2</td>
<td>10.2t</td>
<td>HDL (PRE)</td>
<td>43.2</td>
<td>14.8</td>
</tr>
<tr>
<td>POST</td>
<td>227.1</td>
<td>30.6</td>
<td>8.9</td>
<td>Cho- POST</td>
<td>48.7</td>
<td>16.4</td>
<td>4.7</td>
</tr>
</tbody>
</table>

(♦p < .05; t trend)

These data show significant improvements and trends in cardiovascular fitness and body composition in senior participants of a comprehensive hospital-based wellness program.
SEXUAL ACTIVITY IN EXERCISING PATIENTS AFTER MYOCARDIAL INFARCTION
Straus, P. and T. Boone. Laboratory of Applied Physiology, University of Southern Mississippi, Hattiesburg, MS 39406

The purpose of this study was to obtain information regarding sexual activity of cardiac patients participating in an outpatient exercise rehabilitation program. Of the 35 sexual activity questionnaires given to the patients, 51% (18 of 35) of the questionnaires were returned. The 18 patients (X = 58 years) consisted of 12 (66%) who had suffered myocardial infarction and 6 who had undergone revascularization and/or angioplasty. The data collected were descriptive in nature, thus frequencies and percentages were calculated from the responses to each item. Ninety-four percent of the respondents were males. Seventeen percent of the patients were married. Thirty-three percent experienced angina pectoris while 50% of the patients did not respond to the item. Thirty-two percent of the patients were not engaging in sexual activity. The majority of the patients who did engage in sex did so one time per week. The main factors influencing whether they engaged in sexual activity or not were age and cardiac drugs. Forty-four percent of the patients felt that sex was poorer after myocardial infarction. Eleven of the 18 patients felt that their cardiac medications reduced their sexual drive and made their moods more negative. Fifteen of the 18 patients received no sexual counseling following myocardial infarction and/or revascularization. These data suggest that there is sufficient reason for the cardiac rehabilitation staff to consider counseling the patient regarding coital practices after myocardial infarction and myocardial revascularization.

THE EFFECTS OF A SMOKING CESSATION PROGRAM ON DIETARY COMPOSITION
J.L. Durstine, A.B. Spruill, W.P. Bartoli, S. Bourque, M.D. Senf, P.G. Davis, J.J. Kerby. Exercise Science Laboratory, University of South Carolina, Columbia, SC 29008

The purpose of this study was to determine the effects of a smoking cessation program on dietary composition. Twenty one smokers (presently smoking) were randomly assigned into a control group (C) (n=7) and an experimental group (E) (n=14) that underwent a smoking cessation program. The Fresh Start Program as developed by the American Cancer Society was used to produce educational materials and support groups. Two day diet records were collected before cessation (pre) and at weeks 1, 2, 4, 6, and 10 (post) following the point of cessation. Each diet record was analyzed by the Nutritionist 3 computer program. A dietary profile was developed for each time period and included Kcals, percent carbohydrate, percent fat, and percent protein. No differences were found in any of these variables after the 10th week of cessation; Kcals (C pre 2473 ± 336, post 2335 ± 231 [mean ± SE]), E pre 2408 ± 203, post 2266 ± 191), percent carbohydrates (C pre 49 ± 2.5, post 47 ± 2.8, E pre 40 ± 2, post 43 ± 2.4), percent fat (C pre 34 ± 2.6, post 35 ± 2.5, E pre 39 ± 2.1, post 38 ± 2.4), percent protein (C pre 15 ± 1.3, post 16 ± 1.5, E pre 16.2 ± 1, post 16.2 ± 1). These data support the theory that smoking cessation has no significant effect on Kcals, percent carbohydrates, percent fat, and percent protein.

Supported by a grant from the American Cancer Society No. IN-107
EFFECTS OF ACUTE SMOKING AND EXERCISE ON HDL-C AND SUBFRACTIONS IN BLACK FEMALE SMOKERS

A.M. Swank and R.D. Feil. Exercise Physiology Laboratory, University of Louisville, Louisville, Ky. 40292

This study investigated effects of both acute bouts of exercise and smoking on high density lipoprotein-cholesterol subfractions, HDL-C and HDL3-C in black females. During two testing trials six subjects were exposed to either acute exercise or smoking. Exercise was performed at 70% of heart rate reserve for fifteen minutes. Blood samples were taken prior to, immediately and ten minutes after exercise. Smoking trial consisted of subjects smoking two cigarettes followed by a non-smoking recovery period. Blood samples were taken before smoking, after each cigarette and during 15 minute intervals of recovery. The exercise protocol resulted in a 10.8% increase in total HDL-C primarily through an increase in HDL2-C. Values returned to baseline within 10 minutes after exercise. Smoking one cigarette decreased total HDL-C by 10%. Neither subfraction was significantly effected by smoking, however HDL3-C decreased 11% and HDL2-C decreased 8.1% from resting values. Values remained depressed through 15 minutes of non-smoking recovery. Acute cigarette smoking was associated with a significant decrease in total HDL-C. It is suggested that the adverse effect on HDL-C by acute smoking, is a significant contributor to coronary heart disease (CHD) risk in black female smokers. Furthermore, low intensity exercise is capable of transiently increasing the total HDL-C via an increase in the antiatherogenic HDL2-C subfraction. Frequent low intensity exercise may favorably alter CHD risk factor profile of black females.

Supported by grants from University of Louisville's Graduate School Research Council and American Heart Association, Kentucky Affiliate.

EVIDENCE FOR AN ALVEOLAR-ARTERIAL O₂ GRADIENT (A–aDO₂) THRESHOLD DURING EXERCISE

S.K. Powers, S. Dodd, J. Lawler, D. Ayers, and D. Criswell. Center for Exercise Science, Department of Exercise and Sport Sciences, University of Florida, Gainesville, FL 32611; Applied Physiology Laboratory, Louisiana State University, Baton Rouge, LA 70803

We tested the hypothesis that an A–aDO₂, threshold exists during incremental exercise and that the work rate (WR) at which the A–aDO₂ threshold occurs differs between sea level normoxic and hypoxic conditions. Six healthy male subjects performed two incremental cycle ergometer tests to volitional fatigue under normoxia (PₐO₂ = 159 Torr) and hypoxia (PₐO₂ = 112 Torr). Arterial blood samples were obtained and the alveolar PO₂ calculated using the alveolar gas equation. Mean A–aDO₂ differences at rest and during exercise were as follows:

<table>
<thead>
<tr>
<th>A–aDO₂ (Torr)</th>
<th>Rest</th>
<th>30W</th>
<th>60W</th>
<th>90W</th>
<th>120W</th>
<th>135W</th>
<th>150W</th>
<th>180W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normoxia</td>
<td>6.8</td>
<td>8.5</td>
<td>6.2</td>
<td>6.1</td>
<td>10.1</td>
<td>13.3</td>
<td>15.3*</td>
<td>19.6*</td>
</tr>
<tr>
<td>Hypoxia</td>
<td>2.8</td>
<td>3.0</td>
<td>5.3</td>
<td>6.1</td>
<td>6.7</td>
<td>12.6*</td>
<td>15.7*</td>
<td>23.3*</td>
</tr>
</tbody>
</table>

*Significantly different from rest (p < 0.05).

The A–aDO₂ increased significantly (P < 0.5) above rest at a WR of 135W during hypoxia and 150W during normoxia. At higher WR's the A–aDO₂ increased linearly with WR (0.25 Torr•W⁻¹) in both conditions. These data support the notion that an A–aDO₂ exercise threshold exists and occurs at a lower WR under mild hypoxic conditions when compared to normoxia.
Does exercise training affect the responsiveness of the sympathetic N.S. to a novel stimulus? The purpose of this study was to determine if differences existed in the plasma catecholamine responses of trained (Tr) and untrained (UnTr) subjects (VO2max = 66±3 and 38.8±2 ml·kg⁻¹·min⁻¹) to a graded hypoxia test. The subjects assumed a supine position and rebreathed room air from a 120 liter Collins gasometer with CO₂ absorbed. A 20g Minicath was inserted into a superficial vein on the dorsal aspect of the hand or wrist and was maintained patent with a heparin/saline solution. Blood samples were collected at the following inspired O₂ values: 20.93%, 19%, 17%, 15%, 13%, 11% and 9%. Heart rate was monitored continuously and recorded when a blood sample was collected. A repeated measures AVOVA indicated that there was no differences in E or NE between Tr and UnTr groups across the range of hypoxia. As expected the HR was lower for the Tr group, however, at the 11% O₂ condition the difference dissapeared due to a greater rate of change in HR for the Tr group. Given the lack of difference between groups in NE and E, this was probably due to a greater decrease in parasympathetic N.S. activity. It is concluded that endurance training or a high VO2max does not alter the normal CA response to hypoxia.

LIPID LOWERING EFFECTS OF LINOLENIC ACID
M.A. Friestap and S.L. Roberts. Cardiac Rehab. Unit Baptist Hospitals, Louisville, KY. 40204

Twenty one long term Cardiac Rehabilitation Patients were studied over a three month period to assess the relative lipid lowering effects of Omega-3 Fatty Acids, specifically linoleic acid, from different dietary sources. Three groups were randomly assigned to dietary regimens which incorporated comparable levels of the fatty acid. Variables used were (1) Sockeye Salmon, (2) ProMega Fish Oil Capsules and (3) Canola Oil. Composite results demonstrated a Serum Cholesterol reduction of 5%, triglyceride reduction of 14% and HDL increase of 8%, over a three month period. Specific group variances were significant with group (1) demonstrating a 2% decrease in Serum Cholesterol, a 3% increase in triglycerides and a 3% increase in HDL. Group (2) demonstrated a 4% increase in Cholesterol, a 54% decrease in triglycerides and an 11% decrease in HDL. Group (3) resulted in a 21% decrease in Cholesterol, a 35% decrease in triglycerides and a 13% increase in HDL. These results were compared to the control results of a 3% increase in cholesterol, a 3% decrease in triglycerides and an 18% decrease in HDL. These data illustrate the potential for lipid lowering effects of dietary linolic acid from alternate dietary sources.

Supported by appropriated funds from Baptist Hospitals of Louisville, Ky.
EFFECTS OF CAFFEINE ON CARDIOVASCULAR RESPONSES AND PERCEPTION OF EFFORT DURING PROLONGED WALKING EXERCISE AT LOW AND MODERATE AEROBIC INTENSITIES

H.-J. Engels and E.M. Haymes, Exercise Physiology Lab., Florida State University, Tallahassee, FL 32306

The effects of 5mg/kg caffeine on cardiovascular dynamics and effort sense during 90 min walking exercise were studied in caffeine-naive subjects. Six non-smoking, aerobically trained college males each underwent a total of four experimental walking trials. Two of these sessions involved a 90 min continuous treadmill walk at 30% VO2max and self-selected "normal" walking speed (2.93 +/- 0.08 mph, mean +/- SD); the other two trials were performed at 55% VO2max and self-selected "fast" walking speed (4.22 +/- 0.25 mph). Ingestion of caffeine 60 min prior to exercise significantly increased systolic blood pressure (SBP, + 4.9%) and oxygen pulse (+ 4.4%) during walking exercise (p < 0.01). Heart rate (HR) and diastolic blood pressure (DBP) were not significantly changed when compared to control trials. A gradual time-dependent upward drift for HR (p < 0.01) was opposed by a similar time-dependent decrease in oxygen pulse (p < 0.05). Caffeine tended to lower the sense of effort during walking (p = 0.052). These findings suggest that the ingestion of 5 mg/kg caffeine may increase walking exercise cardiac output by increasing stroke volume which, in turn, could account for the increase in SBP without changing DBP and HR. Caffeine may assist some individuals at a perceptual level during walking.

NUTRITIONAL CONSIDERATIONS FOR FEMALE COLLEGIATE GYMNASTS

R.D. Lewis and C.A. Ray, University of Georgia, Athens, Georgia 30601

In order to provide nutritional guidance to 11 female collegiate gymnasts, 18 to 21 years of age, 3 day dietary intakes were assessed for nutritional adequacy. Using a computer diet analysis program (Nutritionist III), mean daily intakes were determined for kilocalories (kcal), protein, fat, carbohydrate, minerals (iron, calcium, zinc, magnesium, sodium) and vitamins (B-1, B-2, B-6, B-12, ascorbic acid, folic acid, niacin). Percent body fat, fat weight (kg) and fat-free weight (kg) were estimated from body density using hydrostatic weighing and mean values were 18.3 +/- 4.5, 9.8 +/- 2.5, and 44.0 +/- 5.0, respectively. The mean caloric intake was 1186 +/- 342 kcal (range 757 to 1794) with approximately 17% of the calories from protein, 58% from carbohydrate and 25% from fat. Seven of 11 gymnasts (64%) received less than 2/3 the Recommended Dietary Allowance (RDA) for calories. In addition, 9 of 11 gymnasts (81.8%) consumed less than 2/3 the RDA for iron and zinc, 63.6% for calcium, vitamin B-6 and vitamin B-12, and 72.7% for folic acid. Mean dietary intakes of meat, fish, poultry and eggs was approximately 1.3 +/- 0.89 ounces per day. These data suggest that during intense training, prior to the competitive season, dietary intakes of several nutrients may be inadequate. Inclusion in the diet of nutrient dense foods such as meat, fish or poultry, low fat dairy products, and green leafy vegetables is indicated to improve the quantity and quality of protein, iron, calcium and other nutrients.
THE EFFECTS OF FLUID AND PROTEIN INTAKE ON MUSCLE DAMAGE DURING EXERCISE.
N. Hommen, R. Cade and M. Privette. Dept. of Physiology, Univ. of FL, Gainesville, FL 32610.

It is well known that the degree of elevation of creatine phosphokinase (CPK) and lactic dehydrogenase (LDH) plasma levels correlate closely with the degree of muscle damage caused by intensive exercise. 5 male and 3 female world class swimmers were studied, observing the effects of altering fluid and protein intake during training. Over 4 weekly trials CPK and LDH were measured before (B), immediately after (A), 3 hrs. (3), 5 hrs. (5), 8 hrs. (8), 24 hrs. (24) post exercise. Workout intensity and duration remained constant. The control trial was H2O ad lib during and placebo after. Second trial (GA) consisted of Gatorade during and placebo after. Third trial (G6O) was H2O during and Gatorade 18 gms. protein/8 oz. milk base, after. The fourth trial (GA+G6O) was GA during and G6O after. CPK in the control group rose significantly from B, compared to A, an 87% increase. LDH during control significantly increased 30% from B to A and at 24 declined but was still 13% higher than 8. In Gatorade trial CPK increased 19.7% from B to A and at 24 declined 30% from B. LDH similarly increased from B to A, +15%, decreasing below B at 24, -10%. Comparing A in both control and GA+G6O, CPK decreased significantly -45%. The data suggest that by maintaining blood volume while preserving vascular perfusion and near normal core temperatures, Gatorade diminished muscle damage. G6O enhanced muscle repair, increasing the availability of essential amino acids consumed by oxidation during exercise.

EFFECTS OF THREE AND SIX DAY SODIUM PHOSPHATE SUPPLEMENTATION REGIMENS ON SERUM PHOSPHATE, HEMOGLOBIN, 2,3 DIPHOSPHOGLYCERATE, AND HEMATOCRIT
R.B. Kreider, G.W. Miller, K.I. Williams, T. Somma, and T. Masser
Human Performance Lab., Old Dominion University, Norfolk, VA 23529

Phosphate loading (PH-L) has been suggested to increase cellular availability of phosphate which may be used to enhance metabolic intermediates involved in oxygen transport. However, questions have been raised regarding the optimal PH-L regimen. Seven male competitive runners (18-28 yrs, VO2 max 73.9 + 6.3 ml·kg⁻¹·min⁻¹) participated in a two-week randomized, double-blind study to determine the effects of 3-day and 6-day PH-L regimens on serum phosphate (SPH), hemoglobin (Hb), 2,3-diphosphoglycerate (DPG), and hematocrit (Hct). Subjects ingested 1000 mg of sodium tribasic phosphate (PH) or a placebo (PB) four times a day for 6 days. All sessions were separated by a 2-week washout period and repeated by alternating PH and PB regimens. Venous blood samples were drawn on the 3rd and 6th day of each session and assayed using standard enzymatic procedures. Repeated measures ANOVA with Newman-Keuls post-hoc statistical procedures were used to analyze data. Significant differences (p<0.05) among means are indicated by (*). Results were as follows:

<table>
<thead>
<tr>
<th></th>
<th>PH-3d</th>
<th>PH-6d</th>
<th>PH-3d</th>
<th>PH-6d</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPH 100ml-1</td>
<td>10</td>
<td>12</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Hb 100ml-1</td>
<td>14.8</td>
<td>15.0</td>
<td>15.0</td>
<td>15.2</td>
</tr>
<tr>
<td>DPG</td>
<td>12.7</td>
<td>13.3</td>
<td>13.3</td>
<td>13.3</td>
</tr>
<tr>
<td>Hct</td>
<td>33.5</td>
<td>33.8</td>
<td>33.8</td>
<td>33.8</td>
</tr>
</tbody>
</table>

Results suggest: 1) resting PB SPH were hyperphosphatemic suggesting that training and/or the competitive athlete's diet influence SPH; 2) PH-L non-significantly elevated SPH values with the greatest adaptation on PH-3d; 3) PH-L decreased serum DPG; and 4) PH-L significantly increased 3 and 6 day Hb supporting the proposed ergogenic benefits to oxygen transport possibly due to a greater involvement in serum 2,3 DPG.

Supported by the Wellness Institute and Research Center and Center for Clinical Practice of Old Dominion University, Norfolk, Virginia 23529
INFLUENCE OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION ON SERUM CORTISOL CONCENTRATION, PAIN AND RANGE OF MOTION


Beta-endorphin (BEP) has been implicated as an active agent in the analgesic response to low frequency, long pulse width transcutaneous electrical nerve stimulation (TENS). BEP and adrenocorticotropic (ACTH) share the pro-hormone proopiomelanocortin (POMC). Current theory proposes that TENS induced breakdown of POMC results in the release of BEP and ACTH from the anterior pituitary gland with a subsequent increase in blood cortisol concentration. The purpose of this study was to investigate the potential anti-inflammatory effects of TENS-induced cortisol release. Eight female volunteers (age 21.8 yr, wt. 58.1 kg, ht. 166.1 cm.) had blood samples withdrawn 15 and 1 min. before and 1, 20 and 40 min. following a 30 min. TENS treatment in a pain free condition and while experiencing delayed onset muscle soreness (DOMS) induced through repeated eccentric contractions of the elbow flexors. The TENS parameters were 2 Hz, 300 µ sec pulse width with the intensity adjusted to maximum tolerance using 1 cm. diameter electrodes placed at four sites suggested for upper arm pain (TH 14, LI 11, LI 13, LI 14). All treatments were begun at 1700 hrs. Samples were analyzed for cortisol concentration by radioimmunoassay.

SERUM CORTISOL LEVELS (nmol/l) BEFORE AND AFTER TREATMENT
IN A PAIN FREE CONDITION AND WHILE EXPERIENCING DOMS (Mean ± SD)

<table>
<thead>
<tr>
<th></th>
<th>before</th>
<th>after</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 min.</td>
<td>749.4</td>
<td>370.5</td>
</tr>
<tr>
<td>1 min.</td>
<td>702.1</td>
<td>398.4</td>
</tr>
<tr>
<td>1 min.</td>
<td>646.4</td>
<td>387.3</td>
</tr>
<tr>
<td>20 min.</td>
<td>624.1</td>
<td>434.6</td>
</tr>
<tr>
<td>40 min.</td>
<td>540.5</td>
<td>363.8</td>
</tr>
</tbody>
</table>

Only one subject demonstrated a rise in serum cortisol level (186.7 nmol/l 1 min. after treatment). While experiencing DOMS elbow extension and pain were assessed at each sampling time. Subjects demonstrated an increase in elbow extension (F(4,28)=10.82, p<0.01) and reported a decrease in pain (F(4,28)=4.10, p<0.01) for all after treatment measurements. The results suggest that if BEP is active in TENS-induced analgesia it is released from sources other than the anterior pituitary gland.

TENS provided by NeuroTech, North Andover, MA.

PREDICTION OF 17 B-ESTRADIOL IN EUMENORHEIC RUNNERS

J. Nutter, J. E. Kinder, and T. Stumpf. Center for Youth Fitness and Sports Research, University of Nebraska-Lincoln, Lincoln, NE 68588 and Department of Animal Science, University of Nebraska-Lincoln, Lincoln, NE 68585

This study attempted to examine the relationship between physical characteristics, training indices, and body composition and 17 B-estradiol (E$_2$) in eumenorheic trained women and to develop an equation using these factors to predict E$_2$. Fifteen women (25.8 ± 0.8 years) running 19.8 ± 1.8 miles per week were studied during the midluteal phase of the menstrual cycle. Age, Ponderal Index, and cycle length (days) were negatively related to E$_2$ (r = -.56, -.55, and -.52, respectively, p < .05). A significant relationship (R$^2$ = .83, p < .05) was found among length of training (yrs), cycle length, weight training (hr/ wk), miles run per week, additional aerobic training (hr/ wk), relative fat (%), Ponderal Index and E$_2$ (pg/ml). These data suggest that the concentration of E$_2$ is the result of a complex interaction of many factors and that the concentration of E$_2$ may be predicted in eumenorheic runners using easily obtained noninvasive measurements.

Supported by grants from the University of Nebraska-Lincoln Research Council and NIH (RR-07055)
The purpose of this study was to examine the influence of the menstrual cycle on swim performance and muscular strength. Subjects were 11 highly competitive female swimmers (mean age of 19.2±3.3) and 12 women weight lifters (mean age of 24.3±3.6). All subjects had regular menstrual cycles and none used oral contraceptives. The subjects were tested during the premenstrual (3-4 days prior to menses), menstrual (days 1-2 of flow) and mid-cycle phases of the cycle. Testing sessions for swimmers consisted of repeated timed trials for either the 100 meter (N=7) or 200 meter (N=4) freestyle event. Each testing session for weight lifters consisted of one maximal repetition (IRM) for the bench press and leg press. An ANOVA with repeated measures indicated statistically significant differences (p<0.05) among cycle phases for both the 100 and 200 meter swim times. Post hoc comparisons revealed that performance decrements of 1.9 and 1.3 seconds occurred during menses when compared to the midcycle phase for the 100 and 200 meter performances, respectively. No significant differences were found between the menses and premenstrual phase. No significant differences were found between the three phases of the cycle for the IRM bench press or leg press. The findings of this study suggest that the phase of the menstrual cycle may affect athletic performance during swimming timed trials of 100 or 200 meters and that strength as measured by IRM was not affected by cycle phase. Further, the results suggest that athletic events of longer duration may be affected more by the menstrual cycle than shorter duration athletic events.

Supported by grants from Tambrands Inc. and the Florida State University Foundation

ENDOCRINE AND HEMATOLOGIC RESPONSE TO AN ACUTE SWIM PROTOCOL

Hormonal and hematologic responses to an interval swim training protocol were studied in 16 collegiate competitive swimmers (X age=19.2 yrs) two weeks into the training season. Venous blood samples were collected immediately before (Pre) and within five minutes upon completion (Post) of a typical swimming workout consisting of (1) 2500 yds of warmup activity, (2) moderately high intensity interval sets of 2000 total yards with minimal rest (3-5 sec) lasting 27 minutes (40 sets X 50 yards free-style), and (3) a second series of mixed intensity swims of 750 yards lasting 15 minutes (30 sets X 25 yards free-style). No differences between pre- and post-samples were observed for hematocrit (Hct) or hemoglobin (Hgb). Eleven of sixteen subjects showed a post-exercise granulocytosis (p<.001), while the absolute number of lymphocytes remained unchanged (p=.1). Pre to Post-exercise response of cortisol decreased significantly (p=.011) as did prolactin (p=.001) and thyroid stimulating hormone (p=.003) regardless of the magnitude of the leukocyte response. Growth Hormone was markedly increased post-exercise in all subjects (0.13 to 5.05, p<.001). These data demonstrate that significant acute alterations in hormonal and hematologic parameters occur early in training for a competitive swimming season without changes in blood volume as represented by a stable Hct and Hgb.

Supported by grants from Coulter Immunology, Hybritech, Inc., Organon Teknika, Puckett Laboratories and USM Office of Research and Sponsored Programs.
COMBINATIONS OF EXERCISE AND IMMERSION ON RELATIVE CARDIAC
EFFICIENCY
C.W. Cortes, T. Boone & D.R. Redondo. Southwest
Mississippi Regional Medical Center, McComb, MS 39648

Fifteen male subjects were studied to determine the
effects of combinations of exercise and immersion on relative
cardiac efficiency (RCE). Subjects cycled at the same
relative workload for 10 minutes before (EX1) and after
immersion (EX2). The immersion phase (IM1) consisted of
sitting quietly in a whirlpool bath for ten minutes at 40.5
degrees C. Metabolic and respiratory data were collected
each minute, while heart rate and blood pressure were
measured at minute 10. Data were analyzed employing a
Repeated Measures ANOVA design, while significant F-ratio's
were analyzed using a Newman-Keuls Multiple Range Test (p
< .05). The results suggest that the combination of EX1 and
IM1 did not significantly decrease RCE values for EX2.
However, the RCE value significantly decreased during IM1,
possibly due to the vasodilatory effect of the whirlpool
bath on the cutaneous vasculature.

<table>
<thead>
<tr>
<th></th>
<th>EX1</th>
<th>IM1</th>
<th>EX2</th>
<th>F-ratio/Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV02 (ml/100g)</td>
<td>27.51</td>
<td>12.80*</td>
<td>29.37</td>
<td>97.23/ &lt; .05</td>
</tr>
<tr>
<td>LV/min</td>
<td>4.09</td>
<td>3.52</td>
<td>5.49</td>
<td></td>
</tr>
<tr>
<td>V02/10 (ml/100g)</td>
<td>2.69</td>
<td>0.46*</td>
<td>2.70</td>
<td>554.87/ &lt; .05</td>
</tr>
<tr>
<td>bw/min</td>
<td>0.38</td>
<td>0.08</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>RCE</td>
<td>18.47</td>
<td>28.42*</td>
<td>11.03</td>
<td>82.92/ &lt; .05</td>
</tr>
<tr>
<td></td>
<td>2.37</td>
<td>8.56</td>
<td>2.38</td>
<td></td>
</tr>
</tbody>
</table>

ACUTE AND PROLONGED LIMB VOLUME CHANGES AFTER
ECCENTRIC EXERCISE
L.L. Smith, J.A. Houmard, R.T. George, T.C. Chenier,
Performance Lab, East Carolina University, Greenville,
NC 27858-4353

To observe acute and prolonged changes in arm volume
after a bout of eccentrically biased exercise known to induce
delayed onset muscle soreness (DOMS), an experimental group
(Ex) (N= 5 females, 6 males) used hand-held weights to
perform the negative phase of a biceps curl (7 sets to
exhaustion) with their non-dominant (ND) arm. A control
group (C, N=5 females) performed no exercise. A water volume
plethysmograph was used to measure the ND and dominant (D)
arm volume of all subjects before exercise, immediately
after, then at 1, 2, 3, 4, 5, 6 and 7 h after, as well as at
24, 48, 72, 96, 120 and 144 h after. A pain scale was used to
assess DOMS at these times. A split-plot analysis (2x15) was
used to analyze the difference between changes in the volume of
the ND vs. D arm for both groups; a contrast-contrast
procedure was used to compare changes in volume for each
group at each time compared to baseline. Soreness was
experienced only by Ex in the ND arm; peak soreness occurred
at 48 h (R = 3.95 out of a possible 6.75). A significant
interaction (p < .01) was found between ND and D across time;
this was due to the volume of the exercised ND arm being
significantly greater (p < .01) from 72 h through 144 h which
represented a 6.4% mean increase over baseline (Y = 9.2;
218.7 + 82.9 ml). In conclusion, we hypothesize that the
observed increases from 72 through 144 h reflect increased
synthesis of connective tissue, which may be part of the
healing response associated with tissue damage and DOMS.
ACCURACY OF OSCILLOMETRIC BLOOD PRESSURE MONITORING AT THE LEFT INDEX FINGER

V. Lythgoe, D. Ayers, and G. Hollins. Exercise Physiology Laboratory, Louisiana State University, Baton Rouge, LA 70803

Accuracy of an oscillometric finger blood pressure monitor (Marshall, Astro F-88) was tested on 125 subjects by comparing it with the standard random-zero mercury sphygmomanometer. Measurements were undertaken by one observer according to the standards set by the American Heart Association and British Hypertension Society. Values for the finger monitor tended to be higher. Mean differences and standard deviations for systolic and diastolic pressures between the two devices were 2.29 ± 14.89 (p < 0.08) and 2.67 ± 14.54 (p < 0.02) mmHg, respectively. These values are not in accordance with the proposed national standards. The correlation coefficient (Pearson) for systolic values between devices is 0.76 (p < 0.0001) and for diastolic is 0.57 (p < 0.0001). Although these differences may well be due to different techniques of monitoring employed by the devices the results show that at present accuracy of the finger monitor is questionable.

Supported by Marshall Electronics and Med-Aid Inc.

DETECTION OF LACTATE THRESHOLD (LT) USING LOG-LOG AND SEMI-LOG TRANSFORMATIONS.

S. Baker, S. Powers, G. Church, and S. Dodd. Louisiana State University, Baton Rouge, LA 70803

We compared the LT determined by the Beaver et al. (J. Appl. Physiol., 59:1936, 1985) technique to a modified log-log and semi-log procedure (Baker). The modification was made in an attempt to eliminate the bias introduced by the assumption that the investigator-picked division point belonged to both of the lines resulting from the transformation. The modified method used piecewise regressions to find the best division of the data into two parts. The LT was defined as the intersection of the two lines determined from the piecewise regression having the smallest mean square error. No significant difference (p > 0.05) in the lactate threshold existed between methods (Baker vs. Beaver) or models (log vs semi-log). However, the log-log model had significantly different mean square errors from the semi-log model (p < 0.05), and the mean square errors of the Baker log-log method were significantly different from those of the Beaver log-log method (p < 0.05). Values are X ± SEM.

<table>
<thead>
<tr>
<th>Method/Model</th>
<th>LT(V0, 1·min⁻¹)</th>
<th>Mean Square Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baker log-log</td>
<td>1.816 ± 0.131</td>
<td>0.0017 ± 0.0005</td>
</tr>
<tr>
<td>Beaver log-log</td>
<td>1.711 ± 0.096</td>
<td>0.0025 ± 0.0006</td>
</tr>
<tr>
<td>Baker semi-log</td>
<td>1.662 ± 0.193</td>
<td>0.0027 ± 0.0006</td>
</tr>
<tr>
<td>Beaver semi-log</td>
<td>1.545 ± 0.155</td>
<td>0.0029 ± 0.0005</td>
</tr>
</tbody>
</table>

It is concluded that the log-log model is a better fit than the semi-log model, and that the Baker log-log method is a more objective method for determining the LT that results in a significantly better fit.
A COMPUTER METHOD TO AID IN THE MEASUREMENT OF ANAEROBIC POWER
H.N. Williford, L.J. Krall, and J. Smidt. Human Performance Lab.,
Auburn University at Montgomery, Montgomery, AL 36193.

The purpose of this investigation was to develop an inexpensive
electronic method to aid in the measurement of anaerobic power. This
method involves interfacing the Apple II computer with a Monark bicycle
ergometer and a photodiode. A pedal detection circuit and a timing
system were built utilizing the computer circuitry. A photo transistor and an infrared
L.E.D., by means of a reflection process were used to detect the
ergometer pedal revolutions. The timing circuit uses a crystal
oscillator/divider along with a 3 decade counter that are wired such
that a 5 second pulse is outputted. A computer program was written in
BASIC to determine anaerobic power with the Wingate Anaerobic Test. The
program asks for the date, subject's name, gender, weight, sex and work
load in kiloponds. The subject then performs the Wingate anaerobic
power 30 sec test. The computer program determines the number of pedal
revolutions for each 5 sec during a 30 sec time period, calculates the
peak power rating in watts (W), the lowest power reading (W), the
average power reading (W), and the power decline index (%). The test
data can then be saved to a data disk or a hardcopy can be printed. To
test the validity of the computer method, trained observers visually
counted the pedal revolutions on 25 subjects and calculated anaerobic
power. Pearson product moment correlations performed between the data of
both methods revealed correlation coefficients of .99 for peak power, mean power, and power decline index. It was concluded that the
computer method is a valid method for determining the examined
variables.

POST-EXERCISE RECOVERY OF MAXIMAL ANAEROBIC POWER
H. C. Hitchcock, Dept. of Physical Education
The University of Tennessee, Knoxville, TN 37996

Following cycle ergometry at workloads equivalent to 60%, 80%, 100%,
and 120% of $\dot{V}_O_2_{\text{max}}$, maximum anaerobic power (MAP) was measured on eight
endurance trained triathletes with an isokinetic dynamometer. MAP was
calculated as the peak torque for each of three consecutive knee
extensions ($t=1, 2, 3$) at 60°/sec immediately post exercise. This
procedure provided three measures of MAP during extensions with $1.75$ sec
rest occurring during the flexion phase of the reciprocating movement.
Immediately post-exercise ($t=1$) MAP decreased to 82.6%, 69.7%, 47.1%, and
38.7% of pre-exercise values for prior exercise intensities (PEI) of 60%,
80%, 100%, and 120% respectively. MAP significantly recovered to 80.6%
and 60.1% of pre-exercise values at $t=3$ for PEI of 80% and 100%
respectively, while MAP showed no recovery following 60% PEI. Following
PEI of 120%, significant recovery (53.7% of initial) occurred by $t=2$.
Thus, the magnitude of MAP recovery appears to be directly related to PEI
and associated fall in MAP immediately post-exercise. These data suggests
that the recovery in MAP occurring following strenuous exercise is not
coupled to reported pH recovery, but more nearly follows reported patterns
in phosphocreatine recovery.

1 Statistical significance based on Tukey’s studentized range, $p < .05$
RELATIONSHIPS BETWEEN MEASURES OF STRENGTH, SPEED, ANAEROBIC POWER, AND BODY COMPOSITION IN YOUNG FEMALE ATHLETES.

P. Freytag, J. Hammett, E. Callen, K. Tice and T. Stec
Human Performance Lab. University of South Carolina-Aiken
Aiken, S.C. 29801

The purpose of this study was to investigate the relationships between isokinetic peak torque knee extension and flexion, 20 and 40 meter sprint times, vertical jump height, anaerobic power and capacity output, and body composition of young female athletes. Twenty six female subjects (mean age, 17.73 yr; mean weight, 67.86 kg; mean height, 166.2 cm) performed several tests: isokinetic knee extension and flexion at 300° -sec⁻¹ to determine peak torque knee extension (PTE) and peak torque knee flexion (PTF); a 30s all-out bicycle ergometer ride to determine peak anaerobic power (PAP) and anaerobic capacity (AC); three-40 meter sprints (40MS) [20 meter sprint times (20MS) were assessed at the midpoint of each 40MS]; three vertical jump (VJ); and body composition assessments [height (HT), weight (WT) and sum of three skinfolds (SF)]. Statistical analyses (Pearson product-moment correlation coefficients) indicated significant positive relationships between: AC and WT, PTE, PTF; PAP and WT, PTE; and AC/WT and VJ. Significant negative relationships were obtained between: AC/WT and SF; PAP/WT and WT, 20MS, 40MS; and VJ and 20MS, 40MS, SF. These data illustrate the positive relationship that exists between lower body strength and strength-dominated muscular power, and the inverse relationship that exists between lower body strength/strength-dominated muscular power and speed-dominated muscular power in these female athletes. These findings also support the importance of specificity of training with regard to skill-specific muscular activity.

EFFECTS OF AN IN-SEASON WEIGHT TRAINING PROGRAM ON MUSCULAR STRENGTH AND ANAEROBIC POWER AND CAPACITY IN MALE COLLEGE BASKETBALL PLAYERS

J. Hammett, E. Callen, S. Nobles, V. Rodemer, and K. Tice.
Human Performance Lab. University of South Carolina-Aiken,
Aiken, S.C. 29801

This investigation determined the effects of an in-season, lower body weight training program on measures of isokinetic musculature strength of the quadriceps and hamstring muscles and anaerobic power and capacity of the lower extremities in male college basketball players. All subjects participate in a pre-season strength and conditioning program, which included a two-day per week weight training program consisting of both lower and upper body lifts. Prior to the beginning of the season, strength and anaerobic power and capacity measures were assessed on all subjects. Isometric peak torque knee extension (PTE) and peak torque knee flexion (PTF) strengths were obtained via a Lido isokinetic device with the velocity set at 900° -sec⁻¹. Anaerobic capacity (AC) was assessed from a 30-sec all-out bicycle ergometer ride with the resistance set at .075 kp/kgbw (Wingate Power Test). Peak anaerobic power (PAP) represented the highest power output during any 5-sec period of the ergometer ride. After pre-tests, the subjects were assigned into either a control (Con) or experimental (Exp) group. Exp continued the lower body weight training program throughout the season (16 weeks) whereas Con did not. Following the end of the basketball season both groups were retested on all measures. Statistical analyses (ANOVA) indicated that only Exp significantly (p<.05) increased in PTF from pre to post testing. Con also increased in PTF, however, the increase was not significant. There was a significant interaction between group and testing reflecting the increase in PAP in Exp and the decrease in PAP in Con from pre to post testing. Also, Con significantly decreased in AC whereas Exp increased in AC, although not significantly. PTE remained unchanged between pre and post measures for both groups. These findings suggest that in-season lower body weight training is beneficial in helping to maintain and improve lower body strength and power in male college basketball players.
The purpose of this study was to compare the physiological and perceptual responses to weight lifting and treadmill exercise performed at matched rates of oxygen uptake. Fifteen males (mean ±SD) age = 22.7 ± 1.6 yrs; height = 175.0 ± 6.2 cm; weight = 82.0 ± 14.3 kg) performed a 27-minute bout of weight lifting consisting of two circuits of eight exercises performed at 60% of one repetition maximum with a work/rest ratio of 45 seconds/60 seconds. Approximately five days following weight lifting each subject walked or jogged on the treadmill at a pace which elicited an oxygen uptake matched with his mean value during weight lifting. Oxygen uptake, respiratory exchange ratio, and ventilation were measured during both exercise sessions using open circuit spirometry. Blood samples were drawn immediately post-exercise and analyzed for lactate using an enzymatic procedure. Heart rate was determined from electrocardiograph recordings. Rating of perceived exertion was determined using the Borg scale. Oxygen uptake during weight lifting (1.58 l/min) and treadmill exercise (1.55 l/min) were not significantly different (p<0.05), thus the two activities were matched for rate of oxygen uptake. Weight lifting elicited a significantly (p<0.05) higher respiratory exchange ratio (0.97 versus 0.77), ventilation (54.7 versus 37.2 l/min), lactate (9.5 versus 0.8 mmol/l), heart rate (140 versus 110 bts/min), and rating of perceived exertion (12.8 versus 9.6) compared to treadmill exercise. In conclusion, weight lifting elicits greater physiological and perceptual stresses compared to treadmill exercise when the two activities are performed at matched rates of oxygen uptake and equal durations.

PHYSIOLOGICAL ADAPTATIONS DURING A ONE WEEK JUNIOR ELITE WEIGHTLIFTING TRAINING CAMP
M.H. Stone, HEPELS Appalachian State University, Boone NC 28608; R.E. Keith and D. Marple, Auburn University, Alabama; S.J. Fleck and J.T. Kearney, USOTC Sports Physiology, Colorado Springs, Colorado.

The physiological effects of a one wk training camp were assessed using elite US junior weightlifters (n=14; age=18.5±1.4 yrs, Ht=169±8 cm, body mass=72±10 kg, % fat=6±2, LBM=67±9 kg). The variables used to assess training status included Triglycerides (TG), Total Cholesterol (T-chol), HDL-C, T-chol/HDL-C, Minerals, Glucose (GLU), Testosterone (T), Estradiol (E2), Cortisol (C), Growth Hormone (GH), T/C, T/E2 and Ammonia (NH3). Dietary factors were assessed by dietary recall over 3 alternate days. Blood Lipids, Glucose and Ammonia were measured by centrifugation and spectrophotometric methods. Hormones were measured by RIA. Blood was drawn after a 12 hr fast on day 1 and on day 8. One wk of camp produced significant changes (p < 0.05) in several variables:

* TG  * T-chol  * HDL-C  * C  * NH3

D1 104±8  67±2  170±12  62±0.5
D2 130±18  171±7  50±2  211±13  9±0.4

No other variables were significantly different. Several individual T/C ratios decreased by 25 % or greater. These data are indicative of the early stages of overtraining.
CORRELATES TO PERFORMANCE ON FIELD AND LABORATORY STRENGTH TESTS IN 9-11 YEAR OLD BOYS AND GIRLS.

Stepwise regression was used to generate prediction models for scores on field tests of strength: pull-ups (PUL), flexed arm hang (FAH), push-ups (PUSH), two types of modified pull-ups (MPULI, MPULII); and laboratory tests of strength: bench press 1RM (BP1RM), latissimus dorsi pull-down 1RM (LAT1RM), biceps curl 1RM (BC1RM), and isometric hand grip (HNGP). Independent variables included: age, ht, wt, sex, lean body mass (LBW), % fat, dominant arm length (DAL), total activity score, arm activity score, community recreation participation score, and a composite strength score (sum 1RM's) that was included in the list for field tests only. Results for prediction of field test scores indicated that the model for prediction of MPULI included % fat, sum 1RM's, and LBW, and explained 53% of the variance. The models for PUSH (sex, % fat, sum 1 RM's), PULL (% fat, sex, ht), FAH (%fat), and MPULII (% fat, sex, ht, DAL) explained 38%, 32%, 31%, and 26% of the variances, respectively. Results for prediction of lab test scores revealed that the models for LAT1RM (LBW, sex), BP1RM (LBW, sex, ht), BC1RM (LBW, sex), and HNGP (sum 1RM's) explained 58%, 54%, 48%, and 15% of the variances, respectively. These results indicate that field scores were predicted mainly by % fat and to a lesser degree by sex, whereas, lab test scores were predicted mainly by LBW and to a lesser degree by sex.

PHYSIOLOGICAL CORRELATES TO 800 METER PERFORMANCE
Applied Physiology Laboratory, Louisiana State University,
Baton Rouge, LA and Heart and Fitness Center, Baton Rouge, LA

Most of the previous research efforts aimed at determining those physiological characteristics that contribute to middle distance running success have centered around distances \geq 1500 meters with little attention to events such as the 800 meter run. It was the purpose of these experiments to examine the relationship between selected physiological and anatomical characteristics and performance in an 800 meter run. Measurements of body composition, VO2, max, running economy, and performance times for 100 and 300 meter dashes were obtained on 11 male track athletes. Stepwise multiple regression analysis was performed using 800 meter race time as the dependent variable. The combination of 300 and 100 meter run times, percent body fat, running economy and VO2 max as independent variables account for the greatest amount of total variance ($r^2 = .89$). However, the additional variance explained by the model did not increase significantly ($p > 0.05$) when VO2 max, percent body fat, and running economy were added to a model which contained 300 and 100 meter time ($r^2 = .85$) as the explanatory variables. These data offer additional support for the notion that much of the inorganic ATP produced and utilized during an 800 meter run comes from anaerobic metabolic pathways.
THE EFFECT OF TWO-LEG AND ONE-LEG TRAINING ON TWO-LEG AND ARM AEROBIC POWER.

T.C. Swensen and E.T. Howley. University of Tennessee, Knoxville, TN. 37996

Three groups of subjects, two training groups and a control group, were formed to determine what effect varying the quantity of muscle aerobically trained had on two-leg and two-arm aerobic power. Seven subjects trained on cycle ergometers with both legs simultaneously, 30 minutes a day, 4 days a week for 4 weeks. Nine subjects trained on cycle ergometers with each leg separately, 15 minutes a day, 4 days a week for 4 weeks. Both groups trained at an intensity equal to 75% of two-leg maximal aerobic power. Arm and leg oxygen uptake tests were conducted before and after training. Only the two-leg training induced significant gains in arm aerobic power (p<.0003), while both modes of training promoted significant improvement in two-leg aerobic power (p<.0008). The conclusions reached: 1. Two-leg training may have promoted larger increases in arm aerobic power than did one-leg training because the two-leg trained group had more muscle mass metabolically active during training and, therefore, experienced greater central cardiovascular adaptations; 2. The significant gain in two-leg aerobic power experienced by the one-leg trained group appears to be independent of central cardiovascular adaptations and dependent on leg muscle changes.


The purpose of this study was to determine whether blood sampling site has any significant effect upon experimental values. Thirty-one subjects volunteered to participate via informed consent. Resting and post-exercise (maximal aerobic effort) whole blood samples were extracted simultaneously via finger stick and via venipuncture. These samples were subsequently treated in a parallel manner. Lactates and hematocrits were determined in duplicate within five minutes using a YSI-23L Lactate Analyzer and a CS&SE-33 centrifuge. The YSI-23L was calibrated frequently (5.7 analyses/call) during the analyses. The data elicited from these capillary (CWB) and venous (VWB) samples were then used to determine whether hematocrit and lactate values are essentially the same across these two sampling sites.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>REST</th>
<th>EXERCISE</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>VWB Hematocrit</td>
<td>44.0±4.6</td>
<td>46.6±2.6</td>
<td>7.4**</td>
</tr>
<tr>
<td>CWB Hematocrit</td>
<td>43.0±6.4</td>
<td>45.0±6.6</td>
<td>6.1**</td>
</tr>
<tr>
<td>VWB-CWB, Rest</td>
<td>0.2</td>
<td>.90</td>
<td></td>
</tr>
<tr>
<td>VWB-CWB, Ex.</td>
<td>2.0*</td>
<td>.85</td>
<td></td>
</tr>
<tr>
<td>VWB Lactate</td>
<td>0.73±.3</td>
<td>6.94±.4</td>
<td>17.7**</td>
</tr>
<tr>
<td>CWB Lactate</td>
<td>1.12±.9</td>
<td>7.91±.8</td>
<td>18.3**</td>
</tr>
<tr>
<td>VWB-CWB, Rest</td>
<td>6.3**</td>
<td>.78</td>
<td></td>
</tr>
<tr>
<td>VWB-CWB, Ex.</td>
<td>3.8**</td>
<td>.81</td>
<td></td>
</tr>
</tbody>
</table>

As you can see from the table above, they are not. Only the group hematocrit changes showed any real constancy. There is even contradiction here, however, for the correlation between individual hematocrit changes was quite low (R=0.28, n.s.). The correlation between venous and capillary exercise lactate values yielded considerable error (R=0.81, SEE=1.24), and the venous values were consistently (91%) and significantly (P<.01) lower than the capillary values. We recommend, therefore, that caution be employed when interpreting results involving these variables. Venous and capillary whole blood values are clearly not the same.
INJURIES DIAGNOSED IN JUNIOR ELITE TENNIS PLAYERS
Lexington Clinic Sports Medicine Center, Lexington, KY 40503

Fifty three junior elite tennis players were evaluated by a
physician for current injuries at a resident tennis camp. An
injury was defined as “any occurrence of disability or pain that
alters performance of the athlete in practice or in a match”.
Thirty injuries were diagnosed in 24 athletes (a 45% injury rate).
The most common injuries diagnosed were rotator cuff tendinitis
(10%), piriformis strain (10%), medial/lateral epicondylitis
(10%), paraspinal muscle strain (7%), ankle sprain (7%), medial
coronary ligament sprain (7%), tight hamstrings (7%), and
latissimus strains (7%). Other injuries included a meniscal
tear, sacroiliitis, tight gastorcnemius, “shin splints”, tight
iliotibial bands, patellar tendinitis, pronator quadratus strain,
lumbar intersegmental hypomobility, chondromalacia patella, and
a chronic cervical strain. Eighty percent of the injuries found
were considered to be of the overload variety with only twenty
percent being traumatic. The extent to which these overload
injuries common in tennis players are preventable with strength
and flexibility training should be investigated.

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