

AMERICAN COLLEGE of SPORTS MEDICINE

Southeast Regional Chapter

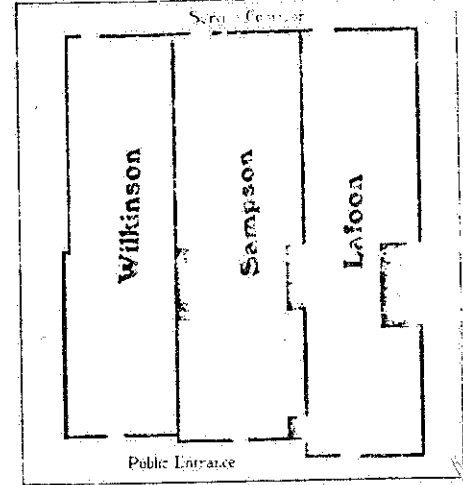


January 31 - February 2, 1991
18th Annual Meeting
Louisville, Kentucky



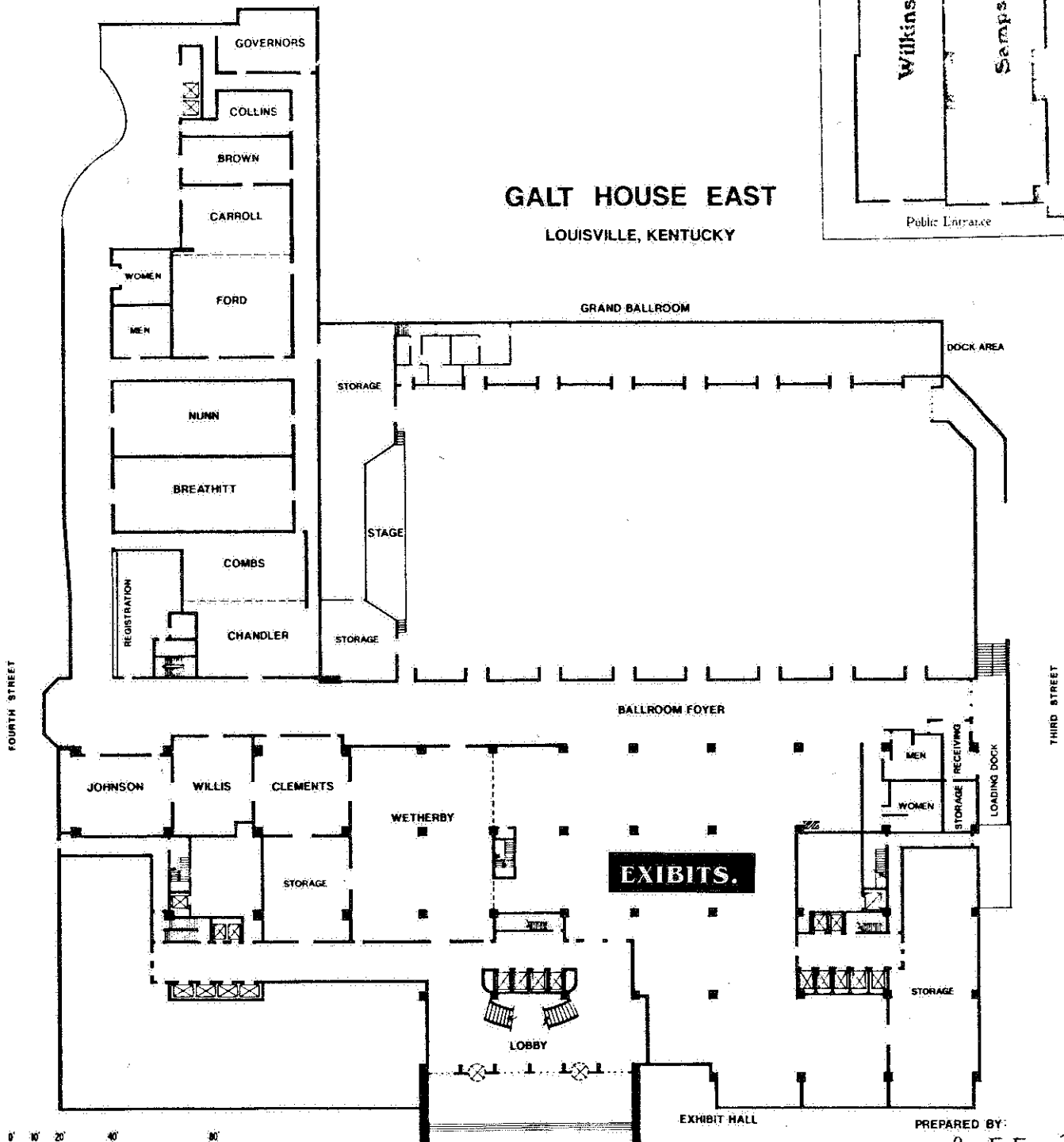
ABSTRACTS

1ST FLOOR — GALT HOUSE EAST



GALT HOUSE EAST

LOUISVILLE, KENTUCKY



2ND FLOOR
THE GALT HOUSE EAST

PREPARED BY:

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3752 CRITTENDEN DR
LOUISVILLE, KY 40209-1122
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SEACSM SALUTES OUR CORPORATE SPONSORS

Eighteenth Annual Meeting
**SOUTHEAST REGIONAL CHAPTER
AMERICAN COLLEGE OF SPORTS MEDICINE**

The Galt House Hotel
Louisville, Kentucky

January 31- February 2, 1991

Officers

President:

Harry DuVal, University of Georgia

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Meeting Host:

J. W. Yates, University of Louisville

Publisher and Editor:

Jon MacBeth, Department of Health, Physical Education, Recreation,
And Safety, Middle Tennessee State University

Meeting Objective

The objectives of this annual meeting are to provide students, scientists, educators and sports medicine practitioners with new research findings, a synthesis of current theories and applications, and contemporary approaches in clinical practice. These objectives will be accomplished via featured addresses, poster presentations, tutorials, symposium and free communications.

Planning Committee

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Maria Burgess
Jeff Chandler
Kevin Davy
Harry DuVal
Emily Haymes

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Ben Kibler, Clinical track program chair
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Paul Ribisl
Phil Sparling
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Art Weltman
Melvin Williams

SUPPORT OUR EXHIBITORS. VISIT OUR EXHIBITS.

Chronology of SEACSM Meetings & Officers

	Date/Place	Pres./PastPres/PresElect	Executive Board
1st	Fall 1973 Gatlinburg, TN		
2nd	Fall 1974 Atlanta, GA	Andrew Kozar	
3rd	Fall 1975 Charlottesville, VA	Clyde Partin	
4th	Fall 1976 Murfreesboro, TN	Rankin Cooter	
5th	Fall 1977 Lexington, KY	Ed Howley	Steve Blair Ron Byrd Joe Smith
6th	Feb. 16-17, 1979 Atlanta, GA	Dennis Wilson Ed Howley Ron Byrd	Earl Allen Thad Crews Art Weltman
7th	Feb. 8-9, 1980 Charlotte, NC	Ron Byrd Dennis Wilson Paul Ribisl	Bruce Gladden Jay Kearney Russ Pate
8th	Feb. 6-7, 1981 Charleston, SC	Paul Ribisl Ron Byrd Bill Herbert	Joe Chandler Tom Cronan Kirk Cureton Harvey Murphy (ES)
9th	Feb. 5-6, 1982 Blacksburg, VA	Bill Herbert Paul Ribisl Russ Pate	Kirk Cureton Joe Chandler Harvey Murphy Tom Cronan Jon MacBeth (ES)
10th	Feb. 4-5, 1983 Gainesville, FL	Russ Pate Bill Herbert Kirk Cureton	David Cundiff Scott Powers Earl Allen Jon MacBeth (ES)
11th	Feb. 3-4, 1984 Auburn, AL	Kirk Cureton Russ Pate Chris Zauner	Emily Haymes Phil Sparling Mike Stone Ron Bos (ES)
12th	Jan.31-Feb2, 1985 Boone, NC	Chris Zauner Kirk Cureton Robert McMurray	Harry DuVal J.W. Yates John Billings Diane Spittler Ron Bos (ES)
13th	Jan. 23-25, 1986 Athens, GA	Robert McMurray Scott Powers	Diane Spittler John Billings Terry Bazzarre Larry Durstine Russ Pate (N) Ron Bos (ES)
14th	Jan. 29-31, 1987 Charleston, SC	Scott Powers Robert McMurray Diane Spittler	Terry Bazzarre Larry Durstine Janet Walberg Steve Messier Allen Moore (S) Russ Pate (N) Ron Bos (ES)

	Date/Place	Pres./PastPres/PresElect	Executive Board
15th	Jan. 28-30, 1988 Winston-Salem, NC	Diane Spittler Scott Powers Phil Sparling	Janet Walberg Steve Messier Gay Israel Dalynn Badenhop Mark Senn (S) Russ Pate (N) Ron Bos (ES)
16th	Jan. 19-20, 1989 Atlanta, GA	Phil Sparling Diane Spittler Emily Haymes	Dalynn Badenhop Mark Davis Gay Israel David Peltzer (S) Art Weltman Kirk Cureton (N) Ben Kibler (MD) Ron Bos (ES)
17th	Feb. 1-3, 1990 Columbia, SC	Emily Haymes Phil Sparling Harry DuVal	Jerry Brandon Mark Davis Diane Ward Art Weltman Maria Burgess (S) Ben Kibler (MD) Kirk Cureton (N) Ron Bos (ES)
18th	Jan. 31-Feb.2, 1991 Louisville, KY	Harry DuVal Emily Haymes Steve Messier	Jerry Brandon Jeff Rupp Amanda Timberlake Dianne Ward Maria Burgess (S) Kevin Davy (S) Alan Rogol (MD) Kirk Cureton (N) Ron Bos (ES)

ES = Executive Secretary
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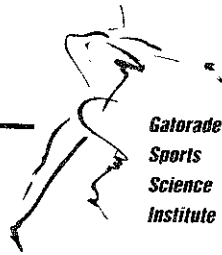
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*The Gatorade
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Extends a Warm Welcome
to all
Southeastern American College
of Sports Medicine
Annual Meeting Attendees!*

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

1991 Annual Meeting Program

**The Galt House Hotel
Louisville, Kentucky**

Thursday, January 31

- 12:00 - 2:00 EXECUTIVE BOARD MEETING
(Lafoon)
- 2:00-7:00 SPEAKER READY ROOM
(Exhibit Hall)
- 2:00 - 6:00 VISIT EXHIBITS
(Exhibit Hall)
- 2:00 - 6:00 REGISTRATION
(Exhibit Hall)
- 4:00 - 5:00 FREE COMMUNICATIONS: **Physiology and the Elderly**
Chair: Bob Moffatt, Florida State University
(Clements)
- (4:00-4:15) **1** **A comparative analysis of lipid profiles for
premenopausal and postmenopausal women.** R.
Fisher and W. Thompson. The University of Southern
Mississippi.
- (4:15-4:30) **2** **The effects of a 9-week strength training regime on the
body strength of 64-84 year old males.** B. Glass and
D. Kinsman. Austin Peay State University.
- (4:30-4:45) **3** **Incidence of injury during moderate and high intensity
walking exercise in elderly men and women.** J.E.
Graves, J. Carroll, M.L. Pollock, S. Leggett, D. Spittle, and
D. Lowenthal. University of Florida.

(4:45-5:00)

4

Effects of walking on memory, cardiovascular function and blood lipids in older adults. K.S. Greene, D.L. Blessing, M. Daviera, and H.N. Williford. Auburn University.

4:00 - 5:00

FREE COMMUNICATION: Metabolic Responses to Exercise
Chair: Mindy Millard-Stafford, Georgia Tech
(Wilkinson)

(4:00-4:15)

5

***Metabolic responses to drafting during front crawl swimming.** D.R. Bassett, Jr., J. Flohr, W.J. Duey, E.T. Howley, and R.L. Pein. University of Tennessee.

(4:15-4:30)

6

***Metabolic determinants of 12-minute swim performance in young women.** D.S. Conley, K.J. Cureton, E.J. Higbie, B.T. Hinson, and P.G. Weyand. The University of Georgia.

(4:30-4:45)

7

Evaluation of metabolic, cardiovascular, and myocardial adaptations to competitive endurance cycling. D. Schenck, R.B. Kreider, G.W. Miller, C.W. Cortes, C. Turner, and P. Rowland. Old Dominion University.

(4:45-5:00)

8

***A comparison of the metabolic and cardiovascular adaptations to walking and jogging at an identical speed.** M.P. Foley and D.R. Redondo. University of Southern Mississippi.

4:00-5:00

FREE COMMUNICATIONS: Resistance Training and Testing
Chair: Jerry Brandon, Georgia State University
(Willis)

(4:00-4:15)

9

A comparison of agonist-antagonist shoulder muscle ratios between prepubertal and postpubertal 12-year old boys. J.R. Ramsey, F.J. Servedio, W.A. Morrison, T. Boone, R. Kazelskis. University of Southern Mississippi.

(4:15-4:30)

10

Effects of resistance exercise and cycling on recovery blood pressure. S.P. Brown, J.M. Clemmons, Q. He, S. Liu, D. Fadgen, E.R. Anderson. The University of Mississippi.

*This abstract was selected by the reviewers as one of the top 30 abstracts out of 99 submissions.

(4:30-4:45) **11** **Effects of resistance training on changes in strength and muscularity in young and middle-age women.** M. H. Stephens, G.D. Wilson, R.E. Cartee, and T.G. Reeve. Auburn University.

(4:45-5:00) **12** ***Effect of testing order on isometric torso rotation strength.** D. Carpenter, J. Graves, J. Blanton, S. Leggett, and M. Pollock. University of Florida.

4:00-5:00 **FREE COMMUNICATIONS: Exercise Physiology**
Chair: Phil Sparling, Georgia Tech
(Sampson)

(4:00-4:15) **13** ***Fluid homeostasis and thermoregulation during a multi-stage ultraendurance cycling event.** B. Drinkard, R.B. Kreider, T. Drews, and C.W. Cortes. Old Dominion University.

(4:15-4:30) **14** **Effects of dietary ascorbic acid and exercise on guinea pig tissue ascorbic acid, plasma cortisol and LDH.** R.E. Keith, M.C. Sun. Auburn University.

(4:30-4:45) **15** ***Ninety second cycle ergometer tests for assessing anaerobic glycolytic power.** S.N. Pearman, and A.C. Hackney. University of North Carolina.

(4:45-5:00) **16** ***Evidence of hemolysis, altered hormonal and vitamin status, fecal blood loss, and anemia in response to multi-stage ultraendurance cycling.** R.B. Kreider, B. Drinkard, T. Drews, C.W. Cortes, S.R. Sechrist, C.T. Somma, M. L. Woodhouse, and L.M. Shall. Old Dominion University.

5:00 - 6:00 **STUDENT MIXER**
(Exhibit Hall)

*This abstract was selected by the reviewers as one of the top 30 abstracts out of 99 submissions.

7:45 - 9:00

KEYNOTE ADDRESS

(Archibald)

William L. Haskell, Ph.D

Stanford Center for Research in Disease Prevention

Stanford University School of Medicine

Palo Alto, California

*"Physical Activity and the Prevention of Coronary Artery Disease:
The Stanford Experience."*

Sponsored by Quinton Instruments Co.

BUSINESS MEETING

Harry DuVal , President , SEACSM

9:00 - 11:00

SEACSM SOCIAL

(Exhibit Hall)

Sponsored by *Dr. Rudy J. Ellis* SPORTS MEDICINE
CENTER

Friday, February 1

8:00 - 12:00

REGISTRATION

(Exhibit Hall)

7:00-7:30

SEACSM COMPLIMENTARY BREAKFAST

(Wetherby)

7:30-8:30

SEACSM BREAKFAST SPEAKER

(Wetherby)

John Lombardo, M.D

The Ohio State University

Columbus, Ohio

"Olympic Team Physician Experiences"

Sponsored by AIRCAST INC.

7:30 - 5:30

SPEAKER READY ROOM

(Exhibit Hall)

8:30- 9:30

TUTORIALS

Beyond training! how athletes enhance performances legally and illegally. Melvin Williams, Old Dominion University.

Chair: Robert McMurray, University of North Carolina at Chapel Hill
(Clements)

Problems in using bioelectrical characteristics in physiological measurement. Phil Bishop, The University of Alabama.

Chair: Jay Graves, University of Florida
(Sampson)

Efficacy of transtelephonic exercise monitoring in hospital base cardiac rehabilitation programs. Donald K. Shaw and Kenneth Sparks, Saint Thomas Hospital, Nashville, TN.

Chair: Don Bergey, Wake Forest University
(Lafoon)

Industrial applications of exercise science, career alternative for the exercise physiologist and biomechanist. Gregory S. Rash, The Rehabilitation Institute, Mobile, AL.

Chair: Raymond McCoy, College of William and Mary
(Wilkinson)

8:30- 9:30

TUTORIAL-CLINICAL TRACK

Chair: David Jackson, University of Kentucky
(Willis)

(8:30-8:50)

Foot and ankle problems in the athlete. J.A. Lombardo, Ohio State University.

(8:50-9:10)

Evaluation and treatment of acute ankle sprains. M. Ray, University of Kentucky.

(9:10-9:30)

Evaluation and treatment of chronic ankle pain. W.B. Kibler, Lexington Clinic Sports Medicine Center, Lexington, KY.

9:00 - 5:00 EXHIBITS - Visit throughout the day!
 These exhibitors help support our meeting.

9:30 - 12:00 **POSTER PRESENTATIONS, Group 1 (# 1 through 11)**
 Authors present from 11:00 to 12:00
 (Exhibit Hall)

9:30-10:30 **SEACSM SCHOLAR LECTURE**
 (Combs-Chandler)

Wendell N. Stainsby, Sc. D
The University of Florida
College of Medicine
Gainesville, FL
"Some Lessons from Muscle Applied to Exercise"

10:30-10:45 BREAK - Coffee and Juice
 (Exhibit Hall)

10:45 - 12:00 **TUTORIAL - CLINICAL TRACK**
 (Willis)

Lumbar and cervical pain in the athlete. S.A. Herring,
Puget Sound Sports Medicine, Seattle, Washington.
Chair: Mike Ray, University of Kentucky

10:45 - 11:45 **SEACSM INVITED TUTORIAL**
 (Clements)

Kenneth Powell, M.D.
Center for Disease Control
Atlanta, GA.
"Progress and problems in promoting physical activity."
Chair: Barbara Ainsworth, University of North Carolina at
Chapel Hill.

SUPPORT OUR EXIBITORS, VISIT OUR EXIBITS.

10:45 - 11:45

FREE COMMUNICATIONS: Exercise Biochemistry

Chair: Bruce Gladden, Auburn University
(Wilkinson)

(10:45-11:00)

17

Time course relationship of serum creatine kinase and muscle soreness to an exhaustive weight lifting bout. B.T. Boyer, C. Lewis, and A.H. Goldfarb. University of North Carolina at Greensboro.

(11:00-11:15)

18

Changes in plasma prostaglandin E2 after eccentric exercise. L.L. Smith, J.M. Wells, J.A. Houmard, S.T. Smith, R.G. Israel, M.R. McCammon and S.N. Pennington. East Carolina University.

(11:15-11:30)

19

***Effects of endogenous opioids on the gonadotropin response to physical and mental tasks.** R.G. McMurray and A. Grossman. University of North Carolina, Chapel Hill.

(11:30-11:45)

20

***Effects of acute exercise intensity on plasma lipid concentrations.** P.G. Davis, W.P. Bartoli, and J.L. Durstine. The University of South Carolina.

10:45-11:45

FREE COMMUNICATIONS : Physiologic Economy

Chair: Michael Berry, Wake Forest University
(Sampson)

(10:45-11:00)

21

Running economy and body structure in well-trained runners. D. Morgan, S. Strohmeier, R. Borden, P. Greer, C. Burleson, C. Caruso, and M. Craib. The University of North Carolina at Greensboro.

(11:00-11:15)

22

Estimate of energy cost at similar submaximal workloads for the Monark 868, Bodyguard 990, and Randall Windracer cycle ergometers. C.L. Burleson and A.H. Goldfarb. University of North Carolina at Greensboro.

(11:15-11:30)

23

***Effects of strenuous cycling on running economy.** S.P. Bailey, C. Maney, and R.R. Pate. University of South Carolina.

*This abstract was selected by the reviewers as one of the top 30 abstracts out of 99 submissions

(11:30-11:45)

24

Comparison of biological, performance and training variables in male and female cross-country runners over a competitive season. M. Loftin, B. Warren, J. Mayhew, and I. Wilkinson University of New Orleans and Northeast Missouri State University.

11:45 - 1:00

LUNCH

1:00 - 2:15

PRESIDENTIAL LECTURE

(Wetherby)

Neil B. Oldridge, Ph.D

President, American College of Sports Medicine
The University of Wisconsin, Milwaukee

"Outcome Assessment: Cardiac Rehabilitation"

Sponsored by Gatorade Sport Science Institute

2:00-4:30

POSTER PRESENTATIONS, Group 2 (# 12 through 23)

Authors present from 3:30 to 4:30

(Exhibit Hall)

2:15 - 3:30

CLINICAL TRACK SYMPOSIUM: OVERLOAD INJURIES IN THE ATHLETE.

Chair: Robert A. Davenport, Lexington Clinic Sports Medicine Center, Lexington, KY.

(Sampson)

(2:15-2:40)

Overview, common causes. J.A.Lombardo, Ohio State University.

Sponsored by AIRCAST INC.

(2:40-3:05)

Framework for evaluation. W.B. Kibler, Lexington Clinic Sports Medicine Center, Lexington, Kentucky.

(3:05-3:30)

Principles of rehabilitation. S.A. Herring, Puget Sound Sports Medicine Seattle, Washington

Sponsored by SYNTEX

2:15 - 3:15

FREE COMMUNICATIONS: Muscle Physiology

Chair: Jay Williams, Virginia Tech.
(Clements)

(2:15 - 2:30)

25

Muscle fasciculation with high lactate concentration during contractions of in situ canine skeletal muscle. R.E. Crawford, M. J. Webster, and L. B. Gladden. Auburn University.

(2:30 - 2:45)

26

***Interstitial volume is reduced by exercise in cat skeletal muscle.** D. S. Ward, P. D. Watson, and M.T. Hamilton. University of South Carolina.

(2:45 - 3:00)

27

Serum creatine kinase and delayed onset of muscle soreness in bicycle riders completing a strenuous 100 mile ride. C.L.Lewis, A.H. Goldfarb, and B. Boyer. University of North Carolina at Greensboro.

(3:00 - 3:15)

28

Low dose isoproterenol treatment alters the cardiac isomyosin distribution in rats. G.S. Morris. Louisiana State University.

2:15-3:15

TUTORIALS

Effective motivational and organizational techniques for fitness classes. R. Thomas Trimble, The University of Georgia.

Chair: William Hottinger, Wake Forest University.
(Wilkinson)

Blood lactate: its use in exercise testing, prescription, and evaluation of training adaptations. Glenn Gaesser, University of Virginia.

Chair: Lynn Berry, Winston-Salem State University
(Willis)

The anatomy of good, useless, and dangerous flexibility exercises. Tommy Boone, The University of Southern Mississippi.

Chair: Lucille Smith, East Carolina University
(Lafoon)

*This abstract was selected by the reviewers as one of the top 30 abstracts out of 99 submissions

3:15 - 3:30

BREAK

3:30-4:30

FREE COMMUNICATIONS: **Psychophysiology**
Chair: Barbee Myers, Wake Forest University
(Lafoon)

(3:30-3:45)

29

Relationship between perceived ideal weight and computed ideal weight for men and women. M.R. McCammon, G.M. Poteat, and R.G. Israel. East Carolina University.

(3:45-4:00)

30

***Effects of exercise training and psychological stress on non-specific immune function in mice.** T.R.H. Bacro, J.A. Woods, J.M.Davis, and E. Mayer. University of South Carolina.

(4:00-4:15)

31

Fitness level and response to a non-exercise stressor. L.R. Martinez, D.S. Ward, W.P. Bartoli, W.A. Burgess, E.E. Shoup, and J.M. Davis. University of South Carolina.

(4:15-4:30)

32

Effects of Multi-stage ultraendurance cycling on psychological profiles of exertion, feeling, and mood. T. Drews, R.B. Kreider, B. Drinkard, and C.W. Jackson. Old Dominion University.

3:30 - 4:30

FREE COMMUNICATIONS: **Validation of Experimental Techniques.**
Chair: Reed Humphrey, Virginia Tech.
(Wilkinson)

(3:30-3:45)

33

Validation of NIR and BIA for estimating body composition of black football players. R.G. Israel, T. Hortobagyi, J.A. Houmard, M.R. McCammon, K.F. O'Brien, J.A. Wells, A.W.Eaton, and B.S.Zamora. East Carolina University.

(3:45-4:00)

34

***There is essentially no order effect associated with fingertip blood sampling.** R. Godsen, J. Smith, and J. Kime. College of Charleston and The University of Alabama.

*This abstract was selected by the reviewers as one of the top 30 abstracts out of 99 submissions

(4:00-4:15)

35

Accuracy of the ACSM equation for predicting the VO₂ of "aerobic bench stepping" in females. M. Scharff-Olson and H.N. Williford, Jr. Auburn University at Montgomery.

(4:15-4:30)

36

Effect of body and arm position on the measurement of systolic blood pressure. H. Williams, J. Heimdal, and T. Boone. The University of Southern Mississippi.

3:30 - 4:30

TUTORIALS

Strength training in children: physiologic benefit and potential damage. Arthur Weltman, The University of Virginia.

Chair: Dianne Ward, University of South Carolina.
(Clements)

The role of protein oxidation during ultraendurance triathlon performance. Richard B. Kreider, Gary Miller, and Mary Tew, Old Dominion University.

Chair: Jeff Rupp, Georgia State University
(Willis)

3:45 - 4:30

CLINICAL TRACK: CLINICAL CASE ABSTRACTS

Hip Pain in Athletes

Chair: Mike Ray, University of Kentucky Sports Medicine Center.

(Sampson)

(3:45-4:00)

37

Hip pain in a collegiate runner. A.J. Colosimo and M.L. Ireland. Kentucky Sports Medicine Center, Lexington, KY.

(4:00-4:15)

38

Hip pain in a professional ballet dancer. H.A. Stiene, University of Kentucky Sports Medicine Center.

(4:00-4:30)

39

Hip pain in a recreational runner. J.L. Chang, Kentucky Sports Medicine Clinic, Lexington, KY.

4:30 - 5:30

SEACSM STUDENT SYMPOSIUM

(Wetherby)

Larry Kenney, Ph.D

The Pennsylvania State University

University Park, PA

"Student Research: To Ask the Right Question "

4:30 - 5:30

FREE COMMUNICATIONS : Biomechanics

Chair: Barry Frishberg, South Carolina State University

(Lafoon)

(4:30 - 4:45)

40

3D kinematics contributing to elite shotput throws. R.W. McCoy. The College of William and Mary.

(4:45 - 5:00)

41

The effect of intense participation in youth sports on strength and flexibility in preadolescent athletes. T.J. Chandler, W,B Kibler, C.J. Odom, and B.P. Wooten. Lexington Clinic Sports Medicine Center.

(5:00 - 5:15)

42

A comparison of strength and throwing velocity relationships between pre- and post-pubescent 12-year-old boys. F.J. Servedio, J.R. Ramsey, and W.J. Morrison. The University of Southern Mississippi and The Hattiesburg Clinic.

(5:15 - 5:30)

43

The influence of treadmill training on the mechanical properties of bone in senescent female rats consuming copper deficient diets. R.T. Smith. University of Southern Mississippi.

4:30 - 5:00

CLINICAL TRACK: CLINICAL CASE ABSTRACTS

Ankle

Chair: David Jackson, Department of Rehabilitation Medicine, University of Kentucky.

(Sampson)

(4:30-4:45)

44

Inversion ankle sprain-football. G.B. Wilkerson, Centre College, Danville, KY.

(4:45-5:00) **45** **The arthroscopic ankle brace, clinical experience.** R.W. Lowe
Scott Orthopedic Center, Paintsville, KY.

5:00 - 5:45 **CLINICAL TRACK: CLINICAL CASE ABSTRACTS**
Chair: Stanley A. Herring, Puget Sound Sports Medicine,
Seattle, WA.
(Sampson)

(5:00-5:15) **46** **Early return to activity after anterior cruciate ligament reconstruction: a case study.** J.A. Nyland, D.P. Currier, J.M. Ray, M.J. Duby, Division of Sports Medicine, The University of Kentucky.

(5:15-5:30) **47** **Sports-specific muscle imbalance-tennis.** C.J. Odom, T.J. Chandler, W.B. Kibler, Lexington Clinic Sports Medicine Center, Lexington, KY.

(5:30-5:45) **48** **Club lacrosse: a physiological and injury profile.** J.A. Nyland and D. Jackson. Division of Sports Medicine, University of Kentucky.

4:30-5:30 TUTORIAL

Exercise and the immune system. David C. Nieman, Appalachian State University.
Chair: Mark Davis, University of South Carolina.
(Clements)

5:30 - EXERCISE, DINNER, REUNIONS!

SEE AND ENJOY LOUISVILLE

Saturday, February 2

8:30 - 10:30 REGISTRATION

8:30 - 12:00 SPEAKER READY ROOM
(Exhibit Hall)

- 8:30 - 9:30 **TUTORIALS -CLINICAL TRACK**
 Chair: W. Ben Kibler, Lexington Clinic Sports Medicine
 Center, Lexington, KY.
 (Willis)
- (8:30-9:00) **Heat illness in the athlete.** R.Q. Bailey, Danville, Kentucky.
- (9:00-9:30) **Endocrinologic concerns in the athlete.** A.D. Rogol,
 University of Virginia.
- 8:30 - 11:15 **POSTER PRESENTATIONS Group 3 (# 24 through 35)**
 Authors present from 10:15 - to 11:15
 (Exhibit Hall)
- 8:30 - 9:30 **FREE COMMUNICATIONS : Physiology and Resistance
 Training**
 Chair: Earl Allen, University of North Carolina at
 Wilmington.
 (Lafoon)
- (8:30 - 8:45) **Anabolic effects of chromium picolinate on beginning
 weight training students.** D.L. Hasten, E.P. Rome, and
 B.D.Franks. Louisiana State University.
- 49**
- (8:45 - 9:00) ***Stability reliability of Cybex II biceps test for peak
 torque utilizing UBXT versus preacher's bench.**
 C.E. Hawkins, J.L. Walberg, D.R. Sebolt, and S.M.C. Lee.
 Virginia Tech.
- 50**
- (9:00 - 9:15) **The effects of short-term overwork on blood lactate and
 ammonia concentrations in elite junior
 weightlifters.** B.J. Warren, M.H. Stone, T. Kearney, S.J.
 Fleck, W.J. Kraemer, and R.L. Johnson. Appalachian State
 University, USOTC, Penn State University.
- 51**
- (9:15 - 9:30) **Physiological effects of combining periodized strength
 training and aerobic training.** F.J. Spaniol and E.R.
 Anderson. Morehead State University, University of
 Mississippi.
- 52**

*This abstract was selected by the reviewers as one of the top 30 abstracts out of 99 submissions

8:30 - 9:30

FREE COMMUNICATIONS: Muscle and Cardiovascular Physiology

Chair: Walter Thompson, University of Southern Mississippi (Sampson)

(8:30 - 8:45)

53

***Effects of muscular anaerobiosis on substrate availability and myocardial compliance to exercise.** G.W. Miller, R.B. Kreider, D. Schenck, C.W. Cortes. C. Turner, and P. Rowland. Old Dominion University.

(8:45-9:00)

54

***Force frequency and fatigue responses of malignant hyperthermic skeletal muscle.** C.W. Ward, J.H. Williams, M. Holland, J.C. Lee, and K.P. Davy. Virginia Tech.

(9:00-9:15)

55

***Weight fluctuation and myocardial adaptation in wrestlers.** S. Smith, R. Humphrey, J. Wolford, and D. Flint. Virginia Tech.

(9:15-9:30)

56

***Changes in rat hindlimb passive tension following disuse atrophy.** P.R. Gillette, K.A. Mook, and R.D. Fell. University of Louisville.

8:30 - 9:30

FREE COMMUNICATIONS : Exercise Biochemistry

Chair: R. Gay Israel, East Carolina University (Wilkinson)

(8:30-8:45)

57

Time course change in beta-endorphin and lactate at 70% VO_2 max. A.H. Goldfarb, E.O. Acevedo, B.T. Boyer, and D.L. Gill. University of North Carolina at Greensboro.

(8:45-9:00)

58

Effects of acute resistance exercise on plasma lipids and lipoproteins. E.E. Shoup, J.L. Durstine, J.M. Davis, and R.R. Pate. The University of South Carolina.

(9:00-9:15)

59

***The effects of acute moderate exercise on lymphocyte function and serum immunoglobulin levels.** D.C. Nieman and S.L. Nehlsen-Cannarella. Appalachian State University.

*This abstract was selected by the reviewers as one of the top 30 abstracts out of 99 submissions

(9:15-9:30)

60

***Influence of glucose polymer ingestion on plasma glucose concentration and performance in male distance runners.**R.L. Wilber and R.J. Moffatt. Florida State University.

8:30 - 9:30

FREE COMMUNICATIONS : Cardiovascular Physiology
Chair: G. Stephen Morris, Louisiana State University.
(Clements)

(8:30-8:45)

61

Central and peripheral responses to postprandial exercise.D. Diboll, T. Boone, and J. Heimdahl. The University of Southern Mississippi.

(8:45-9:00)

62

***Effect of aerobic fitness on hemodynamic responses to upright-tilting.** J. Mustain and T. Boone. The University of Southern Mississippi.

(9:00-9:15)

63

***Cardiovascular responses in black and white males during exercise.** M.J. Berry, C. B. Berry, T. J. Zehnder, S. E. Davis, and S. Anderson. Wake Forest University.

(9:15-9:30)

64

Circulatory responses during seated rest at three different water temperatures. D.T. Lee, S.G. Owens, W.W. Tremper, and E.M. Haymes. Florida State University.

9:30-10:30

SPECIAL TOPICS LECTURE
(Combs-Chandler)

Joseph Hamill, Ph.D
University of Massachusetts
Department of Exercise Science
"If the Shoe Fits: Biomechanics of the Lower Extremity"
Sponsored by Advanced Mechanical Technology
Inc.

10:30-10:45

BREAK

*This abstract was selected by the reviewers as one of the top 30 abstracts out of 99 submissions

10:45 - 12:15

TUTORIALS - CLINICAL TRACK

Chair: Mary Lloyd Ireland, Kentucky Sports Medicine Clinic,
Lexington, KY.

(Willis)

(10:45-11:15)

Return to play after mononucleosis. R.A. Davenport.
Lexington Clinic, Lexington, Kentucky.

(11:15-11:45)

Sport specific conditioning programs. W.B. Kibler. Lexington
Clinic Sports Medicine Center. Lexington, Kentucky.

(11:45-12:15)

Drug use and abuse. J.A. Lombardo, Ohio State University.

10:45-12:15

SYMPOSIA

CNS regulation of the cardiorespiratory responses. J.
Michael Overton, Tony G. Waldrop, and Richard W. Stremel.
University of Louisville.

Chair: Dianne Spitler, University of Florida.

(Wilkinson)

**Psychological and physiological status of anorectics,
bulimics, and compulsive overeaters-exercise
considerations.** Michael Mangum, Columbus College.

Chair: Art Weltman, University of Virginia.

(Sampson)

The physiology of ultraendurance exercise. Mindy Millard-
Stafford, Mary O'Toole, and Gordon Warren. Georgia
Institute of Technology, The University of Tennessee, and
The University of Georgia.

Chair: Don Morgan, University of North Carolina at
Greensboro

(Wetherby)

Miles Inc./Bayer AG. Symposium
Activity and calcium mediated events in skeletal muscle.
Jay H. Williams, Gary A. Klug, and Robert B. Armstrong.
Virginia Tech, University of Oregon, and University of
Georgia.
Chair: Alan Goldfarb, University of North Carolina at
Greensboro
(Clements)

12:15 - 2:00

SEACSM LUNCHEON
(Archibald)

SEACSM LUNCHEON SPEAKER

Jack Wilmore, Ph.D
The University of Texas
Department of Kinesiology and Health Education
Austin, TX
"Exercise and Weight Control: Past, Present, and Future"
Sponsored by Gatorade Sport Science Institute

2:00 -

SEACSM EXECUTIVE BOARD MEETING
(Lafoon)

2:00 -

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PHYSIOLOGY AND THE ELDERLY

A COMPARATIVE ANALYSIS OF LIPID PROFILES FOR PREMENOPAUSAL AND POSTMENOPAUSAL WOMEN

Rachel Fisher, M.Ed. and Walter R. Thompson, Ph.D. Laboratory of Applied Physiology, School of Human Performance and Recreation, The University of Southern Mississippi, Hattiesburg, Mississippi, 39406-5142

The purpose of this study was to compare blood lipid profile changes with age and the level of physical activity in women. Plasma measures included total cholesterol (TC), triglycerides (TRIG), high density lipoprotein cholesterol (HDL-C), and low density lipoprotein cholesterol (LDL-C). Subjects were premenopausal (n=20) and postmenopausal (n=20) females between 30 and 80 years of age. These groups of subjects were separated into four groups of 10 according to activity level (i.e., premenopausal active, premenopausal inactive, postmenopausal active and postmenopausal inactive). Subjects were characterized as active if they had been participating regularly in an aerobic exercise program for at least six months. Plasma lipid values were obtained from venous blood samples taken after a 12-hour fast. Analysis of variance showed significantly higher values in TC for postmenopausal groups compared to premenopausal groups regardless of activity level ($p < 0.05$). Further significance was found between the premenopausal active group and postmenopausal active group for both TRIG and LDL-C values ($p < 0.05$). No significant differences were found between groups for HDL-C. These findings suggest that TC, TRIG and LDL-C are altered more by age than by the physical activity level of premenopausal and postmenopausal women. They further suggest that HDL-C levels are not altered by age or activity level in these females.

1

THE EFFECTS OF A 9-WEEK STRENGTH TRAINING REGIME ON THE BODY STRENGTH OF 64-84 YEAR OLD MALES

B. Glass, and D. Kinsman. Austin Peay State University, Clarksville, TN 37044

Twenty-one male subjects, age 64-84 ($\bar{x}=70$), participated in a 9 week strength training program designed to produce increased upper body strength. Initial upper body strength was determined with the Cybex II by measuring shoulder flexion/extension (f/e) and abduction/adduction (a/a) at 60°/sec and 180°/sec torque. Subjects then participated 3 days a week in a periodization type free weight program for 9 weeks. Shoulder f/e and a/a were again measured and compared to the pretest measures with a 2 way ANOVA. Results of the analysis indicated a significant increase ($p < .01$) in strength gains for all measures of shoulder strength (f/e and a/a at 60°/sec and 180°/sec torque) with the greatest increase occurring for a/a at 60°/sec torque (\bar{x} difference = 8.29 ft/lbs). The results indicated that significant improvements in upper body strength are obtainable for the older male and does not necessitate any previous weight training experience.

2

INCIDENCE OF INJURY DURING MODERATE AND HIGH INTENSITY WALKING EXERCISE IN ELDERLY MEN AND WOMEN

J.E. Graves, J. Carroll, M.L. Pollock, S. Leggett, D. Spitler, & D. Lowenthal, University of Florida, Gainesville, FL 32611

3

Twenty-two men and 28 women, 60 to 79 years of age, completed a 26 week walking exercise program. During the first 13 weeks of training, exercise intensity was progressed from 50% of maximum heart rate reserve (HRRmax) to 70% HRRmax. Then subjects were randomly assigned to a moderate intensity (MOD) group (n=26) that maintained intensity at 70% HRRmax or a high-intensity (HI) group (n=24) that was progressed to 85% HRRmax for the final 13 weeks. Training frequency was 3 times per week. Training duration was 45 minutes for the MOD and 35 minutes for the HI groups. To achieve the prescribed HR, many subjects walked uphill on a treadmill. The MOD and HI groups improved their aerobic power ($p \leq 0.05$) by 16.5% and 23.8%, respectively. A control group (n=11) showed no change. Six (12%) of the subjects that trained suffered an orthopedic injury. Four injuries occurred during the first 13 weeks of training and were located in the lower leg and foot. Two injuries occurred during the final 13 weeks and were in the hip and groin. Five of the injuries were to women. The observed incidence of injury is comparable to other walking studies with younger adults but considerably less than that noted for elderly subjects who jog. Because only one injury occurred during uphill treadmill walking, the injuries appeared to be more related to fast walking than to exercise intensity. As previously noted from a study in our laboratory that employed jogging, elderly women are also more susceptible to orthopedic injury during walking exercise compared to elderly men.

EFFECTS OF WALKING ON MEMORY, CARDIOVASCULAR FUNCTION AND BLOOD LIPIDS IN OLDER ADULTS

K.S. Greene, D.L. Blessing, M. Daviera, and H.N. Williford
Psychology & Health and Human Performance, Auburn University,
Auburn, AL. 36849

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The purpose of this study was to compare the effects of walking on memory, cardiovascular fitness, body composition and blood lipids in older adults. Subjects (n=22), males and females (51-70 yr) with no history of CHD were randomized into a walking (n=14) and control (n=8) group. Walking consisted of 2.5 miles, 3 times/wk for 8 wks. Pre and post-training data included: multiple memory test, blood lipid analyses (TC, Trig, HDL and TC/HDL-C), body composition (% fat) using skinfold measures, resting HR and BP, RPE (Borg's Scale), and total time to target (TTT) utilizing the Bruce GXT protocol. A paired t-test revealed significant ($P < .05$) pre to post-training differences in the walking group for RHR, % fat, RPE and TTT. No differences were found for the control group. There were no significant changes in either group in plasma levels of Total, HDL cholesterol or Triglycerides. These data suggest that a short-term walking program in sedentary men and women substantially increases cardiovascular fitness and body composition but does not alter blood lipid levels or cognitive processes related to memory.

Supported by a grant from Auburn University VP for Research

METABOLIC RESPONSES TO DRAFTING DURING FRONT CRAWL SWIMMING

D.R. Bassett, Jr., J. Flohr, W.J. Duey, E.T. Howley, and R.L. Pein. Department of Human Performance and Sport Studies, University of Tennessee, Knoxville, TN 37996-2700

We examined the metabolic responses to front crawl swimming when following directly behind (drafting) another swimmer. Seven trained male swimmers participated as subjects. $\dot{V}O_{2max}$ (L/min) was measured during a progressive tethered swim test, and was also estimated from a 20-sec sample of expired air collected immediately after an all-out, 549 m (600 yd) swim. On different days, each subject performed two 549 m trials at 95% of his maximal swim velocity; one with drafting and one without drafting, using a counter-balanced design. Underwater pace lights were used to establish the pre-determined swim velocity. Drafting significantly reduced post-exercise $\dot{V}O_2$ (2.85 ± 0.63 vs. 3.12 ± 0.66 L/min), blood lactate (3.4 ± 0.6 vs. 5.0 ± 0.5 mM), and rating of perceived exertion (11.7 ± 0.4 vs. 14.9 ± 0.5) ($P < .05$). A repeated measures ANOVA (condition x distance) also revealed significant reductions in heart rate during the 549 m swim (137.7 vs 146.8 beats/min) ($P < .05$). The results indicate that drafting results in a decrease in energy expenditure, for the range of speeds examined.

METABOLIC DETERMINANTS OF 12-MINUTE SWIM PERFORMANCE IN YOUNG WOMEN

D.S. Conley, K.J. Cureton, E.J. Higbie, B.T. Hinson and P.G. Weyand. Exercise Physiology Laboratory, The University of Georgia, Athens, Georgia 30602

The 12-min swim is widely used to classify maximal aerobic power ($\dot{V}O_{2peak}$). This implies that $\dot{V}O_{2peak}$ is the principal determinant of 12-min swim variance. The purpose of this study was to determine the relative importance of $\dot{V}O_{2peak}$, swimming economy ($\dot{V}O_2$ measured at $0.65 \text{ m}\cdot\text{sec}^{-1}$; $\dot{V}O_{2econ}$), and % $\dot{V}O_{2peak}$ used at the average 12-min swim speed as determinants of variance in 12-min swim performance. Thirty-four female recreational swimmers completed 12-min swim and tethered swim $\dot{V}O_{2peak}$ tests, and assessments of $\dot{V}O_{2econ}$ and % $\dot{V}O_{2peak}$ used at the average 12-min swim speed within a 3-wk period. Means (\pm SD) for 12-min swim distance, $\dot{V}O_{2peak}$, $\dot{V}O_{2econ}$, and % $\dot{V}O_{2peak}$ were 597 ± 82 m, $39.2 \pm 4.9 \text{ ml}\cdot\text{kg}^{-1} \text{ BW}^{-1} \text{ min}^{-1}$, $21.2 \pm 4.9 \text{ ml}\cdot\text{kg}^{-1} \text{ BW}^{-1} \text{ min}^{-1}$ and $80.5 \pm 7.9\%$. Correlations between 12-min swim distance and $\dot{V}O_{2peak}$, $\dot{V}O_{2econ}$, and % $\dot{V}O_{2peak}$ used were .42, -.75, and .01. Standardized regression coefficients from the multiple regression equation predicting 12-min swim performance from $\dot{V}O_{2econ}$ (-.87), $\dot{V}O_{2peak}$ (.53), and % $\dot{V}O_{2peak}$ utilized (.27) indicated that $\dot{V}O_{2econ}$ was the most important metabolic determinant of 12-min swim performance, followed by $\dot{V}O_{2peak}$ and the % $\dot{V}O_{2peak}$ utilized. It was concluded that in young female recreational swimmers, variance in 12-min swim performance is primarily determined by differences in swimming economy. The variability in swimming economy accounts for the relatively low correlation between 12-min swim performance and $\dot{V}O_{2peak}$.

METABOLIC RESPONSES TO EXERCISE

EVALUATION OF METABOLIC, CARDIOVASCULAR, AND MYOCARDIAL ADAPTATIONS TO COMPETITIVE ENDURANCE CYCLING
 D. Schenck, R.B. Kreider, G.W. Miller, C.W. Cortes, C. Turner, & P. Rowland. Wellness Institute and Research Center, Human Performance Lab., Old Dominion University, Norfolk, VA 23529-0196

The accurate non-invasive assessment of cardiovascular and myocardial function during high intensity exercise has been difficult. However, recent advances in cardiac ultrasound and doppler technology may provide an improved capacity to assess myocardial function during exercise. The purpose of this study was to evaluate metabolic and myocardial adaptations during competitive endurance cycling using a newly designed Hewlett-Packard Sonar 1000 two-dimensional echocardiograph. Six trained cyclists ($\dot{V}O_{2\max}$ $69.2 \pm 9 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) competed in a 40 km time trial on their racing bicycle attached to computerized Schwinn Velodyne ergometer under controlled laboratory conditions. Metabolic and respiratory data were sampled at 15s intervals. Blood samples were drawn from a venous catheter while 2D-Echo and doppler evaluations were obtained at 8 km intervals throughout the race. Blood samples were assayed for a number of fuel substrates and hematological variables. Data were analyzed by repeated measures ANOVA and Newman-Keuls post-hoc analysis. Results revealed that the subjects maintained approximately 80% of $\dot{V}O_{2\max}$ for the first 32 km and then averaged 86% of $\dot{V}O_{2\max}$ during the last 8 km. Respiratory exchange ratio values averaged 0.935 ± 0.04 during the first 32 km and then increase to 0.98 ± 0.11 in the last 8 km. Serum glucose levels averaged $89 \text{ mg} \cdot \text{dl}^{-1}$ during the first 32 km and then peaked at $110 \text{ mg} \cdot \text{dl}^{-1}$ at 40 km. Lactate, free fatty acid, and triglyceride levels progressively rose throughout the duration of the race to $3.2 \pm 1.2 \text{ mmol} \cdot \text{l}^{-1}$, $1.33 \pm 0.4 \text{ mmol} \cdot \text{l}^{-1}$, and $101 \pm 44 \text{ mg} \cdot \text{dl}^{-1}$, respectively. Mean arterial pressure decreased after the first 8 km from $115 \pm 38 \text{ mmHg}$ to about $96 \pm 6 \text{ mmHg}$ from 8-40 km. Heart rate increased from 141 to $162 \text{ b} \cdot \text{min}^{-1}$ during the first 16 km and then averaged about $171 \text{ b} \cdot \text{min}^{-1}$ from 24-40 km. 2D-Echo and doppler studies revealed no significant alterations in end diastolic interventricular septum dimension, left ventricular posterior wall dimension at end diastole, left atrial dimension, aortic valve dimension, left ventricular outflow tract diameter, ejection fraction, or fractional shortening throughout the race. However, left ventricular internal diameter at end diastole was decreased by 5%, left ventricular internal diameter at end systole was decreased by 2%, and peak aortic velocity was increased by 7% throughout the race. These data suggest that end diastolic filling is decreased during high intensity endurance exercise possibly due to reductions in mean arterial pressure and that end systolic volume is also decreased apparently due to increases in peak aortic velocity. These adaptations, in addition to the observed increases in heart rate, appear to allow for a maintenance of cardiac output although hemodynamic and metabolic alterations are evident.

Supported by grants from Hewlett-Packard, Inc. and the Wellness Institute and Research Center

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A COMPARISON OF THE METABOLIC AND CARDIOVASCULAR ADAPTATIONS TO WALKING AND JOGGING AT AN IDENTICAL SPEED

M.P. Foley and D.R. Redondo. Laboratory of Applied Physiology, College of Health & Human Sciences, University of Southern Mississippi, Hattiesburg, MS 39406-5142

The purpose of this study was two fold: to compare the metabolic and cardiovascular responses to walking and jogging at $8 \text{ km} \cdot \text{hr}^{-1}$ and to classify statistically significant differences as central and or peripheral adjustments to the exercises. Ten college-age students (6 males & 4 females) volunteered to participate in this study. The subjects were instructed to walk on a treadmill at a speed of $8 \text{ km} \cdot \text{hr}^{-1}$ for 12 minutes, during which metabolic measures were determined. After 10 minutes cardiac output was determined by CO_2 rebreathing (plateau method). The subjects then rested for 15 minutes prior to jogging on the treadmill, during which the aforementioned procedures were used. The order in which the subjects performed the protocol was randomly assigned. Results from statistical analysis (dependent t-tests) are:

Variable	Walking	Jogging	%CHG
$\dot{V}O_2$ ($\text{L} \cdot \text{min}^{-1}$)	2.26 ± 00.41	$2.53 \pm 00.42^*$	11.95
$\dot{V}CO_2$ ($\text{L} \cdot \text{min}^{-1}$)	2.01 ± 00.44	$2.27 \pm 00.43^*$	12.94
\dot{Q} ($\text{L} \cdot \text{min}^{-1}$)	15.84 ± 03.84	$17.09 \pm 03.56^*$	7.89
HR ($\text{bts} \cdot \text{min}^{-1}$)	155.00 ± 19.00	$162.00 \pm 22.00^*$	4.52
SV ($\text{ml} \cdot \text{bt}^{-1}$)	102.10 ± 27.05	105.40 ± 25.59	3.23
$a-\bar{v}O_2$ diff ($\text{ml} \cdot 100\text{ml}^{-1}$)	14.43 ± 02.51	15.01 ± 02.07	4.02

* ($p < 0.05$)

Results indicate that jogging at $8 \text{ km} \cdot \text{min}^{-1}$ places higher metabolic demands on the body than walking at the same speed. The increased metabolic demands were accommodated by a central adjustment (\dot{Q}), more specifically a positive chronotropic effect on the heart.

8

RESISTANCE TRAINING AND TESTING

A COMPARISON OF AGONIST-ANTAGONIST SHOULDER MUSCLE RATIOS BETWEEN PREPUBERTAL AND POSTPUBERTAL 12-YEAR-OLD BOYS

J.R. Ramsey, F.J. Servedio, W.A. Morrison, T. Boone, R. Kazelskis.
 Laboratory of Applied Physiology, University of Southern Mississippi;
 Department of Orthopaedics, Hattiesburg Clinic, Hattiesburg, MS 39406

Relationships between agonist and antagonist (A-A) muscle groups are important for determining an athlete's ability to return to sports participation following injury. The purpose of this study was to determine the ratios between dominant shoulder A-A muscles of male Little League baseball players. Forty 12-year-old boys (30 prepubertal, Tanner 1,2; 10 postpubertal, Tanner 3,4,5) volunteered to participate. Strength testing was done for eight shoulder motions (flexion, extension, abduction, adduction, horizontal abduction, horizontal adduction, external rotation, internal rotation) of each subject's throwing arm at 120 deg/sec using a Cybex II isokinetic dynamometer. Table 1 indicates the means and standard deviations for peak torque. Table 2 indicates the A-A ratios.

Table 1. Peak torque (N-m).

	flex.	ext.	abd.	add.	hor. abd.	hor. add.	ER	IR
Prepubertal	46.83	54.06*	29.88*	55.87*	42.22	50.90	27.44	33.90
	±15.04	±14.10	±8.07	±12.27	±11.34	±17.50	±7.58	±8.09
Postpubertal	54.78	66.04	40.81	69.56	46.04	63.60	31.19	37.29
	±15.71	±15.84	±12.89	±15.92	±9.15	±18.01	±7.59	±8.53

* = significant difference between prepubertal and postpubertal (p < .05)

Table 2. A-A ratios.

	flex./ext.	abd./add.	hor.abd./hor. add.	ER/IR
Prepubertal	.866	.534	.828	.809
Postpubertal	.829	.587	.724	.837

Upon statistical analysis none of the A-A ratios were found to be significantly different. These ratios are similar to those reported for adults, and high school and college baseball players, indicating no difference between adolescent boys and more mature individuals with regard to A-A ratios about the shoulder.

EFFECTS OF RESISTANCE EXERCISE AND CYCLING ON RECOVERY BLOOD PRESSURE

S. P. Brown, J. M. Clemons, Q. He, S. Liu, D. Fadgen, E.R. Anderson.
 The University of Mississippi, University, MS 38677

To investigate the effects of different intensities (% 1RM) of resistance exercise (RE) on recovery blood pressure (BP) and to compare this effect to cycling a heterogeneous sample (e.g., training experience, race, sex) of seven male and female normotensive volunteers were studied. Mean±SD weight and age were 71.5±12.2 kg and 20.5±1.5 yrs, respectively. RE consisted of three sets of five exercises (arm curl, hamstring curl, squat, lat pull, and bench press) on four occasions: (1) twice using 40% 1RM for 20-25 repetitions, and (2) twice using 70% 1RM for 8-10 repetitions. Cycling (C) consisted of 70% HRR for 30 minutes on two occasions. ANOVA revealed no significant differences between 40% 1RM, 70% 1RM, and C training heart rate (HR). Student t-tests revealed that duplicate experiments separated by one week were nonsignificant for resting and recovery BP and HR. Baseline HR and BP were averaged after 60 min of quiet laboratory sitting over two visits: HR, \bar{X} ±SD=73.1±9.4 bpm; BP, \bar{X} ±SD=107.6/68.0±9.0/7.2 mmHg. BP measures are auscultated systolic and 5th phase diastolic. Recovery HR and BP were measured at minutes 2,5,10,15,30,60 in the seated position. A repeated measures ANOVA (BMDP2V) revealed that there were no significant differences across treatments. Average 2 min systolic BP was elevated (121.8±20.2, p<0.0001) and diastolic BP was depressed (47.6±12.4, p<0.0001). Systolic BP was recovered at 5 min and diastolic at 15 min, however, both systolic and diastolic BP remained empirically below baseline to 60 min of recovery. It is concluded that different intensities of RE produce the same BP response in recovery and that these changes were approximately equal to those produced by cycling. In addition, since recovery was very quick both training modalities would probably serve no useful purpose in the acute management of hypertension.

RESISTANCE TRAINING AND TESTING

EFFECTS OF RESISTANCE TRAINING ON CHANGES IN STRENGTH AND MUSCULARITY IN YOUNG AND MIDDLE-AGE WOMEN

M.H. Stephens, G.D. Wilson, R.E. Cartee, & T.G. Reeve, Department of Health and Human Performance, Auburn University, AL 36830

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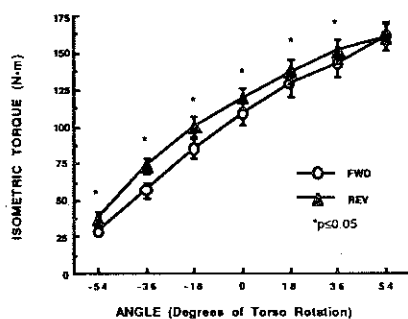
This study evaluated the effects of 16 weeks of progressive resistance training on changes in strength and muscularity in five young (Y = 19.0 yrs.) and 25 middle-age (MA = 45.3 yrs.) women. Comparisons were performed between circumference, net circumference, and real time, B-mode ultrasonographic measurements for estimation of changes in muscularity. Significant increases in strength were demonstrated by Y and MA, respectively, on bench press (34% and 41%), and squat (40% and 86%). In the squat, MA gained significantly more strength during the first 8 weeks. Muscle hypertrophy occurred in Y and MA as evidenced by significant increases in ultrasonographic measurements of muscle thickness of the posterior upper arm (41% and 14%), and anterior thigh (8% and 10%). Assessment of muscle hypertrophy by circumference and net circumference measures indicated significant increases, although the relative magnitude was less than ultrasonographic measures indicated. Evaluation of strength and muscularity changes indicated that different neuromuscular adaptations may have occurred between the groups.

EFFECT OF TESTING ORDER ON ISOMETRIC TORSO ROTATION STRENGTH

D. Carpenter, J. Graves, J. Blanton, S. Leggett, and M. Pollock. Center for Exercise Science, University of Florida, Gainesville, Florida 32610

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Previously reported data from our laboratory have shown high reliability and low variability for isometric (IM) torso rotation (TROT) strength at the first 5 of 7 test angles. Pilot research on the effect of reversing the testing order has shown improved reliability at the other 2 angles. The purpose of this study was to compare the reliability and variability of two testing orders on maximal IM torso rotation strength. Twenty-four subjects (12 males: age=26±6 yr, ht=178±6 cm, wt=75±11 kg; 12 females: age=24±3 yr, ht=166±6 cm, wt=63±7 kg) were given two TROT strength tests on each of two separate days. Each test measured maximal IM strength at 7 angles through a 108° ROM from right to left, or left to right on a transverse plane. Tests began in either the stretched (54°) position and progressed to the contracted (-54°) position (FWD), or began in the contracted position and progressed to the stretched position (REV). The direction (right, left) and order (FWD, REV) of testing was randomized and balanced among subjects. Correlation coefficients (r) ranged from 0.87 to 0.98 for FWD, and from 0.83 to 0.99 for REV. Single test variability (SEE/2) ranged from 5 to 8 N·m for FWD, and from 4 to 8 N·m for REV. Mean torque values at each measurement angle for FWD and REV are shown in the figure. Repeated measures analysis of variance



indicated a significant order-by-angle interaction, and significantly greater ($p \leq 0.05$) torque values for REV at 6 of the 7 testing angles. These data show similar reliability and variability for both FWD and REV order testing. The data also show a greater fatigue effect for FWD consequent to the multiple joint angle test protocol. Since reliability and variability are not affected by testing order and because fatigue significantly reduces FWD torque values, it is recommended that REV order testing be used to obtain the most valid measurement of maximal IM TROT strength.

EXERCISE PHYSIOLOGY

FLUID HOMEOSTASIS AND THERMOREGULATION DURING A MULTI-STAGE ULTRAENDURANCE CYCLING EVENT

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The purpose of this study was to analyze the effects of a 4-d ultraendurance cycling stage-race on fluid homeostasis and thermoregulation. Six elite cyclists competed in two 4-d, 161 km·d⁻¹, stage-races on a computerized race simulator under controlled laboratory conditions (29°C, 60% R.H.). Mean race times were 4.58±0.482 h with a mean $\dot{V}O_2$ of 4.38±1.2 l·min⁻¹ throughout the 4-d event. Food and fluid intake as well as 24 h urine samples were analyzed throughout the 4-d event. Unclothed total body weight was recorded prior to and following each race. Core (T_{Re}) and skin temperatures (T_{Sk}) were recorded at 8 km intervals throughout each race. Data were analyzed by repeated measures ANOVA with Newman-Keuls post-hoc procedures. Results revealed that total body weight decreased 1.44±0.9, 1.0±0.6, 1.09±0.6, and 1.19±0.9 kg following race 1-4, respectively. The athletes ingested 5.74±1.6, 5.38±1.4, 5.46±1.5, and 5.50±1.7 liters of fluid from liquid and food supplements during races 1-4. Therefore, total water loss during each race was 7.18±1.9, 6.38±1.5, 6.55±1.79, and 6.69±2.0 l for races 1-4. Sweat rate averaged 1.61±0.5, 1.42±0.4, 1.46±0.51, and 1.43±0.5 l·h⁻¹ for races 1-4. No significant differences were observed among race to race total body weight loss, fluid intake, total water loss, or sweat rate. T_{Re} significantly increased throughout the duration of each race, however, T_{Re} values were relatively low with daily mean values of 38.3±0.6, 38.4±0.6, 38.3±0.5, and 38.3±0.5 °C for races 1-4. No significant differences were observed among race to race T_{Re} responses. T_{Sk} values were not changed throughout the duration of each race, however, mean T_{Sk} values were significantly lower on days 2-4 of the event with T_{Sk} averaging 34.9±0.3, 34.4±0.6, 34.5±0.2, and 34.6±0.3 °C, respectively. Core to skin temperature gradient (T_{Grad}) significantly increased throughout the duration of each race with mean T_{Grad} responses significantly greater following race-1. Urine output significantly increased throughout the 4-d event (1.42±1.0, 1.60±1.4, 1.78±1.2, and 2.43±1.8 l·d⁻¹). However, post-race fluid intake was adequate to offset urine output and maintain pre-race total body weight to within 0.07% of pre-event values. Results indicate: 1.) the cyclists maintained a $\dot{V}O_2$ of 4.38±1.2 l·min⁻¹ for 4.58±0.48 h per race; 2.) sweat rate averaged 1.5±0.5 l·hr⁻¹; 3.) total fluid loss during each race was 6.63±1.8 l; 4.) the athletes consumed 1.2±0.3 l·h⁻¹ of fluid during each race; 5.) T_{Re} and T_{Sk} values were relatively maintained; and, 6.) an average daily fluid intake of 8.4±1.8 l was necessary to maintain pre-race total body weight. Based on this data, cyclists should consume 1-2 l·h⁻¹ of fluid in order to maintain fluid homeostasis and thermoregulation during ultraendurance cycling events.

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EFFECTS OF DIETARY ASCORBIC ACID AND EXERCISE ON GUINEA PIG TISSUE ASCORBIC ACID, PLASMA CORTISOL AND LDH

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The effect of dietary ascorbic acid and exercise on tissue ascorbic acid, plasma cortisol and lactate dehydrogenase (LDH) was investigated in 40 male guinea pigs. Guinea pigs were divided into one of five experimental groups: 1) resting, ascorbic acid fed at requirement level (RR), 2) 10-min post-exercise, ascorbic acid requirement (10R), 3) 24-hour post-exercise, requirement (24R), 4) 10-min post-exercise, triple-requirement (10T), 5) 24-hour post-exercise, triple-requirement (24T). Animals in RR, 10R, and 24R were given 0.6 mg ascorbic acid (the dietary requirement) and animals in 10T and 24T were given 1.8 mg ascorbic acid (triple-requirement)/100 g of body weight/day for 3 weeks. Body weight and food consumption were monitored. Animals in RR were killed in the resting state (no exercise). 10R and 10T were killed 10 min and 24R and 24T 24 hours after running on a rotating drum treadmill at 12 m/min for one hour. Plasma was obtained and analyzed for cortisol, LDH, and ascorbic acid. Hearts, lungs, and adrenal glands were removed, weighed and analyzed for ascorbic acid. Results indicated no difference in growth and organ weights among groups. Cortisol was significantly higher in 10R and 10T than in RR, 24R, and 24T. Triple-requirement ascorbic acid induced a lower (p=0.08) level of plasma cortisol. Ascorbic acid treatments did not affect activity of LDH. Plasma ascorbic acid was significantly lower (p=0.05) 24-hrs post-exercise while organ ascorbic acid tended to increase following exercise. Results suggest that ascorbic acid at triple requirement somewhat reduced cortisol production in response to exercise. In addition, following exercise, ascorbic acid concentrations tended to be lower in plasma and greater in tissue.

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EXERCISE PHYSIOLOGY

NINETY SECOND CYCLE ERGOMETER TESTS FOR ASSESSING ANAEROBIC GLYCOLYTIC POWER.

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The purpose of this study was to determine a resistance setting (RS) for eliciting maximal power output (PO) responses (mean & peak) during a 90 second performance test, intending to assess anaerobic glycolytic power (AGP). Subjects (N=24) completed a 30 second Wingate test (WG) and four 90 second AGP tests at RS of 2%, 6%, 8% and 10% of body weight. Psychophysiological measurements (heart rate, blood pressure, serum lactate, serum cortisol, rating of perceived exertion, & feeling scale) were taken before the tests, immediately after, and at 30 minutes of recovery. Statistically, the WG and AGP tests produced significant changes ($p < .05$) in the psychophysiological measures. These results were variable, but did imply the 6% and 8% AGP tests were the most stressful. Polynomial regression analysis was performed on all PO responses. Significant equations ($p < .05$) for PO were found. Results suggested that the 2% RS setting was not sufficient enough, and the 10% RS was too much for optimal AGP results. The 6% and 8% trials appeared comparable; however, regression analysis suggested that a 6.5% resistance for 90 second AGP tests would elicit maximal PO responses.

EVIDENCE OF HEMOLYSIS, ALTERED HORMONAL AND VITAMIN STATUS, FECAL BLOOD LOSS, AND ANEMIA IN RESPONSE TO MULTI-STAGE ULTRAENDURANCE CYCLING

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Exercise induced anemia related to iron deficiency, foot-strike hemolysis, and/or gastrointestinal blood loss has been reported in endurance runners. Recent studies suggest that intravascular hemolysis may also occur in non-weight bearing events possibly due to turbulence and/or osmotic forces in the microcirculation of the working muscle. Therefore, the purpose of this study was to determine the effects of repeated ultraendurance cycling on various markers of erythrocyte homeostasis. Six elite cyclists competed in two, 4-d stage races ($161 \text{ km} \cdot \text{d}^{-1}$) on a computerized race simulator over very challenging mountainous terrain. Mean race times were $4.58 \pm 0.48 \text{ h}$ with a mean VO_2 of $60.6 \pm 16 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ throughout the 4-d event. PRE race, POST race, and 3-d post event recovery blood samples were assayed for hemoglobin (Hgb), hematocrit (Hct), total bilirubin (TBIL), ferritin (FER), cortisol (CORT), folate (FOL), and cobalamin (B12). Feces samples were collected throughout the event and recovery period and assayed for Hgb. Data were analyzed by repeated measures ANOVA with Newman-Keuls post-hoc procedures. Results revealed $p < 0.05$ decreases throughout the 4-d event in PRE and POST race data, respectively, as follows: Hgb (-9.7%, -7.8%); Hct (-8.0%, -8.3%); CORT (-10.7%, -24.2%); FOL (-42.9%, -42.6%); and B12 (-19.0%, -26.3%). PRE and POST event FER (+23.1%, +14.4%) and TBIL (+43.5%, 13.2%) levels were significantly increased. 41/80 (51%) of feces samples were positive for Hgb most of which becoming evident following race-2. 3-d recovery results revealed that Hgb (-3.2%), Hct (-5.4%), FER (-23.9%), CORT (-39.9%), and FOL (-12.0%) values remained significantly lower than pre-event values. Results reveal evidence of hemolysis, altered hormone and vitamin status, and fecal blood loss in response to 4-d of high intensity ultraendurance cycling. Further, 3-d recovery Hgb, Hct, and FER levels remained significantly lower than pre-event values while CORT and FOL levels continued to decline. Observed responses could not be explained by exercise induced blood volume expansion resulting in a pseudoanemia. Results suggest that repeated ultraendurance cycling may alter hormonal and vitamin status, suppress erythropoiesis, and possibly lead to anemia.

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EXERCISE BIOCHEMISTRY

TIME COURSE RELATIONSHIP OF SERUM CREATINE KINASE AND MUSCLE SORENESS TO AN EXHAUSTIVE WEIGHT LIFTING BOUT.

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Ten men were exercised to exhaustion (weight lifting) in order to determine the time course relationship of serum creatine kinase (CK) and delayed-onset muscle soreness (DOMS). Subjects performed three sets of five exercises at 70% of their 1-RM until muscular failure. Venous blood samples were obtained both before and immediately after exercise from an antecubital vein, as well as 24, 48, and 72 hours after exercise. DOMS was rated by the subject on a scale of 0 to 10. DOMS was evaluated prior to each blood sample. The table presents the values and the Pearson correlation coefficients for the measured parameters (X±SE).

	REST	POST-EX	24hrs	48hrs	72hrs
CK (IU)	48.12 ±10.92	50.37 ± 7.86	66.91 ±10.09	113.41* ± 25.09	374.49* ±142.17
DOMS	0.00	1.73 ± 0.52	4.64** ± 0.62	6.00** ± 0.67	3.18 ± 0.73
Pearson r (ΔCK vs. ΔDOMS)		.05	.66***	.61***	.73***

*significant difference from rest ($p < .05$)

**significant difference from post-exercise ($p < .05$)

***significant correlation ($p < .05$)

The results demonstrate that after an exhaustive weight lifting bout CK increases at 48 and 72 hours after exercise, with peak values attained after 72 hours. DOMS increased 24 and 48 hours from the post-exercise score, with peak values attained 48 hours after exercise. Significant correlations between DOMS and CK occurred at 24, 48 and 72 hours. These data indicate that muscle soreness will occur prior to significant increases in serum CK despite a mild correlation of these factors 24-72 hours after the exercise.

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CHANGES IN PLASMA PROSTAGLANDIN E2 AFTER ECCENTRIC EXERCISE

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An unaccustomed bout of eccentric exercise produces delayed onset muscle soreness (DOMS). Little is known about the chemical mediators involved in the generation of these sensations of soreness. The purpose of this study was to investigate whether plasma prostaglandins E2 (PGE2), a central mediator of inflammatory pain, is associated with the sensation of DOMS. Six subjects performed the negative phase of a bench-press (4 sets, 12 repetitions/set) at 100% of maximal concentric strength. Blood was drawn before and at 24 h, 48 h, and 72 h after exercise and analyzed for PGE2. Subjective ratings of soreness were assessed at these same intervals using a 10 point scale (1 = no soreness, 10 = unbearable soreness). A non-parametric repeated measures ANOVA was used to analyze the data. Peak PGE2 levels were seen at 24 h (2071 ± 260 pg/ml); this was significantly elevated ($p < 0.05$) over pre-exercise levels (326 ± 137 pg/ml). Peak soreness ($p < 0.05$) was also seen at 24 h (4.3 ± 0.9). These preliminary findings suggest that there might be an association between PGE2 and the sensation of DOMS.

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EXERCISE BIOCHEMISTRY

EFFECTS OF ENDOGENOUS OPIOIDS ON THE GONADOTROPIN RESPONSE TO PHYSICAL AND MENTAL TASKS

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FSH and LH responses were examined in 8 men before and after physical and mental tasks to determine the role of the endogenous opioids in the control of the gonadotropins. All completed 2 trials, one infused with naloxone (10 mgm bolus plus 7 mgm/hr; N) and the other using saline (C). Six hours after starting infusion they climbed stairs (82 step/min) for 30 min. This was followed by 3 hrs rest and 50 min of mental tasks. Blood was sampled hourly from initial infusion to 1 hr after mental tasks. Baseline LH and FSH levels were similar for both trials. FSH and LH were elevated throughout the N trial ($p < 0.02$). Physical and mental stress resulted in no response differences comparing the C or N trials ($p > 0.2$).

	LH (IU/l)		FSH (IU/l)	
	Control	Naloxone	Control	Naloxone
Baseline	4.8±0.3	5.1±0.7	4.6±0.7	4.6±0.7
Pre-Exer	4.7±0.5	6.0±0.6	4.2±0.7	4.8±0.8
Post-Exer	5.0±0.5	6.5±0.7	4.5±0.7	4.8±0.8
1 hr post	4.7±0.7	5.4±0.7	4.4±0.8	4.5±0.8
Pre-Mental	4.0±0.4	6.2±0.6	4.1±0.6	4.3±0.6
Post-Mental	3.9±0.5	5.8±0.7	4.4±0.7	4.9±0.8
1 Hr Post	5.6±0.9	6.3±1.0	4.2±0.7	4.7±0.7

These results indicate that the endogenous opioids have a significant role in the general, long term control of the gonadotropins but do not seem to alter any acute effect.

EFFECTS OF ACUTE EXERCISE INTENSITY ON PLASMA LIPID CONCENTRATIONS

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The purpose of this study was to determine the effects of exercise intensity on plasma lipids. Specifically, concentrations of triglyceride, cholesterol, high density lipoprotein cholesterol (HDL-C) and its subfractions (HDL₂-C and HDL₃-C), low density lipoprotein cholesterol, and very low density lipoprotein cholesterol were measured. Ten trained runners completed treadmill exercise on two different occasions; a high-intensity (HI) session at 75% maximal oxygen consumption (VO₂max) lasting 60 minutes, and a low-intensity (LI) session at 50% VO₂max lasting 90 minutes. Energy expenditure for each session was equal [953 ± 84 kcal (HI) vs. 951 ± 67 kcal (LI)]. Blood samples were obtained 24 hours before, immediately before, immediately after, 1, 24, 48, and 72 hours following each exercise session. After correcting for plasma volume changes, no significant differences were found for the blood variables across time or between treatments. However, HDL₂-C was slightly elevated 2 days after each session [15 ± 3 mg·dl⁻¹ (HI), 13 ± 3 mg·dl⁻¹ (LI)] when compared to values obtained immediately before exercise [13 ± 3 mg·dl⁻¹ (HI), 11 ± 3 mg·dl⁻¹ (LI)]. These results suggest that acute exercise sessions lasting less than 90 minutes, regardless of intensity, are not adequate to elicit plasma lipid changes.

PHYSIOLOGIC ECONOMY

RUNNING ECONOMY AND BODY STRUCTURE IN WELL-TRAINED RUNNERS

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Running economy (RE), defined as the aerobic demand of submaximal running, has been shown to be associated with distance-running success among athletes roughly comparable in maximal aerobic power ($\dot{V}O_2$ max). While marked interindividual RE differences have been reported in this cohort, few studies have examined structural bases for this phenomenon. Hence, the purpose of this investigation was to quantify the relationship between RE and body structure in well-trained runners. Following treadmill accommodation, 12 males ($\bar{X} \dot{V}O_2$ max = 70.5 ± 3.3 ml/kg/min; \bar{X} age = 33 ± 4 yrs) completed three 6-min level treadmill runs at 4.02, 4.47, and 4.92 m/s. $\dot{V}O_2$ data were obtained during the last 2 min of each run, expressed relative to distance traveled, and averaged across speeds to derive a mean RE value for each subject. Triplicate measures of height, body mass, and 37 other structural parameters encompassing various upper and lower body segment lengths, breadths, circumferences, and skinfolds were also collected on both sides of the body (where appropriate) and averaged to obtain mean values. Results demonstrated a 26% variation in mean RE between the least and most economical subjects (\bar{X} RE = 186.8 ml/kg/km; range = 164.0 to 206.1 ml/kg/km). Correlational analyses also revealed that relative to height, more economical runners displayed significantly ($p \leq 0.05$) shorter legs ($r = 0.79$) and longer trunks ($r = -0.69$). Although speculative, these data suggest that variability in RE among trained runners may be related to individual differences in segmental inertial characteristics.

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ESTIMATE OF ENERGY COST AT SIMILAR SUBMAXIMAL WORKLOADS FOR THE MONARK 868, BODYGUARD 990, AND RANDAL WINDRACER CYCLE ERGOMETERS

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Fourteen men ($X = 23$ yrs) and fourteen women ($X = 27$ yrs) volunteered as subjects to determine the energy costs of three different bicycle ergometers. Resting $\dot{V}O_2$ was obtained prior to cycling for each subject and this value was subtracted out to determine the actual oxygen cost for the submaximal workload. Subjects were randomly assigned to the cycle ergometers in a counter balanced design and cycled for 5 minutes at each workload. The men cycled at 50, 100, 150 and 200 watts, while the women cycled at 25, 50, 75 and 100 watts. During minutes 3-5 of each workload expired air samples were obtained and determined for oxygen cost. Heart rates and relative perceived exertion were obtained at each workload. Regression equations were generated from the $\dot{V}O_2$ data and compared for each ergometer. The regression equations are as follows for all subjects, males and females.

Bodyguard 990	$Y = .1569 X + 1.81$
Monark 868	$Y = .1436 X + 1.89$
Windracer	$Y = .1420 X + .60$

The mean $\dot{V}O_2$ at 50 and 100 watts for the ergometers were.

Bodyguard	50 watts = $9.30 + 1.59$	100 watts = $17.68 + 3.04$
Monark	50 watts = $8.55 + 2.13$	100 watts = $16.18 + 4.23$
Windracer	50 watts = $7.29 + 1.56$	100 watts = $14.76 + 2.29$

These data suggest that the Bodyguard cycle ergometer requires greater energy output at similar submaximal workloads than the Monark, whereas the Windracer slightly underestimates the energy cost at similar submaximal workloads compared to the Monark.

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PHYSIOLOGIC ECONOMY

EFFECTS OF STRENUOUS CYCLING ON RUNNING ECONOMY

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Running economy (RE) and maximal oxygen consumption ($\dot{V}O_2$ max) were measured in 10 well conditioned male triathletes during two randomly applied conditions. Oxygen consumption was measured continuously during experimental sessions consisting of 4 four minute stages of horizontal running at 187.6, 214.4, 241.2, and 187.6 m·min⁻¹. Upon completion of the last stage, workload was increased each minute until the subject reached a state of voluntary exhaustion. One experimental session was completed when subjects were well rested (run only or RN), while the other session was completed immediately following 1 hr of cycling at 69.7±1.2% of cycling $\dot{V}O_2$ max (bike-run or BRN). Submaximal oxygen consumption ($\dot{V}O_2$ submax) during RN was measured to be 2.55±0.09, 2.91±0.10, 3.31±0.12, and 2.57 L·min⁻¹ at the 4 respective treadmill velocities. In comparison, during BRN, $\dot{V}O_2$ submax was measured to be 2.67±0.08, 3.03±0.11, 3.39±0.12, and 2.70±0.10 L·min⁻¹ at the 4 respective treadmill velocities. Statistical analysis revealed $\dot{V}O_2$ submax during BRN to be significantly greater than $\dot{V}O_2$ submax during RN ($p=0.0038$). No significant differences were found between the two $\dot{V}O_2$ submax values at 187.6 m·min⁻¹ under either condition. Further, $\dot{V}O_2$ max (65.43±2.52 vs. 67.33±2.61 ml·kg⁻¹·min⁻¹; $p=0.038$) and run time to exhaustion (5.45±0.35 vs. 5.58±0.38 min; $p=0.8131$) during RN and BRN were not significantly different. These results indicated that RE may be significantly reduced following a 1 hr bout of strenuous cycling.

COMPARISON OF BIOLOGICAL, PERFORMANCE AND TRAINING VARIABLES IN MALE AND FEMALE CROSS-COUNTRY RUNNERS OVER A COMPETITIVE SEASON.

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Five men and five women from the University of New Orleans cross-country team were tested in the early portion (T-1) and at the conclusion (T-2) of the competitive season. $\dot{V}O_2$ max and related variables were assessed via open-circuit spirometry using a protocol by Bulbulian, MSSE (18: 107-113, 1986). Running economy (RE) was assessed while running at 11.3 & 12.9 km/hr for the women and 12.9, 14.5 & 16.1 km/hr for the men. The duration of each run was 5 minutes with no pause between workloads. Relative fat was determined via densitometry with residual volume determined by the oxygen dilution method. The runners also completed a 3.2-km run at T-1 and T-2. Two-way ANOVA revealed sex differences ($p \leq 0.05$) but no seasonal change for all variables. Results included the following:

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	$\dot{V}O_2$ max*		RE*		T-vent*		% Fat		3.2-km Run	
	M	F	M	F	M	F	M	F	M	F
T-1	75.2	55.9	41.2	45.2	57.1	44.7	10.1	19.2	10.3	15.9
T-2	76.6	56.1	41.5	47.5	57.5	46.4	10.9	18.9	10.1	14.8
%	1.9	0.4	0.7	5.1	0.7	3.8	7.9	-1.6	-1.9	-6.9

*units ml/kg/min, RE at 12.9 km/wk

Although the men were more efficient than the women, when $\dot{V}O_2$ was regressed on running speed, there was no significant difference in the slope of the regression lines. Since conditions such as time of day for testing, type of running shoe and treadmill habituation remained constant, only minor biological and technical variations during measurement can be assumed. Thus the increase in RE for women at T-2 was unexpected and suggests that fatigue may have been a factor. Training information indicated that the men ran 52.6% more mileage than the women during the pre-season (78 vs 37 km/wk). From the results, it is suggested that male runners have a significantly greater cardiorespiratory capacity than female runners and limited changes occur in either group over a competitive season.

MUSCLE FASCICULATION WITH HIGH LACTATE CONCENTRATION DURING CONTRACTIONS OF IN SITU CANINE SKELETAL MUSCLE

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In our studies of the effect of arterial lactate concentration ([La]) on lactate uptake by contracting muscle, we have observed muscle fasciculation (small, spontaneous muscle twitches) at high [La]s. This is a report of experiments on 19 in situ dog gastrocnemius muscle preparations. Lactate infusion was increased in a series of 4-5 steps to achieve peak arterial [La]s ranging from 20-50 mM. Muscles were isometrically stimulated at 1 Hz. Blood and muscle samples were taken at rest, during contractions, and after contractions. Thirteen of 19 muscles (68%) fasciculated when the peak arterial [La]s were reached. Fasciculations were never observed at an arterial plasma [La] less than 22 mM. However, no major factors were significantly different between the 13 muscles which fasciculated and the 6 muscles which did not. Plasma [La] (33.1 ± 3.5 vs. 29.0 ± 3.5 mM) (fasciculation vs. no fasciculation), post-contraction muscle [La] (15.9 ± 2.8 vs. 10.0 ± 1.2 mM), post-contraction muscle pH (7.00 ± 0.04 vs. 6.98 ± 0.02), post-contraction muscle water (74.0 ± 0.6 vs. 73.8 ± 0.5 %), and oxygen uptake (56.1 ± 3.1 vs. 53.1 ± 6.1 ml/kg·min) were not significantly different between the two groups. This lactate-infusion related fasciculation could be the result of some effect on the nerve, the neuromuscular junction, the muscle membrane, the sarcoplasmic reticulum, or the contractile filaments. There is no obvious explanation from the available data.

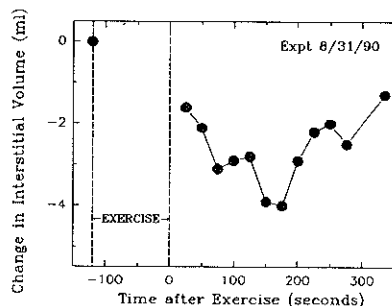
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INTERSTITIAL VOLUME IS REDUCED BY EXERCISE IN CAT SKELETAL MUSCLE

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Skeletal muscle swells during exercise. To determine the changes in interstitial space (IS) volume after exercise, we measured the ^{51}Cr -EDTA space in isolated muscles of the cat calf. These were perfused at constant flow from a reservoir containing approx. 30 ml blood. The recirculated perfusate was warmed to 37-38°C and bubbled with 95% O₂ - 5% CO₂. Plasma volume was determined with Evans Blue-labelled albumin. The tracers were equilibrated for 70 min. before 2 min. of intense isometric exercise was induced by stimulation of the popliteal nerve (4 Hz, 2 volts, 0.1 msec dur.). After the exercise, all the venous outflow was collected in test-tubes at 15-25 sec intervals. Extracellular and plasma volumes were calculated from each plasma sample assuming that the plasma was in equilibrium with the IS. From these data we calculated that IS volume was *reduced* by 3.2-7.1 ml/100g in the following 2-3 min. See fig. This is consistent with the notion that intracellular osmoles remove water from the IS faster than water flows from the plasma into the IS.



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MUSCLE PHYSIOLOGY

SERUM CREATINE KINASE AND DELAYED ONSET OF MUSCLE SORENESS IN BICYCLE RIDERS COMPLETING A STRENUOUS 100 MILE RIDE

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The purpose of the study is to determine the time course relationship of serum creatine kinase (CK) and perceived delayed onset of muscle soreness (DOMS) following a strenuous concentric event. Eleven males mean age 35.4 yrs (± 12.6 yr), completed the 1990 Assault on Mt. Mitchell, a 102 mile bicycle ride with a gain of 6000 ft elevation. Subjects trained a mean of 130 mi/wk (± 34.4 mi). Mean finishing time was 7.2 hrs (± 1.4 hr). Blood was collected prior, immediately post, 24, 48, and 72 hours post event. At each blood drawing, subjects rated DOMS on a rating scale of 1 (no soreness) to 10 (very, very sore). Serum CK was analyzed spectrophotometricly. Statistical analysis included: repeated measures ANOVA to determine statistical differences; Pearson Correlation to determine the relationship between variables. Significance level was set at $p < 0.05$. Serum CK levels were: pre--53.6 IU (± 19.0); post--167.2 IU (± 95.6); 24hr--239.2 IU (± 160.9); 48hr--202.1 IU (± 157.5); and 72hr--169.8 IU (± 160.4). Mean pre event CK level was significantly less than all post event values ($p < 0.01$). DOMS ratings were: pre--1 (± 0); post--5.4 (± 2.1); 24hr--4.2 (± 1.6); 48hr--1.7 (± 0.8); and 72hr--1.1 (± 0.4). The post and 24hr event ratings were significantly greater than pre, 48 and 72 hr ratings ($p < 0.05$). Serum CK and DOMS were not correlated statistically. Values were: pre--0; post--.105; 24hr--.302; 48hr--.255; and 72hr--.405. In summary, a strenuous concentric cycling activity will produce elevated serum CK levels and increased DOMS ratings, however, CK and DOMS do not appear to be related.

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LOW DOSE ISOPROTERENOL TREATMENT ALTERS THE CARDIAC ISOMYOSIN DISTRIBUTION IN RATS

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Evidence suggests that increased consumption of carbohydrates by the heart for energy provision can influence the distribution of cardiac myosin among its three isoforms (V1, V2, V3). Given the impact of the beta-adrenergic nervous system on carbohydrate mobilization and utilization, it is possible that chronic modulation of this system may redistribute isoform profile in the heart. To test this possibility, young female Sprague Dawley rats were randomly assigned to one of two groups, control (C, N=6), and treated (I, N=6). The treated animals received daily SQ injections of isoproterenol (50 ug/Kg). This dose was selected because it does not cause cardiac hypertrophy. After 5 wks of treatment, animals were sacrificed, hearts removed, myofibrills isolated from the left ventricle, and analyzed electrophoretically for the relative myosin isoenzyme distribution. A portion of the left ventricle was spectrophotometrically analyzed for hexokinase activity. Although treatment failed to increase myofibrillar ATPase activity, the amount of V1 present increased from 80% to 91% of the total myosin present. Isoproterenol treatment also increased hexokinase activity (18%). These data demonstrate that chronic treatment with a low dose of isoproterenol can increase expression of the V1 cardiac myosin isoform. The increased hexokinase activity suggests that processing of carbohydrates was increased which may have induced the observed change in myosin isoenzyme distribution.

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PSYCHOPHYSIOLOGY

RELATIONSHIP BETWEEN PERCEIVED IDEAL WEIGHT AND COMPUTED IDEAL WEIGHT FOR MEN AND WOMEN.

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Anecdotal evidence suggests that individuals possess an intuitive ability to assess their ideal weight with "reasonable accuracy." **Purpose.** The goals of this study were 1) to compare perceived ideal weight (PIW) with computed ideal weight (CIW) for men and women, and 2) to determine if there was a difference between genders in PIW. **Methods.** 1411 men and 258 women responded to a questionnaire that inquired about their PIW. Subjects were then hydrostatically weighed at residual volume. Residual volume was determined by oxygen dilution. CIW was based on fat free mass (FFM; FFM/1-ideal percent fat). CIW was computed for men and women based on the following body fat percentages: less than 35 yr (15% m, 22% f); 35-49 yr (18% m, 25% f); and >49 yr (20% m, 28% f). **Results.** The average CIW for men was 172.1 ± 20.4 (mean, SD) and the PIW was 175.3 ± 20.8 . There was a significant correlation $r=.802$ ($p<.0001$) between PIW and CIW. For women CIW and PIW were 127.6 ± 17.2 and 125.9 ± 14.8 , respectively and a significant correlation $r=.712$ ($p<.0001$) was observed. A significant difference ($p<.001$) was observed between men and women with regard to PIW. Men tended to overestimate PIW by 3.2 lbs and women underestimated PIW by 2.5 lbs. **Conclusion** For research purposes accurate assessment of body composition is essential; however, from a health risk appraisal perspective, a questionnaire might be adequate.

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EFFECTS OF EXERCISE TRAINING AND PSYCHOLOGICAL STRESS ON NON-SPECIFIC IMMUNE FUNCTION IN MICE.

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This study investigated the effects of exercise and psychological stress on macrophage cytotoxicity. Inbred male C3H/Hen mice ($n=41$), 22-24 wk of age, were numbered and randomly assigned to 4 treatment groups: Exercise and Stress (EX-ST) ($n=10$), Exercise and Control (EX-CON) ($n=10$), Rest and Stress (RE-ST) ($n=11$) and Control (CON) ($n=10$). Exercise consisted of 25 days of treadmill running (30 min/d, 18 m/min, 5 % grade, 5 d/wk). Psychological stress (PS) was 16 h of confinement in small plastic tubes (30 mm X 150 mm). Blood was collected for corticosterone (CORT) analysis. Macrophages (MO) harvested from the peritoneal cavity were assayed for macrophage cytotoxic function (CF) (with and without Salmonella typhimurium Lipopolysaccharide; 10 ug/ml LPS). Both quadriceps were dissected and immediately freeze-clamped for succinate dehydrogenase (SDH) and total protein (PROT) analyses. No differences were found for CORT, SDH, and PROT among the 4 groups. EX-CON had significantly higher CF than CON ($p<.05$) at the ratio of 20:1 for target cells (TC) without LPS and 10:1 and 20:1 for TC with LPS, . RE-ST had a lower CF than CON ($p=.0001$) only at 40:1 TC ratio with LPS. In that case, exercise did not prevent the depression. Thus, contrary to an earlier report, psychological stress did not appear to impair macrophage function. Exercise training seemed to enhance macrophage cytotoxic function, but had no effect on the response to psychological stress.

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PSYCHOPHYSIOLOGY

FITNESS LEVEL AND RESPONSE TO A NON-EXERCISE STRESSOR

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Exercise training is thought to improve ones ability to tolerate other forms of stress. Twenty male volunteers, classified as high fit (HF) or low fit (LF) ($\dot{V}O_{2max} \geq 50 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ or $\leq 40 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, respectively) were compared in their responses to a cold pressor test (CPT) as measured by changes in heart rate (HR), blood pressure (BP), and plasma cortisol (PC). Each subject also completed the Spielberger state and trait anxiety inventories (SSAI, STAI) pre- and post-experimental treatment. The experimental protocol consisted of a 30 min. rest period, a 2 min. CPT (immersion of hand and forearm into cold water at 5°C .), and a 45 min. recovery period. HR, BP, and PC were measured pre-CPT (-15, -1 min.). HR was measured 1 min. into CPT and both HR & BP were measured at immediately post-CPT. HR, BP, and PC were all sampled during recovery. STAI & SSAI were administered pre-CPT, and SSAI was given during the CPT and immediately post-CPT. HR & BP increased similarly in both groups, although recovery was faster in the HF. LF experienced a significant elevation in PC ($p < .05$) while the HF did not. Trait anxiety scores were similar for both groups. Thus, fitness status may contribute to controlling certain physiological responses, i.e. cortisol, to stressors other than exercise while the cardiovascular responses remain similar.

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EFFECTS OF MULTI-STAGE ULTRAENDURANCE CYCLING ON PSYCHOLOGICAL PROFILES OF EXERTION, FEELING, AND MOOD
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The purpose of this study was to determine the effects of repeated ultraendurance cycling on Rating of Perceived Exertion (RPE), Feeling Scale (FS), and the Profile of Mood States (POMS). Six elite cyclists competed in two 4-d stage-races ($161 \text{ km} \cdot \text{d}^{-1}$) on a computerized race simulator over very challenging mountainous terrain. Mean race times were $275 \pm 29 \text{ min} \cdot \text{d}^{-1}$ with oxygen uptake averaging 74% of $\dot{V}O_{2max}$. No significant differences were observed among daily $\dot{V}O_2$ responses or performance times. The Eysenck Personality Inventory (EPI) was administered prior to the first 4-d event. POMS was administered prior to (PRE) and immediately following (POST) each 161 km race while RPE and FS data were recorded at 8 km intervals. Data were analyzed by repeated measures ANOVA with Newman-Keuls post-hoc procedures. The EPI revealed that the subjects tended to be introverted (11.5 ± 4.7) and stable (7.7 ± 4.1) with a lie of 2.3 ± 0.9 . RPE responses began each race at approximately 13-14 and significantly increased ($p < 0.05$) to 18-19 throughout each 161 km race. No significant differences were observed among race to race RPE responses. FS values significantly decreased from states of good to fairly bad throughout each race with no differences observed among race to race FS responses. RPE and FS responses were not related to oxygen uptake responses. PRE race tension scores were approximately 10 and significantly increased to about 12 following races 1, 3, and 4. No significant differences were observed among race to race tension responses. PRE race-1 depression scores (24) were significantly greater than POST race-1 depression responses (21) and race 2, 3, and 4 PRE depression responses. Race 2-4 PRE (21) and POST (20) depression scores were not significantly different. Anger values were relatively high prior to each race (21-17) and were significantly decreased to 11-15 following each race. PRE race-1 anger responses were significantly greater prior than remaining PRE anger responses with no differences observed among race 2, 3, or 4 PRE race responses. POST race anger scores significantly increased from race 1-4. Vigor scores were low prior to each race (12-10) and were decreased to 9 following each race. Only race-1 PRE and POST vigor scores were significantly different. No significant differences were observed between PRE and POST race fatigue scores (8-9) or confusion responses (9-10) throughout the 4-d event. PRE race global mood states ranged from 61-57 whereas POST race global mood states ranged from 54-55. Results suggest that the cyclists' perceived increasing psychological stress during each 161 km race which was not related to exercise intensity. POMS data revealed a mood state profile consisting of low tension, slight depression, anger, low vigor, low fatigue, low confusion and a relatively high global level of psychological stress.

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VALIDATION OF EXPERIMENTAL TECHNIQUES

VALIDATION OF NIR AND BIA FOR ESTIMATING BODY COMPOSITION OF BLACK COLLEGE FOOTBALL PLAYERS

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Near-infrared spectrophotometry (NIR) and bioelectrical impedance (BIA) have been introduced in recent years as methods to assess body composition; however, data validating these methods in black college football players have not appeared in the literature. The purpose of the current study was to test the validity of NIR (Futrex-5000, Futrex Inc., Gaithersburg, MD) and BIA (Spectrum II, RJL Systems, Detroit, MI) devices for determining body composition in this population. NIR and BIA were compared to a criterion method hydrostatic weighing (HW), and seven site skinfolds (SF) in 42 black, Division I college football players. NIR and BIA measurements were made in duplicate following manufacturer specifications. SF measurements were made in duplicate on the right side of the body with the Jackson and Pollock seven site equation used to predict body density. Body density was determined by HW, with residual volume determined in duplicate using oxygen dilution. Body densities for HW and SF were converted to percent fat using the equation of Schuttè et al. Mean values \pm SD for percent fat were: HW 14.0 ± 5.99 , NIR 12.6 ± 4.46 , BIA 19.5 ± 4.80 and SF 13.2 ± 4.91 . Results from ANOVA demonstrated that BIA significantly ($p < .01$) overestimated percent fat, while other methods were not significantly ($p > .05$) different from HW. Correlations between HW and other methods were: NIR ($r = .80$), BIA ($r = .78$), and SF ($r = .91$). Standard error of estimates (SEE) were: NIR(3.55), BIA(3.74) and SF(2.44). It was concluded that NIR and BIA do not provide valid estimates of body composition in black college football players.

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THERE IS ESSENTIALLY NO ORDER EFFECT ASSOCIATED WITH FINGERTIP BLOOD SAMPLING.

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Conventional laboratory wisdom has it that the first drop of fingertip blood should be discarded and that "milking" the finger for additional blood should be avoided due to possible measurement errors caused by contamination with cellular debris. This study was conducted to test that wisdom. Fingertip blood was taken from twenty-four volunteers under conditions of rest, moderate (HR=140 \pm 1 BPM) and vigorous (HR=171 \pm 1 BPM) ergometer exercise. For each subject and condition, six separate samples were "milked" from a pre-warmed finger and then centrifuged. Lactates were determined from the plasma supernatant using a YSI 23-L; thus, two variables (lactate and hematocrit) were evaluated via univariate ANOVAs with repeated measures and multivariate MANOVAs. Three (of 30) polynomial contrasts achieved significance; none of the multivariate F-tests was significant. The ANOVA for resting hematocrit was significant at the 0.02 level, however. The data are summarized in the table below (mean values \pm approximate SEM; SEMs were similar or equivalent within variable and condition; thus, only the initial value is included).

VARIABLE/CONDITION	SAMPLE						MANOVA	ANOVA
	1	2	3	4	5	6	F _t	F*
Lactate, Rest	1.4 \pm 0.1	1.3	1.3	1.2	1.3	1.3	.62	.62
Lactate, HR \approx 140	5.4 \pm 0.6	5.5	5.4	5.4	5.2	5.3	.80	.84
Lactate, HR \approx 171	9.7 \pm 0.8	9.5	9.5	9.7	9.5	9.5	1.21	1.29
Hematocrit, Rest	43.8 \pm 0.7	44.1	44.4	44.5	44.4	44.9	1.59	3.09*
Hematocrit, HR \approx 140	45.8 \pm 0.7	46.1	46.1	46.2	45.7	45.8	.80	1.23
Hematocrit, HR \approx 171	46.8 \pm 0.7	46.6	47.3	47.4	47.2	47.2	.62	.65

+ All P values were greater than 0.20 * F_{0.05, 5, 19} = 2.74

We conclude that there is essentially no order effect associated with fingertip blood sampling. Except for resting hematocrit, the first drop of blood is apparently as good as the last.

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ACCURACY OF THE ACSM EQUATION FOR PREDICTING THE VO₂ OF "AEROBIC BENCH STEPPING" IN FEMALES

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Nine active females (mean age = 30.4 yrs.) were studied in a cross-over design while performing 20 minute bouts of "aerobic" bench stepping. The 20 minute stepping bout was formatted by three experienced group exercise leaders and tested on four frequently utilized bench heights: 15.42 cm (6 in.), 20.32 cm (8 in.), 25.4 cm (10 in.), and 30.48 cm (12 in.). Directly-determined measures of VO₂ were compared to predicted VO₂'s as calculated by the ACSM Equation for bench stepping. The results demonstrated that the ACSM equation under-predicted the actual VO₂ for the lowest step height, but progressively over-predicted for higher benches (mean difference reported in ml·kg⁻¹·min⁻¹ and METS):

Bench Height (cm)	Predicted VO ₂ (ml·kg ⁻¹ ·min ⁻¹)	Actual VO ₂ (ml·kg ⁻¹ ·min ⁻¹)	Mean Difference (ml·kg ⁻¹ ·min ⁻¹)	METS
15.42	23.98	28.42	-4.44	-1.27
20.32	31.29	31.36	-0.07	-0.02
25.4	38.57	33.78	+4.79	+1.37
30.48	45.88	37.38	+8.5	+2.43

The 20.32 cm bench was the only condition in which the difference between the predicted and actual VO₂ was negligible. The reasons for the disparity between the actual and predicted VO₂ for the majority of the selected bench heights is not entirely clear. Differences in subjects and methodology may have functioned to diminish the accuracy of the ACSM prediction equation. The present "aerobic" bench exercise bout was conducted only with females and arm movements were integrated with the various stepping maneuvers. Compared to traditional bench stepping movements, the active incorporation of arm mass may differentially alter the VO₂ of stepping with respect to the step height.

EFFECT OF BODY AND ARM POSITION ON THE MEASUREMENT OF SYSTOLIC BLOOD PRESSURE

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This study determined the effect of body and arm position on the measurement of systolic blood pressure (SBP). Twenty male subjects (mean age, 22 yrs) were studied using six body and arm positions: (1) standing with the arms in the anatomical position, (2) standing with the arms elevated above the head, (3) supine with the arms in the anatomical position, (4) supine with the arms alongside the head, (5) inversion with the arms in the anatomical position, and (6) inversion with the arms in the dependent overhead position. Resting auscultatory blood pressure measurements were recorded from the left brachial artery (arm) following randomization of the six body and arm positions. ANOVA with repeated measures and the Tukey test were used to analyze the data. The mean SBP measurement for each of the six body and arm positions one through six was 119, 99, 117, 119, 125, and 146 mmHg, respectively. Results indicate that a significant difference exists between body and arm positions 1 vs 6, 1 vs 2, 2 vs 6, 2 vs 5, 2 vs 4, 2 vs 3, 3 vs 6, 3 vs 5, 4 vs 6, and 5 vs 6. These data confirm that the measurement of SBP during different body and arm positions provides quantitative information specific to both body and arm position at the time of the measurement. Knowledge of this point should help in avoiding misleading information when measuring and interpreting SBP during full inversion with the arms in the anatomical position vs the arms in the dependent overhead position and when either is compared to the standing SBP measurement with the arms in the anatomical position.

CLINICAL: HIP

HIP PAIN IN A COLLEGIATE RUNNER

19 YOWF middle distance track and cross country collegiate freshman athlete was evaluated for complaints of anterior right hip pain related to activity. She was doing more vigorous track workouts but denied increase in distance. She felt pain in the anterior thigh of her right leg when running sprints and with track workouts. The athlete had been running competitively for four years. She had been amenorrheic for twelve months. She denies prior musculoskeletal injury or pain at night or when inactive.

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PHYSICAL EXAM: Height was 5'3", weight was 102 lbs. Full range of motion of both hips without pain. Pain on MMT of hip flexion over the mid proximal third rectus. No swelling of the thigh. Neurocirculatory intact. Back exam was normal.

Hip Pain in a Professional Ballet Dancer Henry A. Stiene, M.D., University of Kentucky

A 24 year old female professional ballet dancer complained of a dull groin pain for 3 weeks. The pain was exacerbated by turnout and landing from jumps. She was seen by a therapist and diagnosed as having a groin strain and given therapeutic exercises. The patient had no improvement and developed an acute worsening, especially with all weight bearing activities. The pain was now described as sharp in nature and precluded the patient from dancing. Her past medical history was unremarkable with the exception of not having a menstrual period for over 3 years. She had not missed any time from dancing due to previous injury and had been dancing since she was 5 years old. Physical exam revealed pain with passive internal and external rotation of the hip along with a 10° loss of IR compared to the unaffected hip. Abduction of the hip produced pain, as did adduction, but to a lesser extent. The patient exhibited tenderness to palpation over the right mid-inguinal region.

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HIP PAIN IN A RECREATIONAL RUNNER

24 YOWM graduate student and recreational runner presented with an 18 month history of exertional left hip pain. He reduced his running activities and began anti-inflammatory medications which helped. Initial radiographs were negative. He resumed running and developed increased medial hip pain when not taking anti-inflammatory medications. The pain awakened the patient at night. He was otherwise healthy without prior fractures or joint complaints.

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PHYSICAL EXAM: Height was 5'8", weight was 180 lbs. HIPS: Pain on palpation over the left adductor region with pain in extremes of range of motion in internal rotation and abduction. No swelling. Neurocirculatory status intact.

3D KINEMATICS CONTRIBUTING TO ELITE SHOTPUT THROWS

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Five men and five women elite shotputters were examined to determine the kinematic parameters contributing to successful throws (men > 20 m; women > 17 m). Three-dimensional video recordings (men, 10 throws; women, 13 throws) from the 1990 U.S. National Championships were digitized at a frequency of 60 Hz. Release parameters of the shot along with over 60 selected parameters of the throwers were calculated for each throw. For example, these parameters included temporal patterns of the feet placement, joint angles and angular velocities, movement of the center of mass, trunk angles, and length of the shot path (LOSP). Along with descriptive statistics, Pearson moment-product correlations were calculated to find the parameters related to the distance thrown (See Table).

	Men & Women				Men & Women		
At Release:				Other:			
Velocity	0.94	0.90	0.86	LOSP (PP-R)	0.48	-0.56	-0.90
Height	0.52	-0.18	-0.32	Lt Knee (PP)	-0.48	-0.53	0.39
Angle	0.22	-0.07	0.54	Total Time	0.27	-0.80	-0.71
Rt toe Ht	-0.53	0.36	-0.81				
Rt Sh Vel	-0.83	-0.58	-0.71				
Rt El Vel	-0.45	0.47	-0.04				

To produce an elite throw these data support a high shot velocity, a slower right shoulder angular velocity, a short length of shot path from the power position (PP) to release (R), a increased flexed blocking leg at PP, and a shorter total time of the throw. However, it is important to consider the interaction effect between the parameters.

Supported by a grant from The Athletics Congress

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THE EFFECT OF INTENSE PARTICIPATION IN YOUTH SPORTS ON STRENGTH AND FLEXIBILITY IN PREADOLESCENT ATHLETES

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Three groups of preadolescents were measured for flexibility using the sit and reach, using goniometric measures the hamstrings, quadriceps, gastroc, and shoulder internal and external rotation, and on field strength tests using sit-ups, push-ups, and grip strength. Groups consisted of intensely trained tennis players from a resident tennis camp (n = 143), intensely trained soccer players from elite city soccer clubs (n = 41) and active but not intensely trained controls. Soccer players were generally tighter in quadricep flexibility. Tennis players were generally tighter in hamstring and shoulder internal rotation flexibility. Controls performed significantly more sit-ups, and tennis players performed significantly more push-ups. Values for sit and reach and grip strength were not significantly different. It is concluded that flexibility and strength adaptations to intense participation in soccer and tennis are specific to the sport.

Supported by a grant from the Lexington Clinic Foundation for Research and Education.

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BIOMECHANICS

A COMPARISON OF STRENGTH AND THROWING VELOCITY RELATIONSHIPS BETWEEN PRE- AND POST-PUBESCENT 12-YEAR-OLD BOYS

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Shoulder strength (STR) has been positively correlated with throwing velocity (V) in professional baseball players. The purpose of this investigation was to examine STR and V ratios in pre-pubescent (PRE) and post-pubescent (POST) 12-year-old Little League (LL) boys. Twenty subjects (10 PRE, 42.7 ± 8.2 kg, and 10 POST, 52.1 ± 6.6 kg) participated. STR testing was conducted on each subject's throwing arm at 120 degsec⁻¹ using a Cybex II isokinetic dynamometer. Shoulder motions included adduction (ADD), extension (EXT), horizontal adduction (H.ADD) and internal rotation (IR). V was determined using a JUGS gun while the boys threw a standard baseball a distance of 46 feet.

Table 1 contains the means ± SD for peak torque generated (N·m) during STR testing, and peak V (km·hr⁻¹).

TABLE 1	ADD	EXT	H.ADD	IR	V
PRE	56.6 ± 16.8	51.8 ± 18.8	51.8 ± 28.4	32.0 ± 9.9	85.0 ± 6.1
POST	69.6 ± 16.0	66.0 ± 15.8	63.6 ± 18.0	37.3 ± 8.5	88.8 ± 10.3

Table 2 reveals the Pearson correlation coefficients for each shoulder motion, against V.

TABLE 2	ADD:V	EXT:V	H.ADD:V	IR:V
PRE	.288	.498	.375	.210
POST	.386	.666 *	-.065	.554 *

Analyses indicated that statistically significant relationships ($p < .05$) existed between EXT:V, and H.ADD:V, in POST only. There was little or no relationship evident in the physically immature group, although both groups had been involved in organized LL for the same number of years. Apparently the PRE group demonstrated more relative variation in the STR testing scores which would account for this occurrence.

THE INFLUENCE OF TREADMILL TRAINING ON THE MECHANICAL PROPERTIES OF BONE IN SENESCENT FEMALE RATS CONSUMING COPPER DEFICIENT DIETS.

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Previous work has shown that the level of dietary copper can influence the mechanical properties of bone in weaning rats. In addition, exercise training in both young and senescent laboratory animals produces a positive effect on bone mechanical properties. The purpose of this study was to investigate the effect of exercise training on mechanical properties of senescent female rats fed copper deficient diets. Eighteen (18) month old female Fisher 344 retired breeders consumed a copper deficient diet containing native copper at a concentration of 0.6 ppm as analyzed by atomic absorption spectrophotometry. Animals were divided into exercise trained (EX-TR, n=5) and control (C, n=5). Training consisted of treadmill running at 18 m/min, 5 days per week for 8 weeks. The right femur was subjected to a three-point loading test on an Instron Universal Testing Machine to determine bone flexibility and maximum breaking strength. Data were analyzed using the Mann Whitney U test for non-parametric samples. There were no significant differences between the two groups for flexibility. Mean values for EX-TR was 9.0 kg while the control animals had a value of 9.28 kg. Femur maximum force was also not significantly different between the groups (EX-TR 11.48 kg, C 11.38 kg). These results would suggest that exercise training of copper deficient animals was not effective in improving the mechanical properties of bone in the senescent female rat.

CLINICAL TRACK

INVERSION ANKLE SPRAIN - FOOTBALL

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HISTORY - 21-year old college football player who presents with a swollen right ankle that he is unable to walk upon. He was injured 14 hours ago, when he slipped on a wet stair-step and inverted the sole of his foot. Self-administered treatment immediately after the traumatic incident consisted of ice-pack application for approximately 30 minutes, followed by application of an elastic wrap and use of crutches. He is the starting fullback on his football team and is very distressed about having sustained such an injury in the middle of his season. He is very anxious to return to participation. There is no history of previous injuries to his right ankle.

PHYSICAL EXAM - Edema is localized on the lateral aspect of the ankle around the fibular malleolus. Palpation reveals extreme point tenderness over the anterior talofibular ligament. Active ROM is limited and painful in all directions. Manual inversion stress produces sharp pain, but no lateral instability is apparent. The anterior drawer test is negative. Standing with his weight evenly distributed between his two feet does not produce significant discomfort, but he is very reluctant to attempt to walk in an unsupported condition.

The Arthrogo Ankle Brace, Clinical Experiences. R. W. Lowe,
Scott Orthopedic Center, Paintsville, KY.

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An ankle brace has been developed that consists of a molded ankle cuff, foot plate, and two submalleolar pads. The pads ride on velcro straps. The foot plate can be attached to the ankle in varied degrees of inversion and eversion to decrease stress on the injured parts about the ankle, be they medial or lateral. This brace has been helpful in basketball players and has been worn an entire season during participation. It is comfortable, and the choice to wear it has been made by the participant, after appropriate healing. It has been helpful to gymnasts whose ankles sprain on dismount, and has been worn greater than six months effectively by the patient. It has been useful for a variety of other clinical conditions. A variant of this device is useful as a golf teaching aide.

EARLY RETURN TO ACTIVITY AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: A CASE STUDY.

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By following an aggressive rehabilitation program consisting of electrical muscle stimulation, progressive resistance exercises, multiple velocity isokinetic exercise, swimming and closed chain functional activities over 12 weeks, this college basketball freshman was returned to his sport without ill effects. Upon return to basketball, the subject presented 13%,3% quadriceps strength deficiency (194 vs 168ftlb),(128 vs 124ftlb) and 31%,27% stronger hamstrings than the contralateral extremity (96 vs 73ftlb),(89 vs 70ftlb) assessed isokinetically at 90 and 240⁰/sec. Single leg broad jump deficit of 20% (82 vs 66.5in); Involved joint laxity (1-2mm); Pain-free/limp-free distance running (1-2mi), sprinting (20-100yd), back pedaling (10yd), lateral shuffle stepping (10yd), figure eights (5-10yd), cross-over stepping (10yd). The subject was returned to basketball participation without restriction while wearing a derotation brace. Structured rehabilitation continued. At six months post-op involved quadriceps strength was 2%,3% less than (209 vs 204ftlb),(143 vs 138ftlb) the contralateral extremity assessed isokinetically at 90,240/sec; Involved quadriceps strength at 450/sec was 8% greater, (106 vs 115ftlb); Involved hamstring strength was greater at each speed by 10%,20%,23%, (88 vs 98ftlb),(69 vs 86ftlb),(67 vs 87ftlb). At one year post-op, single leg broad jump deficit was 12% (84 vs 74in). Joint laxity assessment at this time was unchanged. The subject is presently excelling at preseason conditioning activities without derotation brace.

46**CLUB LACROSSE: A PHYSIOLOGICAL AND INJURY PROFILE**

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Club lacrosse is a popular and growing sport in the United States, with over 10,000 players nationally. While collegiate lacrosse injury patterns have been studied, information is lacking concerning the physiological status and injury incidence of the club player, who is generally beyond college age. In order to determine the musculoskeletal and aerobic fitness level of these athletes, preseason evaluations were performed on 22 lacrosse players aged 19-34 years, and their injuries were recorded during a season. The group included 11 midfielders, 6 attackmen, 4 defensemen, and 1 goalie. The midfielders were the fittest of the group (VO₂ max. of 57.5 ml/min/kg vs. 48.0 ml/min/kg), while the defensemen tended to be the least fit (percent bodyfat 23.4 vs. 19.6; situps 30.5/min vs. 42.1/min; quadriceps torque 0.71 bodyweight vs. 0.81 bodyweight). The athletes with overuse injuries all had areas of inflexibility or muscle imbalance on preseason testing. The most commonly injured area was the shoulder, with 3 A-C separations, 3 rotator cuff injuries, and one shoulder dislocation.

Preseason evaluations and routine attendance by trained medical or paramedical personnel appears useful in identifying players at risk for injury and reducing the severity of injury in this high-speed, high-impact sport.

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CLINICAL: TRACK

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SPORTS-SPECIFIC MUSCLE IMBALANCE -- TENNIS

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HISTORY -- 17 year-old female professional tennis player who presents complaining of chronic shoulder pain of her dominant side. The pain began approximately one year ago with no specific acute onset. She observed a brief period of complete rest with no resolution of symptoms. She continued to play with anterior shoulder pain and a feeling of tiredness with continued use. She has been treated previously by two different physicians for rotator cuff tendinitis with inference to a palsy of the long thoracic nerve. It was highly recommended that she significantly reduce and/or cease playing. Presently, she practices/plays 12-15 hours per week and participates in a self-directed conditioning and strengthening program.

PHYSICAL EXAM -- She has inflexibilities of her dominant side including external shoulder rotators, forearm supinators, wrist extensors. She is below recommended strength levels for shoulder internal and external rotator muscle groups bilaterally. She has positive lateral scapular slide of her dominant side with noticeable scapular winging in the anatomical reference position.



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PHYSIOLOGY AND RESISTANCE TRAINING

ANABOLIC EFFECTS OF CHROMIUM PICOLINATE ON BEGINNING WEIGHT TRAINING STUDENTS

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The effects of chromium picolinate (CrPic) supplementation were studied in a group of 59 college-age students (37 M, 22 F) over a 12-week weight lifting program. Using a double-blind protocol, half of the students were given 200 µg/day chromium (Cr) in the form of chromium picolinate (CrPic), while the other half received a placebo (P). Therefore, four groups were randomly formed: 1) F-CrPic; 2) F-P; 3) M-CrPic; and 4) M-P. The variables examined included bodyweight (BW), lean body mass (LBM), percent bodyfat (%BF), a sum of 3 body circumferences (ΣC), and the 1 repetition maximum for the squat (SQ) and bench press (BP). All four groups exhibited gains in LBM and decreases in %BF. However, only the F-C group differed from the others, by gaining significantly more BW ($p=0.0010$), mostly due to an increase in LBM ($p=0.0459$). Although the ΣC measurement approached significance for treatment ($p=0.0344$), no treatment effects were noted for %BF, SQ, or BP. Pre- to posttest differences were:

Group	BW(kg)	LBM(kg)	ΣC(cm)
F-CrPic	2.5±2.0	2.7±0.9	3.0±5.1
F-P	0.6±1.8	1.5±0.9	0.0±3.8
M-CrPic	0.8±1.5	1.4±1.5	3.6±2.5
M-P	1.3±1.9	2.0±1.6	1.8±3.3

In conclusion, the CrPic supplementation appeared to have a greater effect on the females than the males. This could have been due to initial differences in Cr status, a dose-dependent effect, and/or sex-related insulin differences.

Supported in part by Twin Laboratories.

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STABILITY RELIABILITY OF CYBEX II BICEPS TEST FOR PEAK TORQUE UTILIZING UBXT VERSUS PREACHER'S BENCH

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In an effort to increase specificity between testing and standard training mode, a preacher's bench (BENCH) was designed and attached to the Cybex II UBXT to test subjects for biceps flexion in a sitting position. Stability reliability comparisons were made between this new test position and the Cybex II UBXT established biceps test protocol position (prone). A total of 14 male experienced weight lifters (20-28 yrs.) were tested/retested on UBXT ($n=7$) and BENCH ($n=7$) utilizing angular velocity 60 deg./sec. and a five trial effort to determine peak torque. Spearman rank order correlation indicated the highest reliability estimate was observed in the BENCH condition ($P=.88$). The reliability estimate for the UBXT condition was ($P=.77$). A Wilcoxon test was used to determine if the isokinetic peak torque measures produced during the UBXT test were significantly different from the values generated during the BENCH test. The test and retest scores within each experimental condition were averages to provide a single data set for statistical analysis (UBXT: $\bar{X}=42.29$ ft. lbs)(BENCH: $\bar{X}=43.43$ ft. lbs) and were not significantly different ($z=.33, P>.74$). In conclusion, the BENCH method may be a superior method over UBXT for testing biceps flexion torque due to increased reliability and greater specificity as it relates to training position.

Supported by part of a grant from National Strength and
Conditioning Association

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PHYSIOLOGY AND RESISTANCE TRAINING

THE EFFECTS OF SHORT-TERM OVERWORK ON BLOOD LACTATE AND AMMONIA CONCENTRATIONS IN ELITE JUNIOR WEIGHTLIFTERS

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Blood lactate and ammonia concentrations have been utilized extensively as markers of exercise intensity and as possible determinants of the overtrained condition. The present study examined the effects of a 1 wk high volume training camp on blood lactate ([LA]) and ammonia ([NH₃]) concentrations. Subjects were 28 junior elite male weightlifters (\bar{x} age = 17.3 \pm 1.4 yr; \bar{x} BM = 67.8 \pm 11.8 kg). Blood samples were drawn at four time periods before (T₁) and after (T₂) 7 d of intensive, high volume weight-training (2-3 workouts/day): resting, preexercise, 5 m postexercise, and 15 m postexercise. The exercise bout on T₁ and T₂ consisted of a brief warm-up and single snatch attempts performed every 15 s as the weight progressively increased until the subjects could not execute the lift successfully. A repeated measures ANOVA with a Fisher's LSD post hoc revealed significant increases ($p < 0.05$) for [LA] and [NH₃] from pre to postexercise bouts. There were no differences in performance measures from T₁ to T₂. In addition, [LA] was significantly higher at T₁ 5 m (12.1 \pm 1.98 to 7.6 \pm 2.09 mmol · L⁻¹) and 15 m (7.0 \pm 2.56 to 4.5 \pm 1.78 mmol · L⁻¹) postexercise while [NH₃] increased significantly at rest on T₂ (33 \pm 17.56 to 68 \pm 38.53 μ mol · L⁻¹) and at 5 m postexercise on T₁ (184 \pm 63.37 to 143 \pm 64.32 μ mol · L⁻¹). Performance measures and [LA] results suggest a positive training adaptation from T₁ to T₂; however, the higher resting [NH₃] at T₂ may be indicative of symptoms of overwork.

PHYSIOLOGICAL EFFECTS OF COMBINING PERIODIZED STRENGTH TRAINING AND AEROBIC TRAINING

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This study was conducted to determine the effect of combining periodized strength training and aerobic training on muscular strength, anaerobic power, aerobic capacity and body composition. Twenty-four college age (18-22) males volunteered to participate in this 9-week strength/aerobic program.

The subjects were randomly assigned to one of three groups. Group I (n=8) performed a three stage periodized strength training program utilizing free weight squat and bench press exercises. Group II (n=8) performed the same strength training but upon completion performed a progressive jogging program for 15-25 minutes utilizing a 65-90% target heart rate. Group III (n=8) did not participate in an experimental treatment. All subjects underwent pre- and post-testing the week prior to and immediately following training, respectively. Muscular strength was measured by the 1RM squat test for hip and leg strength, and 1RM bench press test for upper body strength. Anaerobic power was measured by the Sargent Jump test. Aerobic capacity was determined by a graded exercise treadmill test (Bruce). Body composition was measured by the BIA-101 bioelectrical impedance analyzer. ANOVA at the 0.05 level of significance was selected for the data analysis. Significant differences were found to exist between the experimental groups and the control group in both hip and leg and upper body strength. No significant difference was shown to exist between the experimental groups. Nor did a significant difference exist between the groups on anaerobic power, aerobic capacity, and body composition. These findings would suggest that the addition of moderate aerobic training does not have a deleterious effect on strength gains.

MUSCLE AND CARDIOVASCULAR PHYSIOLOGY

EFFECTS OF MUSCULAR ANAEROBISIS ON SUBSTRATE AVAILABILITY AND MYOCARDIAL COMPLIANCE TO EXERCISE

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Previous reports have suggested that alterations in fuel substrates available to the heart as a result of muscular anaerobisis may affect myocardial metabolism resulting in a decreased inotropic and increased chronotropic responses. Consequently, a disproportionate increase in heart rate at anaerobic threshold (AT) has been suggested to be a marker of AT. The purpose of this study was to determine whether muscular anaerobisis affects myocardial compliance to exercise at or following AT. Six trained cyclists performed an incremental maximal exercise test on the computerized Schwinn Velodyne ergometer. Workloads were initiated and increased by 50W every 3 min until the subjects reached volitional fatigue. Blood samples were drawn each stage from a venous catheter. Two-dimensional echocardiographic and doppler evaluations were obtained during each stage of exercise using a Hewlett-Packard Sonar 1000 echocardiograph. Metabolic and ventilatory data were sampled at 15s intervals. Blood samples were assayed for a number of substrates, muscle and cardiac enzymes, and hematological variables. Lactate and ventilatory thresholds were identified by standard procedures. Stage to stage data were analyzed by repeated measures ANOVA and Newman-Keuls post-hoc analysis to determine if significant alterations occurred at or following AT. Results revealed that the subjects had a maximal oxygen uptake of $69.2 \pm 9 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ with AT occurring at 82% of $\text{VO}_{2\text{max}}$. No significant changes were observed in glucose or triglyceride levels at or following AT, however, free fatty acid and lactate levels significantly increased at AT. Creatine kinase and creatinine levels were significantly increased at AT, however, lactate dehydrogenase and creatine kinase-myocardial band concentrations were not affected by AT. Serum phosphorus levels were also significantly increased at AT. Echocardiographic and doppler studies revealed no significant differences in end diastolic interventricular septum dimensions, left ventricular posterior wall dimensions at end diastole, left ventricular internal diameter at end diastole, left ventricular internal diameter at end systole, left atrial dimensions, aortic valve dimension, left ventricular outflow tract diameter, peak aortic velocity, ejection fraction, or fractional shortening at or following AT. Additionally, no significant inflections in heart rate or R-R interval were observed at or following AT. Results indicate that muscular anaerobisis does not affect myocardial compliance to exercise and that the use of heart rate as an indicator of anaerobic threshold does not appear valid.

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FORCE FREQUENCY AND FATIGUE RESPONSES OF MALIGNANT HYPERTHERMIC SKELETAL MUSCLE.

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Malignant hyperthermia (MH) is an inherited skeletal muscle disorder characterized by accelerated skeletal muscle metabolism, rising body temperature, muscle rigidity and tachycardia. This reaction is triggered by inhalational anesthetics and depolarizing muscle relaxants. The incidence of MH responses in humans is approx. 1:15,000. Because the mechanism of this syndrome resides in skeletal muscle, this study sought to examine the force frequency and fatigue characteristics of MH skeletal muscle. Fiber bundles were dissected from Porcine MH (n=16) and normal (n=10) gracilis muscles. Force frequency characteristics were examined by 250 msec trains of stimuli (1-100 Hz). Peak tetanic tensions (100 Hz) were not different between MH and normal muscle (5.09 ± 0.62 & $5.12 \pm 0.48 \text{ N/cm}^2$, resp.). At stimulation rates between 20-80 Hz, MH muscle produced significantly ($p < 0.05$) less force. Further, MH muscle stimulated between 20 and 80 Hz demonstrated greater tetanic "sag" (% of force decline thought the tetanus). The fatigue characteristics were examined by tetanic trains (100 msec @ 100 Hz) delivered at 1 per sec for 5 minutes. Fatigue rate constants (0.523 ± 0.067 and $0.496 \pm 0.085/\text{min}$) were similar between muscle types during the 0-2 minute interval. During the 2-5 minute interval the normal muscle continued to fatigue at the same rate whereas MH muscle showed no further change in tension. The magnitude of fatigue at 5 minutes was (% of initial tetanus) MH $x = 46.7 \pm 5.0$, NML $x = 16.5 \pm 4.6$ ($p < 0.05$). Results show that MH & normal muscle differ in response to repetitive stimulation.

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MUSCLE AND CARDIOVASCULAR PHYSIOLOGY

WEIGHT FLUCTUATION AND MYOCARDIAL ADAPTATION IN WRESTLERS

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The effect of seasonal weight fluctuation on myocardial adaptation of 7 college wrestlers was examined during the 1989-1990 season. Standard m-mode and 2-D echocardiographic measurements were used to determine left ventricular end diastolic dimension (LVED), fractional shortening (FS), LV diastolic posterior wall thickness (DPW), and LV mass (LVM) during pre-season (test 1) and 4 months later at the season's end (test 2). The wrestlers' qualifying weights ranged from 118-177 lbs and each competed in an average of 17 meets. Systolic and diastolic blood pressure (SBP, DBP), heart rate (HR), and body weight (BW) were measured at both tests. Daily weight records and qualifying weights were used to calculate seasonal weight fluctuation as a percentage of the highest BW attained between each meet and the wrestler's subsequent qualifying weight. Paired t-test analysis were used to determine differences between tests ($\bar{X} \pm SD$):

Variable	Test 1	Test 2	:	Variable	Test 1	Test 2
BW lbs	155+20	148+21*	:	LVED mm	50+5	51+2
HR bt/min	57+7	56+6	:	FS %	34+3	33+4
SBP mmHg	115+8	115+14	:	LVM mm ³	171+24	210+13*
DBP mmHg	77+7	76+5	:	DPW mm	9+1	10+1*

(* $p < .01$). LVM and DPW increased and BW declined from test 1 to 2 while the other variables remained constant. The wrestlers' mean % weight fluctuation throughout the season was $7.5 \pm 1.5 (\bar{X} \pm SD)$ ranging from 4.4 to 9.1%. These findings suggest that significant increases in myocardial mass occur over the course of a competitive season resulting from increased LV wall thickness. The magnitude and cyclic method of weight reduction used by wrestlers does not appear to prevent myocardial adaptation to intense regular training.

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CHANGES IN RAT HINDLIMB PASSIVE TENSION FOLLOWING DISUSE ATROPHY.

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Whole body suspension (WBS) results in significant hindlimb muscle atrophy as a result of nonload bearing disuse conditions imposed. It was the purpose of this study to develop a model for examining hindlimb flexibility in rats and determine if WBS induced disuse results in tissue alterations which affect flexibility and hence the viscous properties of the hindlimb. Adult male rats (300 g) were exposed to 0, 7, or 14 days of WBS. On days 0, 7 and 14, the animals were anesthetized and placed on a platform with their left hindlimb supported on a metal plate attached to a pulley system. This system allowed movement of the ankle about a 90° axis. An isometric force transducer was attached to the pulley system and measured plate tension from the hindlimb when the foot was moved from a 90° neutral position to either 125° or 140° dorsiflexed position. Five tension measurements at each angle were made each testing day. Passive tension was always highest on the initial measurement and declined to a constant baseline with subsequent recordings. Following 7 days of WBS, peak tension was significantly increased by approximately 75% at both 125° and 140° angles. An additional 7 days of WBS (14 days total) resulted in only a 6-8% increase in passive tension at both joint angles. It is suggested that hindlimb disuse during WBS results in rapid and significant loss of limb flexibility which can be easily and reproducibly measured by our hindlimb tension model. However, it is unknown at this time whether this reduced flexibility is due to changes in the muscle/connective tissue ratio, increased rigidity of the connective tissue, or a shortening of the muscle.

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TIME COURSE CHANGES IN BETA-ENDORPHIN & LACTATE AT 70% $\dot{V}O_2$ MAX.

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Twelve male subjects ($X = 29.9 \pm 1.8$ yrs) with a $\dot{V}O_2$ max of 64.6 ± 1.5 ml $\text{kg}^{-1} \text{min}^{-1}$ ran for 2 hr on a treadmill to determine the time course of Beta-Endorphin (B-EP) at 70% $\dot{V}O_2$ max. Subjects reported to the lab after a 12 hr overnight fast and rested 30 min. A venous catheter was inserted into a forearm vein and a resting blood sample obtained. Another resting sample was obtained 15 min later while the subject stood on the treadmill. Blood samples were obtained at 30 min intervals during the run and 15 min after the run (rec). Subjects were allowed to drink water during the run. The $\dot{V}O_2$ was monitored every 30 min ($X = 71.9\% \dot{V}O_2$ max). B-EP were extracted by column chromatography and determined by RIA (IncStar). Blood lactate was determined enzymatically. Values were corrected for hemoconcentration. Resting B-EP were $5.03 \pm .32$ and $5.15 \pm .34$ pmol.l⁻¹ and did not differ. B-EP were significantly elevated at 30 min (11.4 ± 1.89 pmol.l⁻¹) and remained fairly constant until 90 min (15.4 ± 2.42 pmol.l⁻¹). At 2 hr B-EP were further elevated to 23.3 ± 5.55 pmol.l⁻¹. Rec B-EP were 15.7 ± 2.62 pmol.l⁻¹. Lactate increased slightly to 2.38 mmol.l⁻¹ at 30 and 60 min and then decreased slightly at 90 and 120 min to 1.73 and 1.57 mmol.l⁻¹, respectively. These data indicate that during steady state exercise for 2 hr at 70% $\dot{V}O_2$ max, B-EP are increased by 30 min and are maintained at this level through 90 min but are further elevated at 120 min. These data also show that during steady state exercise B-EP will continue to rise at a time when plasma lactate is decreasing.

57**EFFECTS OF ACUTE RESISTANCE EXERCISE ON PLASMA LIPIDS AND LIPOPROTEINS**

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Ten inactive middle-age males (age 40 ± 6 yrs; ht 173 ± 7 cm; wt 93 ± 14 kg; % fat $22 \pm 2\%$; mean \pm SD) having lipid profiles at risk for coronary artery disease were studied to determine the effects of an acute session (40 min) of circuit weight lifting (CWL) on plasma lipids and lipoproteins. Subjects were considered inactive if they performed recreational physical activity ≤ 1 time per week for ≤ 30 min. The lipid criteria for subject inclusion were triglyceride concentrations > 150 mg.dl⁻¹, high density lipoprotein cholesterol (HDL-C) levels < 40 mg.dl⁻¹, and a total cholesterol/HDL-C ratio > 5.0 . Subjects participated in a CWL session and a control session. The CWL session was comprised of 10 ordered exercise stations. A complete circuit consisted of 1 set of 10 repetitions per exercise station with the subjects performing a total of 4 circuits per exercise session. Each exercise was performed at 50% of the individuals maximum lifting capacity. The control session consisted of the subjects remaining inactive for an identical 40 min time period. Fasted venous blood samples were obtained 24 h pre, immediately pre, immediately post, 24 h, and 48 h post-exercise. Blood samples were assayed (mean \pm SE) for triglyceride (188 ± 12), total cholesterol (209 ± 7), HDL-C (33 ± 1), HDL₂-C (5 ± 0.3), HDL₃-C (28 ± 1), and the total cholesterol/HDL-C ratio (6.5 ± 0.3). There were no significant alterations in any lipid or lipoprotein parameter following the CWL session after adjusting for changes in plasma volume. These findings suggest that an acute session of CWL lasting 40 min does not beneficially affect blood lipids or lipoproteins in individuals having lipid profiles at risk for coronary artery disease.

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EXERCISE BIOCHEMISTRY

THE EFFECTS OF ACUTE MODERATE EXERCISE ON LYMPHOCYTE FUNCTION AND SERUM IMMUNOGLOBULIN LEVELS

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The extent and duration of changes on lymphocyte function and serum immunoglobulin (Ig) levels were examined in 12 women who walked 45 minutes at 60% $\text{VO}_{2\text{max}}$ in a laboratory setting. A two factor, 2 x 6 design with repeated measures on both factors was utilized. The first factor was condition (exercise and rest), and the second factor was time (six times of measurement over a 24 hour period), with treatment order counterbalanced. The 45-minute walk, in comparison to rest in a seated position, was not associated with significant changes in circulating numbers of interleukin-2 activated T cells (CD5 & CD25) or on spontaneous or concanavalin A-stimulated lymphocyte proliferation. A trend for decreased phytohemagglutinin-stimulated lymphocyte proliferation in comparison to the rest condition, however, was seen 1.5 hours following the exercise bout ($p=0.047$). The patterns of change for serum IgG, IgA, and IgM were significantly different ($p=0.001$, $p<0.001$, $p=0.010$, respectively) between conditions. IgG rose 7.2% immediately following exercise, and then returned to baseline 1.5 hours later which contrasted significantly with changes in the rest condition. These same patterns of change occurred also with IgA and IgM, but increases immediately following exercise were not significant, although a trend was seen for IgA ($p=0.03$). The 45-minute walk had no effect on plasma cortisol and epinephrine levels relative to the rest condition, but was associated with a significant 89% increase in norepinephrine. These data suggest that moderate exercise leads to a transient increase in serum immunoglobulin levels by way of contribution from extravascular pools and/or nonspecific stimulation of memory B cells. Antigen-dependent mechanisms do not appear to play a major role.

Supported in part by a grant from The Rockport Walking Institute

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INFLUENCE OF GLUCOSE POLYMER INGESTION ON PLASMA GLUCOSE CONCENTRATION AND PERFORMANCE IN MALE DISTANCE RUNNERS

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Ten well-trained male runners ($\text{VO}_2 \text{max} = 64.9 \pm 4.8 \text{ ml/kg/min}$) performed a treadmill exercise test at 80% $\text{VO}_2 \text{max}$ under two experimental conditions, glucose polymer (GP) and placebo (P), to determine the effect of GP ingestion on endurance performance (treadmill run time), plasma glucose concentration, respiratory exchange ratio (RER), and perceived exertion (RPE). Treatment order was randomized and counterbalanced and test solutions were administered double-blind. Ingestion took place at 15 min pre-exercise (250 ml) and at 15-min intervals during exercise (125 ml). Performance was enhanced by 29.4% ($p < .05$) during GP ($115.4 \pm 25.1 \text{ min}$) compared to P ($92.0 \pm 27.4 \text{ min}$). Plasma glucose concentration was significantly greater during GP ($100.1 \pm 15.9 \text{ mg/dL}$) compared to P ($90.0 \pm 11.9 \text{ mg/dL}$). Respiratory exchange ratio was significantly greater during GP ($.94 \pm .01$) compared to P ($.90 \pm .01$) and RPE was significantly less during GP (14.5 ± 2.3) compared to P (15.4 ± 2.4). These data suggest that time to exhaustion of high-intensity exercise is delayed as a result of GP ingestion. It is further suggested that favorable alterations in plasma glucose concentration and substrate utilization are responsible for the ergogenic effect associated with GP.

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CARDIOVASCULAR PHYSIOLOGY

CENTRAL AND PERIPHERAL RESPONSES TO POSTPRANDIAL EXERCISE

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The present study was designed to investigate the central and peripheral responses during steady-state treadmill exercise with and without ingestion of a 1000 kcal meal just prior to exercise. Fifteen subjects (mean age, 24 yrs) were used in the study. Each subject repeated the research protocol on two different mornings, one in which no food was consumed (Control data) and the other in which the meal was consumed (Treatment data). All subjects fasted for nine hours prior to each treadmill exercise, which consisted of 10 minutes of exercise at a speed of 3.12 km·hr⁻¹ at 2% grade. The exercise data were collected using the Beckman MMC and CO₂ rebreathing procedure and, then, subsequently analyzed using an analysis of variance with repeated measures (and the Tukey's post hoc test when indicated). The results indicated that there were no significant differences ($p > .05$) between Control and Treatment exercise data. Heart rate [(C) 144 vs (T) 152 beats·min⁻¹], stroke volume [(C) 129 vs (T) 127 ml], cardiac output [(C) 18.4 vs (T) 19.2 L·min⁻¹] and arteriovenous oxygen difference [(C) 130 vs (T) 130 ml·L⁻¹] were non-significantly changed during the postprandial exercise test. Therefore, the experimental hypothesis that the ingestion of a 1000 kcal meal just prior to submaximal steady-state treadmill exercise would significantly increase central and peripheral responses was not supported.

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EFFECT OF AEROBIC FITNESS ON HEMODYNAMIC RESPONSES TO UPRIGHT TILTING

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The purpose of this study was to determine whether the level of aerobic fitness significantly influences hemodynamic responses to upright tilting. Specifically, this study examined the influence of aerobic fitness on heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) to upright tilting in 9 average and 9 above-average aerobically conditioned male adults. Aerobic fitness levels were determined during a maximal treadmill test using the Bruce protocol. The maximal oxygen consumption (VO₂) value for the above-average group (54.62 ml·kg⁻¹·min⁻¹) was significantly higher ($p < .05$) than the value for the average group (43.31 ml·kg⁻¹·min⁻¹). Heart rate and blood pressure (BP) responses were obtained during supine rest for 30 minutes and during 5 minutes of upright 58° tilt. A dependent *t*-test indicated that the increase in HR, DBP, and MAP to upright tilting was significant ($p < .05$) for both groups. The SBP response for both groups was non-significantly different with upright tilting. The results indicate that the HR and BP responses to upright tilting are not different between above-average and average aerobically fit male adults. Therefore, the experimental hypothesis that at a comparable angle of upright tilt, mean HR and BP responses would be significantly attenuated for the above-average compared with average aerobically fit subjects was not supported.

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Cardiovascular Responses in Black and White Males During Exercise

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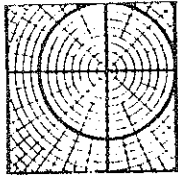
Previous investigations have shown Blacks to have a significantly lower resting heart rate as compared to Whites. It was the purpose of this investigation to determine if these resting differences exist during exercise and to compare the cardiovascular responses to submaximal exercise in black and white males. Sixteen black and 16 white males matched on age, body surface area and fitness level exercised at 0, 50 and 100 watts on a cycle ergometer. The following variables were measured at rest and each work rate: heart rate (HR), oxygen consumption and cardiac output via CO₂ rebreathing. Stroke volume (SV) was then calculated. Oxygen consumption was not significantly different between Blacks and Whites at rest, 0, 50 or 100 watts ($P > 0.05$). Cardiac output increased from rest with 0, 50 and 100 watts work for both Blacks and Whites (6.1, 13.0, 14.4 and 16.9 L·min⁻¹ and 5.7, 12.2, 14.3 and 16.3 L·min⁻¹ respectively). The differences in cardiac output between Blacks and Whites at rest and all work rates were not statistically significant ($P > 0.05$). At rest, 0, 50 and 100 watts, HR was significantly lower ($P < 0.05$) in Blacks as compared to Whites (71, 99, 108 and 119 beats·min⁻¹ vs 80, 107, 114 and 127 beats·min⁻¹, respectively). The lower HR in Blacks as compared to Whites was accompanied by a trend ($P = 0.08$) towards a higher SV at rest, 0, 50 and 100 watts (85.2, 130.3, 134.7 and 142.9 ml vs 72.5, 114.9, 126.4 and 127.4 ml, respectively). These results suggest different cardiovascular adaptations to exercise between black and white males.

CIRCULATORY RESPONSES DURING SEATED REST AT THREE DIFFERENT WATER TEMPERATURES.

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Tallahassee, FL 32306.

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To evaluate circulatory responses during one hour seated resting immersion (SRI) at three different water temperatures (T_{wa}, 21 C°=cold, 31 C°=neutral, 37 C°=hot), five healthy males, 29-40 years, completed three testing sessions. After a 10 hour overnight fast they emptied their bladder and rested at least 20 minutes in ambient temperature before SRI. During SRI, heart rate (HR), blood pressure (BP) and rectal temperature (T_{re}) were continuously monitored. Blood samples from an antecubital vein were collected during pre-SRI and after 12 and 60 minutes of SRI. Mean arterial pressure (MAP) and % plasma volume (PV) shift were calculated. All testings were conducted between 7-9 a.m. Repeated measures ANOVA revealed a significant ($p < 0.05$) change in T_{re}, HR, diastolic BP, MAP, and % PV between the three T_{wa}. Both diastolic BP and MAP with HR were negatively correlated in hot T_{wa}, while HR and T_{re} were positively correlated in cold and hot T_{wa}. These data suggest that progressive vascular volume loss with peripheral vasodilation induce strenuous cardiac compensation to aid both circulatory and thermoregulatory demands in hot T_{wa}. It appears that circulation is more independent of T_{wa} than thermal stress in this particular experiment.



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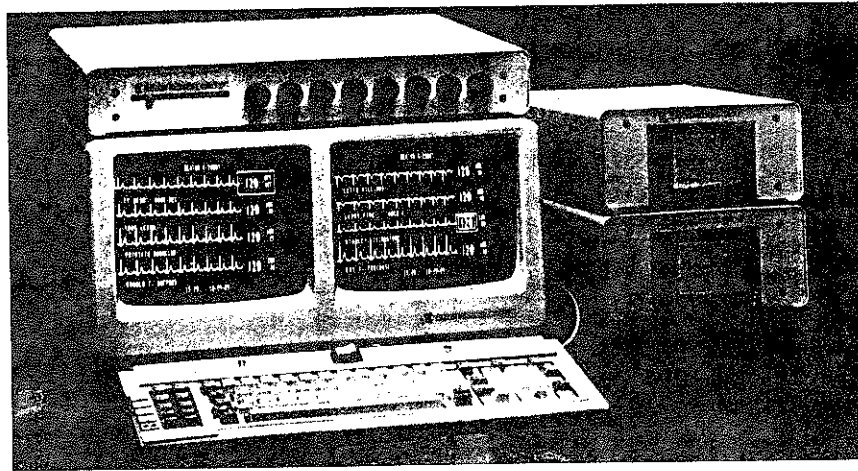
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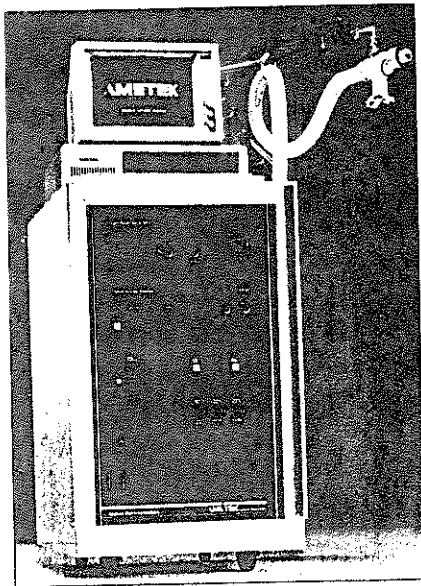


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POSTER PRESENTATIONS

Times and Locations

Friday, February 1

9:30 - 12:00 Group 1 (A - K)
Authors present
from 11:00 to 12:00
Exhibit Hall

2:00 - 4:30 Group 2 (L - W)
Authors present
from 3:30 to 4:30
Exhibit Hall

Saturday, February 2

8:30 - 11:15 Group 3 (X - II)
Authors present
from 10:15 to 11:15
Exhibit Hall

DIETARY HABITS OF FEMALE COLLEGE DORMITORY STUDENTS

L. C. Colligon, Wellness Center,
University of North Alabama, Florence, AL 35632-0001

A

Dietary habits of three hundred and eighty-eight (N=388) students, who were enrolled in either Physical Fitness or Nutrition classes, were examined with respect to total calorie, carbohydrate, protein, fat, cholesterol, dietary fiber, vitamin, and mineral consumption. The purpose of this study was to determine whether or not students were consuming an appropriate percentage of the Recommended Daily Allowance (RDA) for each of these nutrients. A three-day analysis was completed by each student utilizing the West Nutritional Analysis Computer Program. The data was analyzed using the t-test for single samples and the level of significance was set at 0.05.

The results indicated that students had: (1) statistically significant deficiencies for total calories consumed, carbohydrates, unsaturated fats, cholesterol, dietary fiber, vitamins B5, B6, and folacin, copper, iron, magnesium, potassium, selenium, sodium, and zinc; and (2) statistically significant excesses for protein and saturated fat. Also, with respect to percent of total calories consumed, students were significantly deficient in carbohydrates and significantly excessive in fats. Finally, with respect to the American Heart Association's standards for total fat consumption, students were significantly deficient in unsaturated fats and significantly excessive in saturated fats. It was concluded that female college dormitory students not only need to increase their consumption of calories but also to be more selective in the foods they choose to consume with regard to increasing carbohydrate, dietary fiber, vitamin, and mineral consumption and decreasing protein and saturated fat intake.

EFFECTS OF QIGONG ON OXYGEN UPTAKE AND RESPIRATORY RESPONSES DURING REST: A PRELIMINARY STUDY

Y.A. Lim, J.R. Flarity, W.R. Thompson and T. Boone.
Laboratory of Applied Physiology, The University of
Southern Mississippi, Hattiesburg, 39406-5142

B

Qigong, a special form of a breathing exercise, was investigated to determine the effects on oxygen uptake and respiratory responses during rest. Ten subjects (five males and five females) participated in a 20-min group instructional session for 10 consecutive days before testing the treatment effects. The testing protocol followed a C_1 -T- C_2 design, where C_1 , T, and C_2 represented the first, treatment, and second control period, respectively. Each period consisted of a 5-min interval, and thus each testing session consisted of 15 min. Results indicated no significant differences in heart rate and tidal volume for the three 5-min periods. A significant decrease in respiratory exchange ratio between T and C_2 was found. A significant increase in ventilatory efficiency for carbon dioxide produced was found between C_1 and T. Significant decreases ($p < .05$) were found in oxygen uptake ($179 \text{ ml} \cdot \text{min}^{-1}$ [T] vs. $248 \text{ ml} \cdot \text{min}^{-1}$ [C_1] and $253 \text{ ml} \cdot \text{min}^{-1}$ [C_2]), carbon dioxide produced, frequency of breath, expired ventilation, and ventilatory efficiency between T and the two control periods. The data suggest that this technique may have useful practical and therapeutic value, especially given the 20% improvement in ventilatory efficiency for oxygen uptake and carbon dioxide produced.

A COMPARISON OF EXERCISE COMPLIANCE IN MEN AND WOMEN CARDIAC PATIENTS

Maria J. Mercier, Ellen Glickman-Weiss, B. Don Franks, Yuruk Iyriboz, Louisiana State University, Department of Kinesiology, Baton Rouge, LA., 70803.

It has been hypothesized that women (W) recover less favorably than men (M) following coronary artery bypass surgery (CABG), percutaneous transluminal coronary angioplasty (PTCA) and myocardial infarction (MI) due to poor exercise compliance in a rehabilitation program. Therefore, the present investigation examined the intensity, frequency (% sessions attended), and duration during cardiac rehabilitation of M and W following CABG, PTCA, and MI. Twenty-four M and W matched for age, race, and diagnosis performed graded exercise tests prior to and upon completion of Phase 2 cardiac rehabilitation (GXT 1 and GXT 2, respectively). Data was compared between the first 12 sessions of Phase 2 (T1) and the last 12 sessions of Phase 2 (T2) and one year later in Phase 3 (T3). Both M and W cardiac patients trained at a similar overall intensity (percent of peak HR), during Phase 2 and Phase 3 (83.5% vs. 83.1%, respectively). Both groups had a significant decline in attendance at T3 (72.6%) as compared to T2 (89.2%) and T1 (94.9%), however, all subjects increased their duration between T1 (21.4 min), T2 (29.6 min) and T3 (35.5 min). The results of the present investigation suggest that M and W cardiac patients have similar exercise compliance during cardiac rehabilitation and therefore may not be the reason for differences in exercise improvement.

C

CARDIOVASCULAR RISK FACTOR ASSESSMENT IN A SELECT GROUP OF FIRE FIGHTER INSTRUCTORS

Ellen L. Glickman-Weiss, Barry S. Cohen, Jay A. Weiss, Arnold Nelson, G. Stephen Morris, Tom Hebert, Mike Dunn, and David Hedrick. Louisiana State University (LSU) Department of Kinesiology, and the LSU Fire Training Center, Baton Rouge, LA. 70810

In 1989, 53.6% of deaths among fire fighters in the United States were the result of myocardial infarction. It has been hypothesized that this may be due to the sedentary lifestyle of the fire fighter. Fire fighter instructors represent a seemingly more active group of firefighters. Therefore, the purpose of the present investigation was to identify the potential risk of cardiovascular disease in a select group of fire fighter instructors. Eighteen male Caucasians (\bar{X} age = 37.9 ± 7.3 yrs) underwent a standard 12-lead graded exercise test (GXT), blood lipid profile (total cholesterol, TCHOL, high density lipoproteins, HDL, and low density lipoproteins LDL, and triglycerides, TRIG), medical history questionnaire, and body composition (BC) evaluation. Subjects demonstrated average functional capacity, CHOL, LDL, and BC. However, the following elevated risk factors were demonstrated:

<u>Risk factor</u>	<u>%</u>
Abnormal ECG	6.0
CHOL/HDL ratio	50.0
TRIG	50.0
HDL	55.5
Family History	46.2
Physical inactivity	92.3
Cigarette smokers	36.4
Blood pressure	12.5

The present investigation suggests that fire fighter instructors are not at a reduced risk for cardiovascular disease. Therefore, a program to modify these risk factors may be beneficial for the fire fighter instructor.

D

EXERCISE AND HYPERTENSION: A META ANALYSIS

G.A. Kelley and P. Mc Clellan. Human Performance Lab.,
Middle Tennessee State University, Murfreesboro, TN 37132

In 1984, a review by Tipton led him to conclude that exercise could be used as an adjuvant to pharmacologic therapy in the reduction of high blood pressure in hypertense individuals. Conversely, Seals and Hagberg, in their review during the same year, concluded that there was inadequate information to recommend exercise as a replacement for pharmacologic therapy. The purpose of this study was to determine, through meta-analysis techniques, whether sufficient justification exists to recommend lower extremity aerobic exercise for reducing blood pressure in hypertense individuals. The results of 15 training studies (n=387, mean age = 39 +/- 9) published in English and conducted over the last 23 years were obtained via manual and computer (Eric, Medline) searches, coded, and analyzed. Dependent groups t-tests revealed statistically significant decreases of 10mmHg (153 +/- 19 vs 143 +/- 22 p<.01) in systolic pressure and 8 mmHg (97 +/- 9 vs 89 +/- 10 <.01) in diastolic pressure as a result of aerobic training. There was an average reduction of 7% in systolic blood pressure and 8% in diastolic blood pressure. Meta-analysis of these research studies indicate that lower extremity aerobic exercise reduces systolic and diastolic blood pressure in hypertense individuals. It was concluded that lower extremity aerobic activity may be useful as a non-pharmacologic therapy in individuals with borderline hypertension, and for people with moderate and severe hypertension, may serve as an adjuvant to pharmacologic treatment.

E

NUTRITIONAL ANALYSIS OF JUNIOR ELITE WEIGHTLIFTERS DURING A ONE WEEK TRAINING CAMP

V. Midgett, M. Stone, B. Warren, HLES Appalachian State University, Boone, NC 28608; J. Kearney, S. Fleck, USOTC Sports Science, Colorado Springs, Colorado; J. Thrush, U.S. Weightlifting Federation.

During heavy training athletes notably have insufficient appetites to compensate for the increased energy expenditures, indicating an inverse relationship may exist between energy consumption and food intake. Therefore, it was the purpose of this investigation to determine Kcal and micronutrient intakes of elite junior weightlifters over a 7 day period of intensive training. Nutritional intakes 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 = 57±9 kg. A 24 hr dietary recall was obtained at three time periods: prior to training (D1); midpoint of training (D2); and final day of training (D3). Analysis of the recalls were performed utilizing the Nutritionist III software package (N-Square Computing). All meals were prepared and consumed at the USOTC dining room. Subjects were instructed in the process of completing the dietary recalls and given examples of serving portions. Diets were analyzed for total Kcal, B vitamins (B1, B2, B3, B6, B12), and minerals (K, Mg, Fe, Zn). One week of intensive training produced significant changes (p < 0.05) in the following nutrient intakes:

	<u>B1 (mg)</u>	<u>B3 (mg)</u>
D1	3.18±.9	45.6±.9
D2	2.65±.7	35.2±.6
D3	2.43±.9	31.3±.3

No other variables were significantly different, although trends indicated a decrease over time in total Kcal, mineral intakes, and remaining B vitamins. These data suggest a significant reduction in B vitamin intake during 7 days of intensive training and may be associated with reduced Kcal.

F

EFFECT OF ARM POSITION ON CENTRAL AND PERIPHERAL HEMODYNAMIC RESPONSES TO VERTICAL HEAD-DOWN SUSPENSION

S. Brock, Y. Lim and T. Boone. Laboratory of Applied Physiology, The University of Southern Mississippi, Hattiesburg, MS 39406-5142

Inversion devices have been advocated as means of therapy for patients with low back pain. This study was undertaken to determine the effect of arm position on central and peripheral responses to head-down suspension with such a device. Ten men (mean age, 23 yrs) were monitored on two different occasions for a duration of 10 min each (5 min in the upright standing position followed by 5 min in the vertical head-down position). The subjects' arm position (dependent overhead vs alongside the body) during head-down suspension was randomly determined. Systolic blood pressure (SBP) was determined by standard sphygmomanometer. Heart rate (HR) was measured by a Physio-Control Lifepak 7. The Beckman MMC and CO₂ rebreathing procedure were used to measure oxygen consumption (VO₂) and cardiac output (Q). ANOVA with repeated measures and the Tukey test were used to analyze the data. Results indicate that the position of the arms during vertical head-down suspension has no effect on VO₂, HR, Q, arteriovenous oxygen difference, stroke volume, and systemic vascular resistance. However, head-down suspension with the arms in the dependent overhead position vs alongside the body resulted in significant increases in the measurement of SBP, DBP, mean arterial pressure, and double product. These data indicate that the measurement of hemodynamic responses during head-down suspension and, therefore, the implications should be considered with an element of caution.

G

CENTRAL AND PERIPHERAL CIRCULATORY RESPONSES DURING TREADMILL RUNNING WITH HAND WEIGHTS

T. Boone. Laboratory of Applied Physiology, School of Human Performance and Recreation, The University of Southern Mississippi, Hattiesburg, MS 39406-5142

The present study was designed to investigate the effect of treadmill running with and without hand weights (2.27 kg) on central and peripheral responses in seven normally active young males (mean age, 30 yrs). The treadmill speed and grade were held constant at 9.6 km/hr and 0% grade for 10 minutes during two exercise sessions (one without weights and one with weights). The subjects were randomly assigned to the sessions. Their arms during running were raised and lowered in a natural alternating fashion. Analysis of variance with repeated measures was used to analyze differences between means. The results indicated that cardiac output (13.9 to 14.8 L·min⁻¹), heart rate (138 to 151 beats·min⁻¹), arteriovenous oxygen difference (150 to 160 ml·L⁻¹), and oxygen consumption (2.2 to 2.4 L·min⁻¹) were significantly increased (p<.05) during the exercise session with hand weights. Further, the data indicate that the significant increase in oxygen consumption was due to both central (cardiac output) and peripheral (arteriovenous oxygen difference) responses. The significant increase in cardiac output was due to the significant increase in heart rate.

H

THE EFFECTS OF ASSISTIVE DEVICES ON THE ENERGY COST OF
NON-WEIGHT BEARING AMBULATION

C. Holder, E. Haskvitz, and A. Weltman, Exercise
Physiology Lab, University of Virginia,
Charlottesville, VA 22901

The purpose of the present study was to compare the energy expenditure, heart rate and blood pressure responses of unassisted ambulation (UA), non-weight bearing ambulation using axillary crutches (AC), standard walker (SW), and wheeled walker (WW). Nine female subjects ambulated at self-selected velocities for seven minutes during each ambulation mode. Meteorological balloons were used to collect expired air during the last two minutes of each ambulation mode. Heart rate and blood pressure responses were monitored at the end of each ambulation mode. Differentiated ratings of perceived exertion (RPE) were also obtained during each ambulation mode. Axillary crutch ambulation resulted in lower energy expenditure per meter ($0.36 \text{ ml/kg}\cdot\text{m}^{-1}$) and greater velocity (44.3 m/min) than both SW ambulation ($0.62 \text{ ml/kg}\cdot\text{m}^{-1}$, 23.5 m/min) and WW ambulation ($0.59 \text{ ml/kg}\cdot\text{m}^{-1}$, 24.1 m/min) ($p < .05$). No differences were found in heart rate and blood pressure responses among the assisted ambulation modes. No differences were found in the differentiated RPE values among the assisted ambulation modes. Based on these results, it can be suggested that when feasible axillary crutches should be prescribed for non-weight bearing ambulation.

RELATION OF MAXIMUM STRENGTH RELATIVE ENDURANCE IN MODERATELY TRAINED MALES

C.N. Cameron, R.L. Johnson, M.H. Stone, H.S. O'Bryant, and V. Midgett.
Department of Health, Leisure and Exercise Science, Appalachian State University,
Boone, NC 28608.

Review of the literature suggests that stronger subjects (based on 1 RM) fatigue at a faster rate during relative intensity endurance tests. Furthermore, these studies suggest that during exercise to exhaustion at relative intensities, stronger subjects generally produce less total work. However, these studies typically used small muscle mass or single joint resistance exercise not requiring high skill levels. The purpose of this study was to examine the relationship between maximum strength (1 RM) and the number of repetitions performed and an estimate of work performed using a large muscle mass exercise. Thirty-seven moderately trained male subjects were divided into 3 different groups based on the 1 RM parallel squat. The depth of the parallel squat was held constant for all trials. On alternate days following completion of 1 RM, subjects performed maximum repetitions at 70, 80, 90, and 95% of their 1 RM. The order of treatments was counterbalanced. Statistical analysis was done using group x trials ANOVA. Results indicated that, although there was no significant difference among groups in total repetitions, the stronger group could perform significantly more work as estimated by load (reps x mass). These results suggest that among moderately trained males, maximum strength appears to be advantageous in enhancing the amount of work which can be accomplished during squatting to exhaustion at relative intensities.

	Body Mass(kg)	1RM(kg)	Total Reps.	Total Load
Group 1	67.5±7.3	84.4±7.3*	37±14	2475±1096
Group 2	78.0±8.9	113.0±8.6*	31±7	2755±623
Group 3	91.2±37.5	155.5±29.2*	32±11	3814±1418*

* $p < .05$

BLOOD PRESSURE RESPONSES IN BLACK AND WHITE MALES DURING EXERCISE

C.B. Berry, M.J. Berry, T.J. Zehnder, S.E. Davis and S. Anderson. Winston-Salem State University and Wake Forest University, Winston-Salem, NC 27110

In order to study the blood pressure (BP) response in young (mean age = 22) black and white males during exercise, 16 black and 16 white subjects matched on age, body surface area and fitness level completed a cycle ergometer exercise test. The exercise protocol consisted of pedaling at 0 watts (unloaded), 50 and 100 watts each for 5 minutes. BP was measured using the auscultatory method at rest and at the completion of each work stage. Total peripheral resistance was determined based on cardiac output estimations from CO₂ rebreathing at the end of each work rate. Resting systolic and diastolic BPs were similar between the black and white subjects. Systolic BP increased at each work stage in a similar manner for both groups of subjects. Diastolic BP increased at each successive work stage by 6, 6 and 3 mm HG, respectively, in the black subjects but remained similar to resting values for the white subjects. Mean arterial pressure (MAP) at rest was similar for the two subject groups and increased by 11, 16 and 17 mm Hg in the black and 7, 10 and 13 mm Hg in the white subjects. Total peripheral resistance was similar for both groups at rest and during exercise. Unlike a study by Ekelund of older (mean age = 37) black males, the results of this study suggest no difference in blood pressure responses to exercise in young black and white males matched for fitness level. Age, fitness level and body surface area are probably important variables to control when studying BP response to exercise.

K

EFFECT OF EXERCISE TRAINING FOLLOWING SMOKING CESSATION ON HDL-C IN FEMALE SMOKERS.

A. Swank and K. Pickering. Exercise Physiology Laboratory
University of Louisville, Louisville, KY. 40292

The purpose of this investigation was to assess the effects of exercise training after smoking cessation on HDL-C in female smokers. It was hypothesized that the exercise training would result in an accentuation of the increase in HDL-C which usually follows smoking cessation. 17 healthy subjects between the ages of 21 and 39 participated in the smoking cessation class and the 10 week exercise training program. The protocol consisted of a seven week smoking cessation class which required subjects set a quit date by week three. Ten weeks of low intensity (50% heart rate reserve), high duration (45-60 minutes) 4 days per week exercise training followed the cessation class. Of the 17 subjects, 8 quit smoking (ex-smokers) while nine continued to smoke. All subjects then participated in the exercise training. HDL-C was assessed weekly during the smoking cessation class and at the 5th and 10th week of exercise training. For the ex-smokers the smoking cessation class resulted in a 20% increase in HDL-C by the second week while the smokers showed no significant change in HDL-C. The exercise training resulted in no change in HDL-C in the ex-smokers, while the smokers demonstrated a significant increase by the 10th week ($p < 0.05$).

	<u>Baseline</u>	<u>5th week</u>	<u>10th week</u>
ex-smokers	56.8 mg/dl	55.6 mg/dl	54.0 mg/dl
smokers	49.0 mg/dl	48.4 mg/dl	57.8 mg/dl *

The change in the HDL-C in the smokers was correlated to a significant reduction in body weight. Results indicate that exercise training did not accentuate the effects of smoking cessation on HDL-C while smokers demonstrated an increase in HDL-C possibly due to weight loss.

Supported by grants from the American Heart Association, Kentucky Affiliate and the University of Louisville Graduate Research Council

L

PHYSICIANS' ATTITUDES AND PRACTICES RELATED TO EXERCISE PRESCRIPTION

H.N. Williford, B.R. Barfield, R.B. Lazenby and M.S. Olson. Human Performance Lab., Auburn University at Montgomery, Montgomery, AL 36117

One hundred sixty-eight physicians responded to a survey to determine their attitudes and practices related to exercise and the development of exercise prescriptions. The mean age was 45.5 ± 10.8 yrs with the majority being males (86.7%). Results of the survey found that 48% of the physicians required an exercise history as part of their initial examination and 91% encouraged their patients to participate in regular exercise. Seventy percent of the physicians did not develop exercise prescriptions and only 23% were familiar with the American College of Sports Medicine guidelines related to the development of exercise prescriptions. Only a small number of physicians (3%) had ever taken a college-level course related to exercise physiology and the development of exercise prescriptions. The majority (78%) felt there was a definite need in medical school for a course related to the medical aspects of exercise. Results of this investigation indicate that while physicians support exercise for health promotion and rehabilitation, greater emphasis should be placed on training physicians related to the medical aspects of exercise.

M

RELATIONSHIPS BETWEEN HEALTH-RELATED HARDINESS, SOCIAL SUPPORT, BURNOUT, HASSLES, AND PHYSICAL ACTIVITY OF WORKING WOMEN IN CLINICAL PRACTICE

W.R. Thompson, T.B. Hildman, J.T. Johnson, and G.H. Furgeson, The University of Southern Mississippi and Forrest General Hospital, Hattiesburg, MS 39406

The purpose of this study was to determine the relationships between health-related hardiness (Pollock's Health-Related Hardiness Scale, 1990 [HRH]), social support (Sarason et al. Social Support Questionnaire-R, 1987 [Socsup]), burnout (Jones' Staff Burnout Scale for Health Professionals, 1982), hassles (unpublished list of potential hassles encountered at work and at home), and physical activity (Daughton and Fix, Human Activity Profile, 1984 [HAP]) in working women. Sixty-five nurses ranging in age from 20 to 63 years engaged in full time employment from a local community hospital participated in this study. The Pearson Product Moment Correlation Matrix developed from these data is as follows:

VARIABLE	HRH	HAP	Socsup	Burnout
Hassles	-.390*	-.134	-.214	.345*
HRH	1.000	.188	.371*	-.488*
HAP		1.000	.191	-.274*
Socsup			1.000	-.229*

* p<0.05

Results from this study seem to indicate that the more hardy were subjects, the less adjustment was required; the higher the hassles adjustment required, the higher the burnout. Social support was related to hardiness and burnout. Physical activity was also related to burnout. The higher the activity score, the lower the burnout score which suggests the important role of exercise as a stress mediator.

N

A PILOT INVESTIGATION OF FITNESS LEVEL, EXPERIENCE, AND COGNITIVE STRATEGY ON PSYCHOPHYSIOLOGICAL RESPONSE TO EXERCISE

E.A. Hart and D.J. Crews. Dept. of Exercise and Sport Science, University of North Carolina at Greensboro, Greensboro, NC 27412

The purpose of this pilot study was to determine whether fitness level or experience in an activity differentiates psychophysiological response using three cognitive strategies: association, dissociation and control. Twelve women completed exercise on a stairmaster and a bicycle ergometer using a different strategy on each day (6 days). Six of the subjects were experienced on the stairs and inexperienced on the bike, while 6 subjects were inexperienced in both activities. Half of each group were classified as high fit or low fit, determined by predicted VO_2 max results. Heart rate, respiration frequency (RF) and RPE were recorded for the 5 min of low and high intensity exercise on each day. Consistent with previous research, association reduced RPE and RF for high fit subjects on the bike and on the stairs (low intensity). Surprisingly, dissociation reduced RPE for experienced and inexperienced subjects in the high intensity stair condition. It appeared that fitness level interacted with cognitive strategy, reducing psychophysiological responses independent of the influence of experience. Further research supporting these findings would suggest that improving one's fitness level and using the appropriate cognitive strategies may reduce psychophysiological response in activities for which experience may be lacking (i.e., triathlons).

Supported by Randall Sportsmedicine Co., Kirkland, WA.

PERCEIVED FITNESS AND SELF ATTITUDES

J.D. Baker, J.W. Pleas, P.D. McClellan.
Department of Psychology and Human Performance Lab.,
Middle Tennessee State University, Murfreesboro, TN 37132

The relationship between physical activity and improved psychological functioning has been studied extensively; however little data are available related to how conscious or unconscious perceptions of physical activity influence personal attitudes and feelings, such as self-concept. The purpose of this study was to determine the impact of social and physiological information upon perceived fitness and feeling of body functions.

Informed consent was obtained from forty undergraduate female students who volunteered to participate. After completing a 12 minute walk/run, each student received predetermined positive or negative social and physiological information about their physical condition from a confederate and the researcher. Subjects were then asked to complete Heaps' Perceived Fitness Inventory, and Secord and Jourard's Body Cathexis Scale.

Positive or negative physiological information produced a significant main effect upon Perceived Fitness Scores ($F=20.46$ $p<.0005$) and Body Cathexis Scores ($F=5.96$ $p<.008$). Positive or negative social information produce a significant main effect upon Perceived Fitness Scores ($F=5.93$ $p<.02$) and Body Cathexis Scores ($F=.54$ $p<.04$).

It was concluded that positive social and physiological information had positive effects on perception of fitness as well as feelings about body functioning and appearance; whereas negative information was associated with a lower perception.

A COMPARISON BETWEEN BLACK AND WHITE ADOLESCENT FEMALES ON HEALTH RELATED FITNESS PERFORMANCE SCORES

L.C. COLVIN AND L.E. THOMAS. The Human Performance Laboratory, Northeast Louisiana University, Monroe, LA, 71201, and F.J. SERVEDIO, The Laboratory of Applied Physiology, The University of Southern Mississippi, Hattiesburg, MS 39406

The purpose of this study was to compare fitness test performance scores between black and white adolescent females. One-hundred-thirty-five female physical education students (mean age = 15.0 ± 0.9 yr) volunteered to participate. The subjects performed the AAHPERD Physical Best Fitness Test. This test included measures of aerobic endurance (mile run = MR), body composition (skinfold measures converted to % FAT), muscular strength and endurance (number of sit ups in one min = SU), upper body strength and endurance (total number of pull ups = PU), and flexibility (sit and reach = SR). Means and standard deviations for all subjects' fitness scores are revealed below. Level of significance was preset at .05.

	MR (min)	% FAT	SU	PU	SR
BLACK (n=72)	13.7 ± 3.7	27.0 ± 10.3	35.4 ± 8.6	0.70 ± 0.86	37.0 ± 5.1
WHITE (n=63)	13.4 ± 3.9	28.0 ± 8.4	39.4 $\pm 7.9^*$	0.86 $\pm 1.06^*$	42.0 $\pm 5.7^*$

* = significant difference between black and white

Statistical analysis indicated that significant differences were evident between blacks and whites on sit ups, pull ups, and sit and reach; with the white students scoring higher on these variables. Indications are that flexibility, and muscular strength and endurance are higher in white adolescent females than they are in black adolescent females. Further examination of this population would need to be conducted to ascertain if these differences are inherent or if they are the result of lifestyle or activity differences.

EFFECTS OF ONE WEEK OF SOCCER TRAINING ON PHYSIOLOGICAL FUNCTIONS

T. Hortobágyi, J. A. Houmard, M.R. McCammon, C. Nute, R. Lust, and R.G. Israel. Human Performance Laboratory, East Carolina University, Greenville, NC 27858

Excessive physical exertion results in overtraining and impairs peak performance. Data on the accompanying physiological changes are scant for soccer players. Thus, we have examined the effects of 1-week intense soccer training (4 to 6 h·day⁻¹) on physiological functions in 11 college soccer players (age 20.3 y, stature 1.77 m, mass 73.4 kg). The players were sedentary during the 2 months prior to testing. During training, heart rate was monitored with UNIQ™ CIC heart watch. The exercise intensity for the most strenuous 0.5 h of the 2 h sessions averaged 148.7 b·min⁻¹ or 76% of maximal treadmill heart rate (HR_{max}). Pre- to post-test of the 1-week period, there were no significant ($p > .05$) changes in body mass, maximal oxygen uptake (55.8 vs. 54.1 ml·kg·min⁻¹), run time to exhaustion on the treadmill (14.1 vs. 14.2 min), and Margaria power test (1486 vs. 1519 W). Treadmill HR_{max} decreased significantly from 202.1 to 193 b·min⁻¹ and submaximal heart rate decreased by 12.2 b·min⁻¹ ($p < .05$) during running on the treadmill at 11.2 and 12.8 km·h⁻¹. These changes in HR were accompanied by a 5.3% shift in plasma volume. Serum creatine kinase activity increased by 103% from 205 to 416 IU/L ($p < .05$). These data suggest that a sudden and large increase in training volume and intensity may elicit an adequate training stimulus and does not induce overtraining in college soccer players.

BLOOD PRESSURE RESPONSES TO STRIKING A MAKIWARA - A TRADITIONAL KARATE TRAINING DEVICE

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Karate training often involves isometric tensing of trunk and appendicular muscles. Valsalva tension is currently proscribed from many exercise programs for the elderly. This study investigated the reaction of blood pressure to exercise activities that incorporate a valsalva technique. Ten male University students enrolled in a Karate class participated in a study designed to measure blood pressure responses to striking a makiwara (MAK). Blood pressure responses were compared to running on a treadmill at 90% of age-estimated maximum heart rate for two minutes (RUN) and to lifting a 121 Kg barbell weight ten consecutive times in a standing military press (WGT), estimating the hemodynamic responses to punching the makiwara. Analysis of variance showed statistically significant decreases in diastolic blood pressure when weight lifting and punching were compared to running ($p < 0.05$). Systolic pressures resulted in statistically higher values for running as compared to weight lifting and punching ($p < 0.05$).

Variable*	RUN	WGT	MAK
systolic	166 ± 39.3	122 ± 10.9**	127 ± 19.5**
diastolic	52 ± 14.1	84 ± 9.1**	83 ± 10.0**

* values are expressed as the mean ± standard deviation

** $p < 0.05$

The makiwara can be safely used as an adjunct to regular Karate training. Caution must be used however, when punching the makiwara, that the aged Karate Player does not tense the muscles for long periods of time, raising the blood pressure.

EFFECT OF INGESTING EXOGENOUS PYRUVATE ON ENDURANCE EXERCISE PERFORMANCE.

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Departments of Medicine and Physiology, University of Florida,
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To study the correlation of pyruvate ingestion on exercise performance, five endurance-trained males exercised at approximately 65% $\dot{V}O_2$ max. on a cycle ergometer until volitional exhaustion. When ingesting a glucose-electrolyte solution with 0.1% pyruvate (GESP) before and during cycling, total work was 14,507 watt-min., a 20% increase over a glucose-electrolyte solution (GES), 11,859 watt-min. and 27% over that of water (W), 10,559 watt-min. Total exercise time on the cycle with the ingestion of GESP was 101 min., 12% greater than GES, 89 min. and an increase of 27% longer than W, 74 min. These data suggest that the ingestion of exogenous pyruvate before and during exercise may be used as an ergogenic aid to increase athletic performance. The pyruvate may be utilized as a substrate that delays perceived exhaustion.

S

T

Accuracy of a Computer Based System for the Determination of Oxygen Consumption

C. Mark Woodard, Michael J. Berry, Judy A. Storsteen, David A. Schnapp and Ann E. Brakefield Wake Forest University, Winston-Salem, NC 27109

Automated computer systems for the measurement of oxygen consumption ($\dot{V}O_2$) are increasingly replacing traditional methods. Whereas the design of these automated computer systems has been well described previously, studies examining the accuracy of these various systems is lacking. It was the purpose of this study to compare the $\dot{V}O_2$ values obtained from a Medical Graphics 2001 system with those obtained by traditional methods. Twenty-seven gas samples taken during rest, steady state and incremental exercise and at maximal exercise were compared using the two methods. A one min gas sample was analyzed using the Medical Graphics 2001 system which incorporates a Hans Rudolph pneumotachograph and O_2 and CO_2 analyzers designed by the Medical Graphics Corp. For the traditional method, these one min respiratory gas samples were then analyzed for gas concentrations using a Beckman OM 11 O_2 analyzer and LB 2 CO_2 analyzer. Gas volumes were subsequently determined using a Collins chain compensated gasometer. No significant differences ($P > 0.05$) were found between those values obtained using the traditional method (mean \pm SEM = 1.42 \pm 0.15 L \cdot min $^{-1}$) vs those obtained using the Medical Graphics system (mean \pm SEM = 1.46 \pm 0.15 L \cdot min $^{-1}$). The coefficient of correlation between the two methods was $r = .98$ and the standard error of the estimate determined from least squares linear regression was 0.14 L \cdot min $^{-1}$. These results show the Medical Graphics 2001 system to be accurate for the determination of oxygen consumption when compared to traditional methods.

U

DISCRIMINATION OF SINCERE AND DECEPTIVE ISOKINETIC KNEE EXTENSION TESTS USING SEGMENTAL CURVE ANALYSIS.

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Seventy-six males volunteered to serve as subjects to develop a discriminate function regression equation to be used to discriminate between sincere (S) and deceptive (D) isokinetic response. Subjects were trained to either give a true maximal performance or fake an injury during a standard Cybex knee extension/flexion test. Subjects were tested at speeds of 60 and 300 deg/sec, and performed five repetitions at each speed. Data was transmitted to a microcomputer interfaced with a DT2801 series data translation board. Each curve was analyzed using Segmental Curve Analysis (SCA) for the following variables: peak torque (PT), torque at 5 degrees beyond peak torque (T+5), and area under the curve prior to 5 degrees before peak torque (A-5). Discriminate function analysis using these variables revealed significant ($P < .05$) prediction of group membership (S or D). The investigators conclude that SCA provides an objective measurement procedure to assist in the detection of isokinetic deception.

V

ACTUAL AND PREDICTED ENERGY COSTS FOR GRADE WALKING IN WOMEN

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Auburn University, Auburn, AL 36849

The purpose of this study was to compare the actual amount of energy required for women to walk one mile level, uphill, downhill, and mixed to predicted values developed for estimating energy costs. Fourteen aerobically trained females walked at speeds of 77.2 ± 4.2 m/min for two miles on three separate occasions, the first mile level and the second mile either 5% uphill, 5% downhill, or mixed (one-third mile at each elevation of +5%, 0%, and -5%). Energy expenditure (kcal), heartrate (HR), and perceived exertion (RPE, 0-10 Borg Scale) were assessed at the end of the mile walk for each elevation. Energy costs and HR both differed significantly ($p < 0.05$) between all elevations. RPEs were significantly ($p < 0.05$) different between all elevations except mixed vs down, a possible result of lack of habituation for negative grade walking. Predictors of energy expenditure varied in their ability to accurately and consistently estimate the energy cost of walking. The energy cost of level walking was accurately predicted by the American College of Sports Medicine's (1986) equation, while uphill costs were accurately predicted by Bobbert's (1960) equation. Six additional equations were evaluated for level and uphill walking and all were found to be significantly ($p < 0.05$) different. Negative grades could not be evaluated due to a lack of equations for downhill elevation. This indicates a need for the development of an equation to predict the cost of downhill walking.

W

EVALUATING BODY FAT PATTERNS IN BLACK AND WHITE FEMALES

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and Iva Gloudon, Spelman College, Atlanta, GA

The purpose of this study was to compare the body fat patterns of black (N=21; Age X 22.6, Sd 4.1 yrs) and white (N=21; age X 21.4, Sd 1.4 yrs) females. Body fat was measured hydrostatically (Hd) with the residual volume measured simultaneously with the underwater weight and by the Jackson et al. seven site skinfold equation. Three peripheral (triceps, biceps, and thigh) and five central (chest, suprailiac, abdomen, axilla, and subscapula) skinfolds sites were measured. The value for a given site was the mean of three measurements trials within one millimeter of each other. The data were analyzed for differences by t-test procedures and for relationships by Pearson correlations. The Hd %fat of 23.7 (black females) and 24.2 (white females) were not different ($p > .05$) and when the skinfolds were evaluated individually and in combinations by race, only the subscapula skinfold was different ($p < .05$). However, the black subjects tended to have larger values for central and white subjects for peripheral skinfold combinations. The relationships between the Hd % fat and the skinfolds were considerably smaller than for the seven site skinfold equation and the skinfolds and ranges from 0.10 to 0.57 and 0.34 to 0.61 for the black and white subjects respectively. The highest relationships were between Hd %fat and triceps for the black subjects and Hd %fat and thigh for the white subjects. These results show that with black and white females of similar body fat levels, no differences are observed in peripheral or central body fat levels. This suggest that central fat deposits are not responsible for black females having higher incidences of cardiovascular diseases.

X

POSTURAL DIFFERENCES IN RESTING HEART RATE: IMPLICATIONS FOR
PRESCRIBING EXERCISE INTENSITY

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It is well known that resting heart rate (RHR) increases somewhat from recumbent to upright body positions. Yet, it is not clear whether these postural differences in RHR are large enough to effect the prescribing of exercise intensity using the Karvonen formula. RHRs were measured in three body positions on 77 undergraduate students, 36 males and 41 females, ages 18-25 yrs. At least 1 day prior to data collection subjects were screened for medications, familiarized with the testing area, and given standard instructions to minimize the effects of diet and exercise. In a quiet laboratory setting subjects rested at least three minutes in a supine position, followed by two minutes sitting, and two minutes standing. Following each rest period RHRs were obtained via a UNIQ CIC heart rate monitor. Means (\pm SD) for supine, sitting, and standing positions were 62 (\pm 9), 69 (\pm 9), and 80 (\pm 11) bt/min, respectively. Each was significantly different from the others. No sex differences were found. Using the mean age-predicted maximal heart rate (199 bt/min) and mean supine RHR, the training heart rate range (THRR) calculated from the Karvonen formula is: 131 - 179 bt/min compared to: 140 - 181 bt/min using the mean standing RHR. The difference of 9 bt/min for the 50% THRR would clearly effect exercise intensity at the low end of the range. Based on these findings it appears reasonable to recommend that the body position during measurement of RHR reflect the position assumed during exercise (i.e. supine for swimming, sitting for cycling, and standing for running). Regardless, it is important that the body position during RHR be standardized in some way.

Y

ACCURACY OF THE KODAK DT60 WHEN USED BY NON-CLINICAL
PERSONNEL.

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Concern has been expressed about the accuracy of portable cholesterol analyzers. As we are involved in a large population study which incorporates a measurement of total cholesterol (CHOL) and HDL cholesterol, we felt it was important to determine the accuracy of the KODAK EKTACHEM DT60 ANALYZER (DT60) which was purchased for its relatively low cost, ease of operation, quick feedback and portability. Analysis on the DT60 was preformed by two undergraduate researchers. Accuracy was assessed using 10 paired venous serum samples collected in the laboratory where the DT60 is housed. One sample was prepared and analyzed on the DT60 according to the directions provided with the analyzer. The other sample was transported to a CDC accredited Official Center for Lipid Standardization. At the Center, total cholesterol was determined using the Abell-Kendall method and HDL was determined using the heparin manganese precipitation method. No significant difference ($p < 0.05$) was found between the two methods for either CHOL or HDL. The correlation coefficients were CHOL $r = .981$ and HDL $r = .976$ (standard error of the estimate = 6.66 and 2.95 respectively). Quality control values were also established for the DT60 by analyzing a control fluid containing a known quantity of analyte and comparing the value obtained with the DT60 with the value of the known quantity. Mean value for a random sample of twenty days (ten from each researcher) using five different preparations of control fluid were well within the range established by the manufacturer. Data presented indicate that the DT60 is an accurate, easy to use instrument for analyzing CHOL and HDL.

Supported by a grant from NIH-MBRS 2 S06 RR08040-19.

Z

THE PREDICTABILITY OF BODY COMPOSITION, AGE, AEROBIC EXERCISE, CIGARETTE SMOKING, ALCOHOL CONSUMPTION, AND INDIVIDUAL STRESS LEVELS ON HDL/CHOLESTEROL RATIO

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AA

This study determined the predictive ability of body composition (BC), age (A), aerobic exercise (AE), cigarette smoking (CS), alcohol consumption (AC), and individual stress levels (ISL) on the HDL/cholesterol ratio. Four hundred and thirty-five males (mean age, 35 yrs) volunteered to participate. Cholesterol and HDL were determined using a SMAC 20. BC (% body fat) was determined using the sum of three skin folds. AE was defined as vigorous activity for 20 to 30 min 3 to 7 day/wk. Nonsmokers never smoked or who had quit for at least one year. AC was reported in drinks/wk. ISL were determined using The Life Survey. Multiple regression procedures were used to analyze data. Results indicated that the total % of variance explained was 10.2%. The % of the variance explained independently by these variables was 3.5% BC, .97% A, .45% AE, .29% CS, .06% AC, and .00% ISL. The means for BC, AC, and HDL/cholesterol ratio were 26%, 4.6 drinks/wk, and 6, respectively. The AE criterion was reached by 28% of the subjects. Smokers represented 14% of this population. These variables have been documented to be correlated with the HDL/cholesterol ratio. Independently, only BC was statistically significant ($P < .001$), but also of limited predictive value.

EFFECTS OF ALPHA₁-BLOCKADE ON AORTIC BLOOD FLOW VELOCITY RESPONSES TO HIGH INTENSITY EXERCISE IN THE HEAT

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BB

Four college age men ($\dot{V}O_{2pk} = 62.8 \pm 2.2 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, $\text{Wt} = 73.2 \pm 2.7 \text{ kg}$, $\bar{x} \pm \text{SEM}$) were studied during 2 trials of 25 min of cycle ergometry at 70% $\dot{V}O_{2pk}$ in an environmental chamber heated to 35°C, 50%RH. Each trial was performed following administration of either 2 mg of prazosin, an alpha₁-adrenergic blocker, (AB) or placebo (PL). Subjects exercised to exhaustion; 25 min was the minimum time completed by all subjects. Repeated measures analysis of variance indicated that peak acceleration (PKA) of blood flow in the ascending aorta followed a significant ($p < .05$) cubic trend; it rose from pre-exercise values (AB = 17.0 ± 1.24 ; PL = $14.5 \pm 2.3 \text{ m} \cdot \text{s}^{-2}$) to AB = 57.8 ± 8.14 and PL = 66 ± 8.71 at the 5th min of exercise (E5) before plateauing a mean $10.1 \text{ m} \cdot \text{s}^{-2}$ higher for the remaining 20 min of exercise. Peak velocity (PKV) demonstrated a similar significant ($p < .01$) trend. PKV increased from resting values (AB = $.67 \pm .06$, PL = $.59 \pm .07 \text{ m} \cdot \text{s}^{-1}$) to AB = $1.12 \pm .14$ and PL = $1.17 \pm .16$ at E5 and then plateaued a mean $.25 \text{ m} \cdot \text{s}^{-1}$ higher. Although not significantly different between trials, both PKA and PKV were consistently lower during AB than PL while heart rate, mean arterial pressure and forearm blood flow tended to be higher. Sweat loss as well as rectal and mean skin temperatures did not differ significantly between trials. Elsewhere, active cutaneous vasoconstriction has been demonstrated to occur during exercise in a hot environment. Removal of this vasoconstriction with AB does not preclude exercising in the heat. However, as suggested by the reduced PKA and PKV concomitant with the elevated HR, central venous return may be attenuated due to the peripheral effects of alpha₁-blockade.

TEMPORAL CHANGES IN POWER OUTPUT DURING CONSTANT LOAD CYCLE ERGOMETRY. K.P. Davy, J.H. Williams, C.W. Ward, J.F. Signorile. HPER Departments. Virginia Tech., Blacksburg, VA. 24061 and University of Miami, Miami, Fla. 33124.

Forty-eight males performed two 15 sec. bouts of maximal-effort cycling exercise. Age, weight, and height were 29.4 ± 1.7 yrs, 78.4 ± 2.2 kg, and 180.0 ± 1.9 cm, (mean \pm SEM) respectively. Tests were performed on a constant load cycle ergometer which allows for the calculation of power output for each one-half pedal revolution. Force and velocity signals were digitally collected and analyzed via microcomputer. Test-retest reliability was high with an intraclass correlation coefficient of .93. Individual power curves were examined for peak power (PP), time to peak power (TTPP), power fatigue index (PFI), power fatigue rate (PFR), and total work (TW). Grand means \pm SEM were: PP = 1021 ± 19.06 watts, TTPP = 3.10 ± 0.10 sec., PFI = 33.20 ± 0.96 %, PFR = 28.45 ± 0.88 watts/sec., and TW = 12.88 ± 0.25 kilojoules. Interrelationships between parameters were examined by a correlation matrix computed by the use of all five parameters. PP was highly related to TW ($r = .95, p < .01$), but was not significantly related to PFI ($r = -.15, p > .05$) and TTPP ($r = -.05, p > .05$). In addition, power curves from a subset of twenty-two subjects were analyzed for maintenance times (MT) (time sustained at percentage of peak power) of 75, 80, 85, 90, and 95 percent of peak power output. Mean \pm SEM were 10.28 ± 0.46 sec., 8.48 ± 0.35 sec., 6.89 ± 0.25 sec., 5.27 ± 0.18 sec., and 3.21 ± 0.18 , respectively. No significant correlations were observed between PP and any of the maintenance times. These results indicate that a single measure of power output may not adequately describe the rapid temporal changes in power during short term, high intensity exercise.

CC

THE EFFECT OF THERAPEUTIC MASSAGE ON FORCE DEFICITS ASSOCIATED WITH A HIGH INTENSITY ECCENTRIC EXERCISE BOUT

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The purpose of this study was to determine the effect that a therapeutic massage, applied immediately after, and 24 hours after, a high intensity eccentric exercise bout (EX) would have on the force deficits that are generally evident. Twenty untrained female subjects (mean age = 23.7 ± 3.95 yr, ht = 164.6 ± 6.5 kg, wt = 61.4 ± 8.1 cm) volunteered for this study. The subjects were randomly assigned to either a massage (M) or control (C) group. EX consisted of eccentric contractions of the elbow flexors on the Eagle Arm Curl machine. Resistance was adjusted downward as the subject fatigued, and exhaustion usually ensued within 15-20 minutes. Force deficits were determined by using measures of maximal isometric force (MAX) at 90° of elbow flexion, and peak torque (PEAK) for elbow flexion at 60 degsec^{-1} on a Cybex II isokinetic dynamometer. MAX and PEAK were determined at 0 hour (before EX) and again at 24, and 48 hours post EX. M (2 min effleurage, 5 min petrissage and 1 min effleurage) was applied immediately following EX and again at 24 hours post EX. C rested for the 8 min period following EX. Results (mean values in ftlbs) are indicated below.

DD

	MAX			PEAK		
	0	24	48	0	24	48
M	30.2 ab ± 4.3	21.8 a ± 5.6	22.3 b ± 5.4	18.8 ef ± 2.7	14.1 e ± 3.5	14.5 f ± 3.9
C	30.2 cd ± 4.5	20.4 c ± 3.2	20.8 d ± 4.6	19.4 gh ± 3.2	12.8 g ± 1.7	11.9 h ± 2.9

same letter indicates significantly different at $p < .05$.

Statistical analysis revealed significant decreases in force generated when 0 hour was compared to 24 and 48 hour measures. However further analysis indicated that there were no differences between the M and C groups. In this case a therapeutic massage was not effective in reducing force deficits associated with a high intensity eccentric exercise bout.

RELATIONSHIPS OF POLICE OFFICER PHYSICAL FITNESS CAPACITIES AND
WORKER COMPENSATION CLAIMS

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Physical Education, University of North Carolina at Charlotte,
Charlotte, NC 28223.

EE

The purpose of this study was to evaluate the relationship of police officer physical fitness capacity with annual worker compensation claims. The 515 subjects were males ($n = 436$) and females ($n = 79$) of a large metropolitan police department. Subjects' fitness levels were determined by scores on their annual physical fitness test batteries which included percent fat, sit and reach flexibility, sit-ups, and one repetition maximum bench press. In addition to these tests a cardiovascular step test for those 34 years and younger and a YMCA bicycle ergometer evaluation for those 35 years and older were administered. A regression analysis revealed only 3% ($R^2 = .026$) to 4% ($R^2 = .037$) of the variability in worker compensation claims could be accounted for when considering age, sex, and the physical fitness variables. The combination of variables were not significant for younger and older officers. Each individual test and an overall score were classified into five age and sex adjusted levels. An ANOVA revealed no significant differences among levels. In conclusion, the degree to which the physical fitness capacity and worker compensation claims relationship can be used to justify maintaining physically fit police officers is low.

Supported by faculty grant from The Univ. of N. C. at Charlotte

PHYSIOLOGICAL RESPONSES TO VO₂ MAX TESTING IN PREPUBERTAL
GIRLS AND FEMALE ADULTS

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Florida State University, Tallahassee, FL, 32304

FF

Ten very active prepubertal girls (mean age 9.1 +/- .57) and ten very active female adults (mean age 24.4 +/- 5.17) performed a VO₂ Max test on a motorized treadmill. The testing protocol consisted of a three minute warm-up walk at 3 mph 0% grade followed by a two minute run at 4.5 mph 0% grade and 2% grade increases every two minutes until voluntary cessation. All subjects exercised to maximal capacity, achieving at least two out of the three criterias established. Although VO₂ Max expressed relative to body weight was similar between the groups (48.36 and 47.45 ml/kg/min in the girls and adults respectively), the duration of the test was significantly lower in the children than in the adults (12 vs 15.5 minutes) ($p < .005$). The maximum heart rate obtained was significantly higher in the girls ($M = 203$ bpm, $SD +/- 4.76$) than in the adults ($M = 190$ bpm, $SD +/- 5.27$) ($p < .001$), while the maximum RER value was significantly higher in the adults ($M = 1.16$, $SD +/- .05$) than in the girls ($M = 1.05$, $SD +/- .06$) ($p < .001$). At each submaximal workload mean VO₂ expressed relative to body weight (ml/kg/min) or as a percentage of VO₂ Max was found significantly higher in the girls than in the adults. Mean RER at each submaximal workload was slightly higher in the adults than in the children, but this difference didn't reach significance. The results of this study suggest physiological differences in the response to VO₂ Max testing between prepubertal girls and female adults.

THE EFFECTS OF ACUTE EXERCISE ON SKINFOLD THICKNESS

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It is possible that an acute bout of exercise could lead to inaccurate skinfold measurements (SF) due to reflex thermoregulatory increases in skin blood flow and later affect an individual's exercise prescription. The purpose of this study was to determine if an acute bout of exercise would alter SF measurements taken immediately after exercise. Fourteen subjects (26 ± 1 yrs, 172.5 ± 1.9 cm, 67.7 ± 3.3 kg; mean \pm SE), after giving informed consent, underwent three randomly assigned separate treatments (TM1, TM2, TM3) seated at a modified cycle ergometer. TM1 (control) required the subject to sit at the cycle ergometer for 20 min. with no movement; TM2 required the subject to pedal at 60 rpm for 20 min. without resistance; TM3 required the subject to pedal at 60 rpm for 20 min at 60% of maximum oxygen consumption ($\dot{V}O_{2max}$). For medical screening and workload determination purposes, all participants had $\dot{V}O_{2max}$ (41.4 ± 2.0 ml O_2 /kg/min) determined on a cycle ergometer. During each treatment, forearm blood flow (FBF) via venous occlusion pleythsmography and heart rate (HR) were measured. Before, immediately after, and at five min. intervals for 15 min after each treatment, SF were taken at seven sites (subscapula, tricep, anterior chest, mid-axilla, anterior abdomen, suprailiac, and anterior thigh). All SF were taken by the same technician to eliminate interobserver variability. All treatments were conducted at 23° - 24° C and at 50 - 60% relative humidity. During TM3, the fourteen subjects exhibited average increases of 104% in FBF and 133% in HR, as compared to increases of 32% and 33% in HR and FBF during TM2, respectively. HR and FBF did not change during TM1. While skin blood flow increased during exercise as implied by FBF, SF was not altered at any site after exercise. Additionally, the sum of the seven skinfolds (SS) was not altered by exercise (TM1 - 92 ± 8 vs. 88 ± 7 mm; TM2 - 85 ± 7 vs. 84 ± 7 mm; TM3 - 85 ± 7 vs. 84 ± 7 mm; pre-exercise vs post-exercise means \pm SE). The present findings indicate that the reflex thermoregulatory processes that occur during an acute bout of exercise would not lead to erroneous post-exercise skinfold measurements under these ambient conditions.

GG

TRAINING ADAPTATIONS OF ELITE JUNIOR OLYMPIC WEIGHTLIFTERS

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Twenty-two male, elite junior olympic weightlifters, served as subjects to investigate the effects of short-term overwork on lifting mechanics. Subjects with a mean \pm SD age of 17.3 ± 1.4 yrs, body mass of 67.4 ± 12.1 kg, and height of 168.4 ± 8.1 cm were videotaped performing successive snatches with incremented increases in resistance. Tests were performed pre-post a week of high volume training. A 2-dimensional spatial model was used to analyze bar trajectories during the last successful trial (LST) and the trial representing 80 - 85% of the pretraining LST resistance. Height, time to peak velocity, and horizontal deviation of the bar were quantified overall. Lifting movement was divided into first and second pulls to identify peak velocities and when they occurred. ANOVA with repeated measures indicated significant differences in both positive ($p = .01$) and negative ($p = .03$) horizontal deviation pre-post. No significant differences ($p > .05$) were found in peak velocities pre-post. However, the time to reach peak velocity was significantly greater pre-post ($p = .02$) during the first and second pulls, at both absolute and relative LST resistances. These responses may be detrimental to optimum performance and indicative of overwork.

HH

AN ANALYSIS OF ROD AND HAND MOTION IN FLY CASTING

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Currently, no biomechanical model is available on fly casting populations. The purpose of this study was to provide descriptive data for hand and rod motion during fly casting and to identify mechanical differences between long and short casts. Subjects were local fly fishermen who were assigned to one of two groups based on the distance of a maximum effort cast. Group I (n=5), designated "skilled" and Group II (n=6), designated "highly skilled" had maximum cast averages (\pm SEM) of 15.4 \pm 3.0 m and 24.2 \pm 1.5 m, respectively. The casters' hand, rod, and line movements were videotaped while performing casts of 9.1 and 15.2 m to a 1.5 x 1.2 m target. The best of 3 trials were analyzed for 15 kinematic parameters using a two-dimensional spatial model. Unpaired t-tests indicated no significant differences ($p > .05$) between Groups I and II for the 9.1 m cast. However, paired t-tests revealed significant differences in Group II ($p < .05$) between the 9.1 m cast and the 15.2 m cast for maximum angular velocity of the rod butt on the forward cast, the range of angular movement of the rod butt on the back cast, and the elapsed time of the back cast, with respective increases of 48%, 28%, and 37%. Angle of maximum angular deceleration of the rod butt was inversely related ($r = -.92$) to the angle at which line left the rod tip during the forward cast. Rod hand trajectories suggests similar path shapes among subjects, by group. The path for the forward cast followed a similar pattern for that of the back cast in Group I. However, in Group II, the path for the back cast and the path for the forward cast were in distinctly separate regions.

II

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BERRY	K	HUNTLEY	Z
BOGNER	V	KELLEY	E
BOONE	H	KREMER	W
BOYCE	EE	LIM	B
BRANDON	X	MARTINEZ	FF
BROCK	G	MERCIER	C
CAMERON	J	MIDGETT	F
COLLIGON	A	O' BRYANT	II
COLVIN	Q	POE	HH
DAVY	CC	SWANK	L
DICARLO	Y	THOMPSON	N
FRANKE	BB	WAGGENER	S
GLICKMAN	D	WEBER	DD
HART	O	WEIR	GG
HEIMDAL	AA	WILLFORD	M
HOLDER	I	WOODARD	U
HOMMEN	T		


Quinton
 instrument co.

POSTER PRESENTATIONS Times and Locations

Friday, February 1

9:30 - 12:00 Group 1 (A - K)
 Authors present
 from 11:00 to 12:00
 Exhibit Hall

2:00 - 4:30 Group 2 (L - W)
 Authors present
 from 3:30 to 4:30
 Exhibit Hall

Saturday, February 2

8:30 - 11:15 Group 3 (X - II)
 Authors present
 from 10:15 to 11:15
 Exhibit Hall

