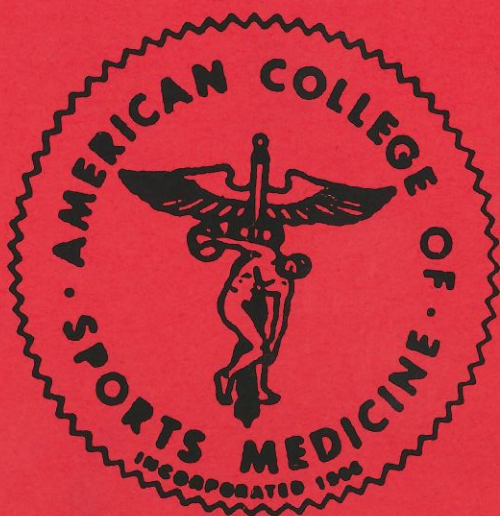


AMERICAN COLLEGE OF SPORTS MEDICINE

CENTRAL STATES CHAPTER

1996 ANNUAL MEETING



RAMADA INN  
NORMAN, OK

OCTOBER 24-25, 1996

**Thursday, October 24**

- 11:30 AM      **On site registration opens**
- 12:45 - 1:00 PM      **Welcome, Opening Remarks**  
Frank A. Kulling, Ed.D.  
Past-President
- 1:00 - 1:30 PM      **"Exercise, Coaguability, and Fibrinolysis"**  
Randy E. Eichner, M.D.  
O.U. Health Sciences Oklahoma City, OK
- 1:30 - 2:00 PM      **"The Acid Base Balance: Status Implications for Exercise Performance"**  
Jeffrey A. Potteiger, Ph.D.  
University of Kansas
- 2:00 - 2:50 PM      **"Physical Activity, Fitness & Health: An Epidemiological Update"**  
Steven N. Blair, P.E.D.  
Cooper Institute, Dallas, TX
- 2:50 - 3:15 PM      **Break**
- 3:15 - 4:15 PM      **"Application of Sport Science and Techniques to Enhance Olympic Performance"**  
Jay T. Kearney, Ph.D.  
U.S. Olympic Training Center, Colorado Springs, CO
- 4:30 - 5:30 PM      **Poster research presentations**  
Jeffrey A. Potteiger, Ph.D.  
President-Elect
- 5:30 - 6:30 PM      **Social Hour**
- 6:30 - 7:30 PM      **Dinner (included in advance registration)**
- 7:15 - 7:30 PM      **Student Research Award and Announcements**  
Jeffrey A. Potteiger, Ph.D.  
President-Elect
- 7:30 - 8:30 PM      **"Public Health Initiatives for Physical Activity: The Role of ACSM"**  
Steven N. Blair, P.E.D.  
Cooper Institute, Dallas, TX

**Friday, October 25**

- 7:45 - 9:00 AM      **Professional Member Business Meeting**  
Michael G. Bembien, Ph.D.  
President
- 7:45 - 9:00 AM      **Student Session: "Development and Implementation of a Fitness Facility"**  
Graydon H. Yohe, M.S. &  
Cheryl A. Armstrong, B.S.  
St. Francis Hospital, Tulsa, OK

*continued . . . . .*

ABSTRACTS OF RESEARCH PRESENTATIONS



The American College of Sports Medicine's Professional Education Committee certifies that this Continuing Education offering meets the criteria for 8 credit hours of ACSM Continuing Education Credit

ORAL PRESENTATION: OCTOBER 25: 9:00 A.M.

THE INGESTION OF L-GLUTAMINE DOES NOT ENHANCE HIGH INTENSITY EXERCISE PERFORMANCE

Haub, M.D., Potteiger, J.A., Nau, K.L., Webster, M.J., and C.J. Zebas  
University of Kansas

Inducing alkalosis prior to exercise by using sodium-based agents have been shown to enhance exercise performance by prolonging the exercise bout. Recent evidence indicates that L-glutamine ingestion alters one's acid-base status through an increase in the production of the bicarbonate ion ( $\text{HCO}_3^-$ ). This may improve athletic performance during high intensity exercise. The purpose of this investigation was to determine whether the ingestion of L-glutamine would alter pH and  $[\text{HCO}_3^-]$  in the blood so that exercise performance on a cycle ergometer might be improved. Ten trained male subjects completed a graded exercise test (GXT) on a cycle ergometer to determine maximal aerobic power ( $\text{VO}_{2\text{max}}$ ) and the exercise intensity for the experimental trials. The subjects reported to the laboratory in a 6-8 h post-prandial state and then ingested L-glutamine (GLN) or a placebo (PLC; sucrose) in a double-blind randomized design. Dosage was set at  $0.03 \text{ g} \cdot \text{kg} \text{ body wt}^{-1}$ . Following the 90 min absorption period, the subjects warmed up and then performed five 1 min repetitions at a power output corresponding to 100% of  $\text{VO}_{2\text{max}}$  with pedal cadence set at  $80 \text{ rev} \cdot \text{min}^{-1}$ . Each repetition was followed by 1 min of passive recovery. The fifth repetition was performed to volitional exhaustion. Time to exhaustion was measured for the fifth ride and used as a performance variable. Venous blood samples were collected pre-ingestion (PRE-IN), pre-exercise (PRE-EX), and following repetitions 4 (R4) and 5 (R5). The blood samples were analyzed for pH,  $[\text{HCO}_3^-]$ , and lactate concentration ( $[\text{La}^-]$ ). A repeated measures analysis of variance and paired t-tests were used to determine significant differences between treatments for pH,  $[\text{HCO}_3^-]$ , and  $[\text{La}^-]$ . Time to exhaustion for the fifth ride was compared between treatments using a paired t-test. pH,  $[\text{HCO}_3^-]$ , and  $[\text{La}^-]$  were not significantly ( $p > 0.05$ ) different between treatments for PRE-IN, PRE-EX, R4, or R5. Time to exhaustion was not significantly ( $p > 0.05$ ) different between treatments. Time to exhaustion was  $263.4 \pm 24.5 \text{ s}$  and  $263.2 \pm 19.4 \text{ s}$  for the GLN and PLC trials, respectively. These data indicate that L-glutamine does not enhance high intensity exercise performance in trained males.

**CHANGES IN CARDIOVASCULAR RISK FACTORS AND FITNESS CONSEQUENT TO DETRAINING**

R.W. Deitrick, FACSM and R.D. Reider. School of HPEL Oklahoma State University, Stillwater, OK and Corona Community Hospital, Corona, CA

Regularity is the most important principle in maintaining desired health outcomes of exercise participation. Adherence to this principle is difficult as high attrition rates in programs have been reported and frequent lapses in exercise participation can occur. This study examined the effects of two weeks of exercise cessation in 15 middle-aged ( $42.9 \pm 10.4$  yr) endurance trained males on alterable blood lipid risk factors and cardiovascular fitness. Pre-post fasting measurements and analyses revealed significant mean increases in total cholesterol (213.9 vs. 228.2 mg/dl,  $p < .05$ ), LDL-C (135.1 vs. 149.8 mg/dl,  $p < .01$ ), and triglycerides (109.8 vs. 117.8 mg/dl,  $p < .10$ ) in the experimental group while HDL-C did not significantly change (57 vs. 54.5 mg/dl,  $p > .10$ ) after 2 weeks of exercise discontinuance. No significant changes were observed for any of these measures in the control group. Cardiovascular fitness, measured by maximal oxygen consumption, was unchanged in both the experimental and control groups while pre-post submaximal HR for the experimental group, determined during Stage 5 of Bruce protocol, significantly ( $p < .05$ ) increased (118.7 vs. 127.9 bpm, respectively). Post submaximal HR for the experimental group was not significantly different from post submaximal control group HR values (127.9 vs. 128.2 bpm, respectively). These data demonstrate the importance of regular exercise participation and suggest an increase in cardiovascular risk via elevations in atherogenic blood lipids with short-term exercise cessation while measures of maximal cardiovascular fitness remain unchanged.

USE OF A SINGLE TEST METHOD FOR DETERMINING MAXIMAL LACTATE STEADY STATE  
Padfield, J.A., Londeree, B.R., Palmer, L.R., Stone, D., and Kim, Y.J.

The maximal lactate steady state is that point at which the clearance of lactate from the blood during exercise is both maximal and equal to the rate of lactate diffusion from the working muscles, or the highest level lactate can be sustained in equilibrium during endurance training or competition. To investigate whether or not the maximal lactate steady state could be identified with an individual lactate equilibrium plot following maximal exercise, 34 runners participated in a stepwise, lactate recovery-challenge protocol with subsequent confirmation of maximal steady state through a series of sustained exercise sessions. A correlation of  $r = 0.91$  was found between the maximum steady state and the individual equilibrium point, and a  $r = 0.86$  correlation was found between maximum steady state and ventilatory threshold. No significant differences were found between blood lactate concentration and running velocity at maximum steady state or between lactate concentration and  $\dot{V}O_{2\max}$ , although there were wide individual differences in the runner's blood lactate concentrations during maximum steady state conditions.

ORAL PRESENTATION: OCTOBER 25: 9:45 A.M.

A KINETIC AND KINEMATIC ANALYSIS OF TWO LIFTING METHODS USED BY EMERGENCY MEDICAL SERVICES PERSONNEL

MARJORIE MALKAMES AND CAROLE ZEBAS, UNIVERSITY OF KANSAS

The purpose of this study was to compare the kinetics and kinematics of two techniques of lifting a weighted spine board to the level of a lowered ambulance cot as utilized by emergency medical services personnel. The two techniques were bent knee/straight back with arms outside the legs (T1) and bent knee/straight back with arms between the legs (T2), the preferred technique in training manuals. A second purpose was to determine which, if any, of the kinematic variables predicted compressive and shear loads on the L5/S1 disc. Twenty-two paramedics and EMTs, working in matched pairs, lifted a weighted spine board (71 kg) with each technique while being videotaped in the sagittal plane with a Peak 2-D motion analysis system. Kinematic data were analyzed using Peak5 software while kinetic data were analyzed using Chaffin's static biomechanical model for lifting. Comparisons using t-tests ( $p \leq .05$ ) were performed on the kinematic and kinetic variables at the point of liftoff. Significant differences were found between T1 and T2 in the following kinematic variables: trunk lean ( $51.3^\circ \pm 11.5$ ;  $56.6^\circ \pm 16.1$ ), hip flexion ( $43.8^\circ \pm 6.7$ ;  $46.4^\circ \pm 8.0$ ), knee extension ( $58.6^\circ \pm 12.9$ ;  $79.4^\circ \pm 18.8$ ), angular velocity of the hip ( $15.9 \text{ deg/s} \pm 31.5$ ;  $63.7 \text{ deg/s} \pm 36.9$ ). No significant differences between techniques were found between angular velocities of the trunk and knee, and vertical velocities of the shoulder, weight, and hip. Significant differences were found in the kinetic estimations of the compression and shear forces on the disc at L5/S: compression forces ( $4126.9 \text{ N} \pm 480.4$ ;  $3991.4 \text{ N} \pm 608.1$ ) and shear forces ( $577.5 \text{ N} \pm 95.8$ ;  $636.3 \text{ N} \pm 115.2$ ). The regression analysis indicated that trunk lean and hip flexion were the strongest predictors of compression and shear forces. Based on the scope and limitations of the study, the following conclusions were made. The T2 method of lifting resulted in lower compressive forces but greater shear forces than T1. This was due, in part, to the initiation of the lift with the extension of the knees and subsequent greater trunk lean and hip flexion at the time of liftoff. Emergency medical personnel should concentrate on attaining a vertical position of the trunk during the lift while simultaneously straightening the knees.

POSTER PRESENTATION: OCTOBER 24: 4:30 - 5:30 P. M.

FREQUENCY OF AEROBIC ACTIVITY CORRELATES WITH A REDUCTION OF ILLNESS-RELATED ABSENTEEISM IN THE WORK-PLACE

B.H. Jacobson  
School of Health, Physical Education, and Leisure  
Oklahoma State University

Steven Aldana  
Brigham Young University

The purpose of this investigation was to assess the relationship between frequency of aerobic activity involvement and illness-related absenteeism in adult workers ( $N=32,052$ ). Subjects included active employees of the Johnson and Johnson companies (males = 16,827 and females = 15,224) from approximately 250 U.S. locations. Data were collected via a Health Risk Assessment questionnaire designed to include work personal demographics and modifiable and non-modifiable health risk behaviors. Aerobic activity was assessed weekly as: 0 = none, 1 = once/wk., 2 = two times/wk., 3 = three times/wk., 4 = four or more times/wk. Annual absenteeism was separated into five categories: 1 = 1-3 days, 2 = 4-6 days, 3 = 7-9 days, and 4 = 10-12 days and 5 = more than 12 days. Statistical control was made for smoking, alcohol use, high blood pressure, and high cholesterol levels. Results indicated significantly higher absenteeism between those who did not participate in aerobic activity (0) and all other groups (1-4). Further, those who indicated two or more days of aerobic activity per week were significantly less absent than those who were either not aerobically active (0) or only aerobically active one time per week (1). It was concluded that frequency of aerobic activity strongly correlates with a reduction in illness-related absenteeism in the work-place.

THE EFFECTS OF AN EXTERNAL NASAL DILATOR ON DIFFERENTIATED RATINGS OF PERCEIVED EXERTION  
 J. R. Hinojosa, W. H. Iman, and T. J. Pujol, Louisiana Tech University, Ruston, LA, and Southeast Missouri State University, Cape Girardeau, MO

Endurance athletes commonly use external nasal dilators even though the research shows that they have little effect on ventilation, recovery, or performance. It is possible that the nasal dilator may reduce perceived exertion by promoting nasal breathing and reducing airway irritation by warming and moistening the air inspired. The purpose of the present study was to determine if the wearing of a nasal dilator reduced differentiated or overall ratings of perceived exertion. Ten college aged males volunteered to participate. Subjects submitted to a maximal graded exercise test and two twenty minute runs at 60-65% of max. Experimental and control trials were randomized. The exercise speed and grade were manipulated to stress central factors and minimize the impact of leg fatigue on results. Prior to each trial the subjects were read standardized instructions regarding the factors involved in local, central and overall RPE. During the trials subjects were polled every five minutes for central RPE (CRPE), local RPE (LRPE), and overall RPE (RPE). Data were analyzed by repeated measures ANOVA. The results indicate no effect of the external nasal dilator on CRPE ( $F(1,17)=1.62, p<0.22$ ), LRPE ( $F(1,17)=0.28, p<0.6$ ), or RPE ( $F(1,17)=1.09, p<0.31$ ). In standard submaximal exercise the external nasal dilator had no effect on perceived exertion or on differentiated RPE. Given these results and the results of previous studies the external nasal dilator offers little in the way of performance enhancement.

COMPARISON OF HEART RATE MEASUREMENT BETWEEN THE PHYSIOGRAPH THREE LEAD METHOD AND POLAR® TELEMETRY.  
 N. Nabavi, J. Wilson, L. Walker, and M. Bemben. Human Performance Laboratory, Dept. of Health and Sport Sciences, University of Oklahoma, Norman, OK, 73019.

Many times in exercise testing and training it is not always feasible to incorporate exact and/or technical methods of assessment. Additionally, various methodologies require strict laboratory control and therefore do not work consistently well in field environments. One basic, yet very important, field and lab measurement in all exercise testing and training is heart rate response. The purpose of this study was to compare one generally accepted method (CM5-CC5 placements), and a recently new mode using telemetry- the Polar® Heart Rate measuring device. Following informed consent, nine male college students, ranging in age from 21 to 45 yrs ( $X=26.6$  yrs) performed a graded treadmill exercise test. Heart rate was taken simultaneously from each subject using both methods at rest, minute one, minute three, minute five, minute seven, and during the first minute of recovery. The mean heart rate responses at each time period were compared with a dependent t-test and the level of statistical significance was set at a probability of 0.05. The 3-Lead ECG method and the Polar® Heart Rate monitor produced similar results at each of the time periods ( $p>0.05$ ). The table below presents the minimal percent difference ( $\pm$  SD) between the two methods for each minute.

	<i>Rest</i>	<i>Min 1</i>	<i>Min 3</i>	<i>Min 5</i>	<i>Min 7</i>	<i>Recov.</i>
<b>3-Lead vs. Polar unit</b>	3.2%	1.4%	.01%	.07%	.24%	1.9%
	( $\pm 1.909$ )	( $\pm 1.061$ )	( $\pm 0.071$ )	( $\pm 0.071$ )	( $\pm 0.283$ )	( $\pm 1.768$ )

Another important observation was that the Polar® unit was consistently transmitting higher heart rate values at each time period, except for minute five. In conclusion, since each method produced similar heart rate results at each timed period, the Polar® telemetry unit can be used interchangeably with the 3-Lead ECG in exercise training and/or testing.

DETERMINANTS OF EXERCISE MODE SELECTION USING PHYSIOLOGICAL VARIABLES

DIANE LOTTMANN, TOM R. THOMAS, Ph.D, UNIVERSITY OF MISSOURI-COLUMBIA

The purpose of this study was to compare three groups of initial exercisers (walkers, cyclers, and steppers) and their physiological response to three modes of exercise: treadmill walking(T), stationary cycling(C), and stair stepping(S). Thirty subjects (X age  $28 \pm 7$  yrs) performed 20 min of exercise at a self-selected intensity(SS) followed by a ventilatory threshold(VT) exercise test on all three modes of exercise. Heart rate(HR), rate of perceived exertion(RPE), and oxygen consumption( $VO_2$ ) were measured during all exercise tests. Body weight(BWT), percentage body fat(%BF), and a self-motivation inventory(SM) were measured prior to any exercise testing. A two-way ANOVA  $p < 0.05$  with repeated measures on exercise mode was used to analyze the HR, RPE, and  $VO_2$  response to exercise. A one-way ANOVA  $p < 0.05$  was utilized for the %BF, BWT, and SM. For all groups HR, RPE and  $VO_2$  during SS was significantly lower on the T than for C and S. The  $VTVO_2$  across exercise modes was significantly lower on the T for all selected groups. Percentage body fat was significantly higher for the walkers while no difference existed in BWT among the three groups. None of the exercise groups performed better on the training specific mode that they had chosen. Results also indicate individuals do not select a mode of exercise based on their physiological response to that mode. Additionally initial exercisers with a higher %BF may select walking as a primary mode of exercise simply because walking elicits a lower HR, RPE, and  $VO_2$  when compared to cycling and stepping.

THE ACCURACY OF PREDICTING 1RM BENCH PRESS PERFORMANCE FROM SUBMAXIMAL EXERCISE LOADS. C.L. Hart, School of Health, Physical Education and Leisure, Oklahoma State University, Stillwater, OK 74078.

The bench press exercise is commonly used to evaluate general upper body strength. However, in some exercise environments a 1RM bench press test is not practical. Previous researchers have estimated bench press 1RM utilizing submaximal loads with the subjects performing continuous repetitions until failure. As a result, various formulae have been developed to convert submaximal performance data to a 1RM estimate. The purpose of this study was to evaluate the accuracy of these formulae to predict 1RM bench press performance in college age males ( $n=15$ ) and females ( $n=16$ ). The subjects were recruited from a university weight training course after 6 weeks of training. The subjects performed a 1RM test for bench press strength using a Cybex Smith Machine. Submaximal exercise loads were calculated at 70% of 1RM. One week after the 1RM test the subjects performed complete continuous repetitions to failure using the 70% workload on the bench press exercise. The exercise weight and the number of repetitions completed were then placed into prediction formulae by Brown (B), Bryzcki (BZ), Epley (E), Lander (L), Lombardi (LO), Mayhew (M), O'Conner (O) and Wathan (W). The results were analyzed using a repeated measures ANOVA with Pearson's  $r$  and Dunnett's  $t$  ( $p < 0.05$ ) for comparison with the measured 1RM. The females (F) 1RM was  $35.5 \pm 8.8$  kg ( $\bar{X} \pm SD$ ) and the males (M) was  $86.7 \pm 14.9$  kg. When expressed relative to body weight the F 1RM was  $0.59 \pm 0.09$  and the M was  $1.15 \pm 0.16$ . The mean exercise loads for F were 41% and 54% of weight and lean body weight respectively. For M the mean exercise loads were 81% and 95% of weight and lean body weight respectively. Females completed  $13.7 \pm 2.6$  repetitions and the males completed  $14.6 \pm 4.4$  repetitions. All predicted 1RM's were significantly correlated ( $r < 0.95$ ) with the measured 1RM. However, the prediction equations of BZ and L significantly overestimated 1RM, and LO underestimated 1RM for both genders. In addition the O formula underestimated 1RM for M. It was concluded that the formulae of B, E, M, and W may be used to predict 1RM bench press strength for college age subjects.

THE ASSESSMENT OF BODY COMPOSITION BY DENSITOMETRY AND ANTHROPOMETRY IN NCAA DIVISION I WOMEN GYMNASTS DURING OFF-SEASON, PRE-COMPETITIVE SEASON AND POST-SEASON. Michael Bemben, Shannon Olson, and Lance Walker, Dept. Health & Sport Sciences, U. of Oklahoma, Norman, Ok, 73019.

In women's gymnastics, it is advantageous to have a low body weight to lean body mass ratio when performing skills that require strength. Additionally, scoring in women's gymnastics is often influenced by the aesthetics of the competitors as well as their skill level. Since many teams do not have the ability to assess body composition (BC) in a laboratory setting, skinfold calipers are often used to estimate percent body fat (%F) and lean body mass (LBM). The purpose of this study was to follow potential changes in BC for women gymnasts throughout an entire year (off-season-T1, pre-season-T2, and post-season-T3) and to determine if results from two population specific skinfold equations (Jackson, Pollock and Ward, 1980-JPSF and Sinning, 1978-SSF) were consistent with densitometry methodology (UWW). Following informed consent, 10 NCAA Division I female gymnasts from the University of Oklahoma were assessed for %F and LMB pre-season (T1). Nine skinfolds and 8 circumferences were measured in triplicate following standardized procedures and locations. Body density was measured by UWW, adjusting for estimated RV and GI gas, and %F calculated by the Siri equation. The exact testing procedures were repeated 4 months later, prior to their competitive season (T2) and another 4 months later at the end of their season (T3). Additionally, attitudes toward their body weight (BW) and physical condition (PC) were also determined by use of the Body Esteem Scale (Franzoi and Shields, 1984) at each period. There were no statistically significant differences

	T1			T2			T3		
	JPSF	SSF	UWW	JPSF	SSF	UWW	JPSF	SSF	UWW
%F (mean ± SD)	15.9 (1.0)	15.4 (1.0)	16.7 (1.0)	15.3 (1.0)	14.8 (1.2)	16.4 (1.1)	15.3 (1.0)	15.6 (1.1)	16.1 (1.3)
LBM (kg) (mean ± SD)	48.8 (1.4)	49.1 (1.6)	48.2 (1.5)	49.1 (1.6)	49.5 (1.6)	49.1 (1.7)	48.2 (1.5)	48.4 (1.5)	48.6 (1.7)

between methods ( $p=0.40$ ), test periods ( $p=0.76$ ), or interactions ( $p=0.10$ ) for %F and LBM parameters, or regarding their attitudes toward BW ( $p=0.34$ ) and PC ( $p=0.86$ ). In conclusion, skinfold measures, with properly chosen equations, can estimate BC in female college gymnasts as well as UWW, although the skinfold equations underestimated %F. Also, BC and attitudes toward BW and PC remained consistent throughout the year.

THE VALIDATION OF THE PLEXOMETER AND VIDEOGRAPHY AS A METHOD FLEXIBILITY EVALUATION

HEATHER HANS, CAROLE ZEBAS, JEFFREY POTTEIGER, UNIVERSITY OF KANSAS

Videography has been suggested as an alternate method of measuring flexibility because of its convenience and expediency, but its validity has not been established. The purpose of this study was to validate the use of the "Hans On Plexometer" and video as a method of evaluating flexibility. Forty-eight male and female subjects, ages 22-65 y, were used in the study. The subjects moved freely through 9 described movements while being filmed by a video camera located perpendicular to the plane of motion and simultaneously measured with a Leighton flexometer. The video was later viewed with a plexi overlay goniometer (Hans On Plexometer) to measure the degrees of movement for each of the 9 movements. A coefficient of variation was used to establish reliability for each of the movements using the Leighton flexometer (range=86%-98% accuracy) and the plexometer (range = 87%-96% accuracy). The Pearson  $r$  correlation coefficient for each of the movements were as follows: shoulder flexion ( $r=0.81$ ); shoulder extension ( $r=0.59$ ); shoulder abduction ( $r=0.86$ ); hip flexion ( $r=.92$ ); hip hyperextension ( $r=0.56$ ); hip abduction ( $r=0.88$ ); trunk lateral flexion ( $r=0.18$ ); ankle dorsiflexion ( $r=0.83$ ); and ankle plantar flexion ( $r=0.81$ ). Of the 9 movements, 3 did not appear to correlate highly. They were shoulder extension, hip hyperextension, and trunk lateral flexion. Based on these findings, it was concluded that the "Hans On Plexometer" could be used to provide reasonably accurate measurements of flexibility in specific joint movements. Particular care, however, should be given to the protocol explanation, especially for bi- or tri-planar joint movements.



COMPARISON OF A MAXIMAL BENCH STEP PROTOCOL WITH THE BRUCE TREADMILL TEST.

Katherine M. Kraus and Christine M. McManamee. Truman State University, Kirksville, MO.

The purpose of this study was to develop a maximal bench step protocol that would elicit similar physiologic demands as produced by the Bruce Treadmill test. College females (n = 16) volunteered to participate after signing consent forms. Metabolic responses were monitored throughout each test by a computerized metabolic cart (SensorMedic 2900), and heart rate (HR) was monitored by a Polar™ watch. The maximal bench step protocol was performed on a 20-cm bench at a beginning cadence of 120 steps/min and gradually increasing to a cadence no faster than 152 steps/min. After an initial 3-minute interval with a 10-lb load, additional 10-lb weight increments were added via a scuba belt and/or a back pack for subsequent 3-minute intervals until exhaustion. Dependent t-test indicated that VO<sub>2</sub>max was significantly lower but HRmax was significantly higher for the step test protocol despite comparable test duration. The correlations for VO<sub>2</sub>max and HRmax between the Bruce Protocol and the maximal bench step protocol were significant but moderate in magnitude. The results indicate that a cadence-incremented, weight-supplemented bench step protocol elicits a VO<sub>2</sub>max that is 93% of that noted during a standard treadmill test and can be safely used with moderately trained females for producing maximal physiologic responses.

Variable	Bruce Test	Step Test	r	t
VO <sub>2</sub> max (ml/kg/min)	37.5 ± 4.8	34.6 ± 4.0	0.56*	2.72*
HRmax (bpm)	187.2 ± 17.0	190.2 ± 12.5	0.68*	-0.95
Test Duration (mins)	9.91 ± 1.07	9.61 ± 2.27	0.22	0.52

\*significant at p<0.05

THE EFFECT OF TENNIS RACKET STRING VIBRATION DAMPERS ON IMPACT DISCOMFORT  
CLAIRE L. STROEDE, LARRY NOBLE, AND HUGH WALKER  
KANSAS STATE UNIVERSITY, MANHATTAN, KANSAS

String vibration dampers have gained popularity among tennis players in recent years, and many types of dampers are commercially available. Some damper manufacturers have indicated on product packaging that their product reduces hand and arm discomfort during racket strokes. No published data has been found to substantiate these assertions. This study evaluated the effect of tennis racket string vibration damper usage on perceptions of discomfort experienced by tennis players due to racket impacts. Twenty tennis players (10 male, 10 female) ranging in age from 18 to 29 years volunteered for the study. Two different racket models were impacted near the center of the string mesh and near the racket tip both with and without string vibration dampers in place, resulting in eight impact conditions. The subjects held each racket in a stationary position while a ball machine projected tennis balls traveling 21.0 m/s toward the racket. The racket head was hidden from view, and the subjects wore ear protection during each impact. This procedure prevented the subjects from knowing the damping condition of the impact and eliminated the element of auditory discomfort. A visual analog scale was used to assess the level of discomfort immediately following each impact condition. ANOVA of the scaled discomfort ratings revealed: (1) there was no significant difference in discomfort ratings between damped and not damped impacts, (2) there was no significant difference in discomfort ratings between the two racket models, and (3) central impacts were more comfortable than impacts near the racket tip. Vibration traces of both damped and not damped impacts at both locations were obtained using an accelerometer firmly attached to the racket handle. Visual inspection of the traces revealed that string vibration dampers quickly absorbed high frequency string vibration without attenuating the lower frequency frame vibration. Power spectral analyses of the traces showed that string vibration energy was insignificant in comparison to frame vibration energy during the first 0.1228 seconds following impact.

**STREPTOZOTOCIN DIABETES AND THE EFFECTS OF ENDURANCE EXERCISE TRAINING.**

C. Mazingo, C. Riggs, and A. Holeyfield, Human Performance Laboratory, University of Arkansas, Fayetteville, AR 72701.

Food and water consumption of male streptozotocin diabetic rats (STZ) increases significantly compared to non-diabetic controls. Previous work in this laboratory indicated that endurance exercise training reduces these effects in male rats. The purpose of the current investigation was to determine if training would have similar effects in female STZ rats. The comparison groups were designated as trained diabetic (DT) and non-trained diabetic (DS). Training consisted of running on a motor driven treadmill (30 min·d<sup>-1</sup>, approximately 28 m·min<sup>-1</sup>, 2% grade) 5 d·wk<sup>-1</sup> for the final 10 weeks of a 20 wk experimental period. Two weeks before beginning pre-training, rats were made diabetic by injection of streptozotocin (50 mg·kg<sup>-1</sup>, ip) dissolved in 20 mM citrate (pH 4.5). Although not used for these comparisons, non-diabetic rats received an injection of the citrate buffer. The urine of all of the rats was checked weekly (Ketostix) for urinary glucose and ketones. All of the diabetic rats had urinary glucose outputs of greater than 2000 mg·dL<sup>-1</sup> throughout the 20 week experimental period. Urinary ketone production occurred in several of the rats and if severe, those rats were started on 4U·d<sup>-1</sup> of insulin to reduce the severity of the diabetic condition. Approximately 2 wk prior to the completion of the training program, all of the diabetic rats were moved to individual housing and given measured quantities of food and water. At 24 h intervals, the food and water were reweighed and the difference recorded as consumption. The procedure was continued for five days. Unlike previous observations in males, DT rats consumed significantly (p>0.05) more food and water than the DS rats. In male STZ rats, training results in reduced caloric wasting and dehydration and higher body weights. In these female STZ rats, body weights were not different as a result of training despite greater food and water consumption. Therefore, while exercise training does stimulate greater food and water consumption in female STZ diabetic rats, it does not prevent or attenuate caloric wasting associated with the disease.

**INFLUENCE OF PRESEASON TRAINING ON SERUM TESTOSTERONE LEVELS IN NCAA DIVISION I WRESTLERS**

D.A. Bemben, L. Walker, M.G. Bemben, and N. Fetters. Human Performance Laboratory, Dept. of Health and Sport Sciences, University of Oklahoma, Norman OK 73019.

Recent studies have found that male reproductive hormones are affected by physical training with endurance-trained male runners having low serum levels of testosterone (T) compared to untrained peers. Wrestlers are another group of athletes who undergo intensive training as well as undesirable weight control practices which might affect reproductive function. The purpose of this study was to investigate the effects of a 14 week preseason training program on serum T levels in NCAA Division I collegiate wrestlers (n=18). The T levels of the wrestlers also were compared to those of untrained college-aged males (n=8). During the training period, the wrestlers performed aerobic conditioning 3 x/week, and resistance training 2 x/week. All subjects reported to the laboratory at 8 am after an overnight fast. Blood samples were withdrawn by venipuncture, immediately centrifuged and the serum frozen at -20°C for the hormone assays. Total T and free T were assayed in duplicate using commercial radioimmunoassay kits and the intra assay variations were 9% and 1.5% respectively. Paired t-tests were used to determine training differences in T levels while independent t-tests were used to compare the hormone levels of the wrestlers and the untrained males. In the wrestlers, total T and free T levels were similar before and after the 14 week training period. Total T was not significantly different (p>.05) between the wrestlers and the untrained men. However, free T was significantly lower (p=.012) in wrestlers compared to the untrained group. In conclusion,

Hormone Concentration	Wrestlers PreTraining	Wrestlers PostTraining	Untrained Males
Total T (ng/mL)	7.1 ± 0.4	6.4 ± 0.6	7.9 ± 0.8
Free T (pg/mL)	24.1 ± 1.7	24.5 ± 1.8	33.8 ± 3.9*

\* p<.05

although preseason training did not influence the serum testosterone levels, free T levels were lower in the wrestlers compared to untrained men suggesting that, similar to endurance-trained runners, the reproductive systems may be altered in these highly trained athletes.

COMPARISON OF BODY COMPOSITION ASSESSMENT METHODS: HYDROSTATIC-WEIGHING, NEAR-INFRARED INTERACTANCE, AND DUAL ENERGY X-RAY ABSORPTIOMETRY.

Body composition is an important component of physical fitness. New methods for body composition assessment are being developed, thus it is important to compare these techniques with validated methods such as hydrostatic weighing, the "gold standard" for body composition assessment in young adults. The purpose of this study was to compare three methods, hydrostatic weighing (HW), near-infrared interactance (NIR), and dual energy X-ray absorptiometry (DXA) for the estimation of % body fat and fat-free body mass (FFB). Six subjects (2 females, 4 males) 23-36 years participated in the experiment. Body density obtained by HW was corrected for RV and VGI and % fat was calculated from the Siri equation; a total body scan was performed using DXA (Hologic QDR-1000/w) to estimate % fat and FFB; and all subjects were measured on the right biceps with Futrex-5000 (NIR). % fat from HW also was corrected for bone mineral density (DXA) and for total body water estimated from the Futrex-5000. All measurements were taken within a one week period. One way ANOVA with repeated measures was used to determine differences between methods for % fat and FFB. Paired t-tests were used to compare corrected % fat (mineral and water content) with the % fat obtained from HW. There were no

	HW	DXA	NIR
% Fat	18.2 ± 2.2	17.3 ± 1.6	15.8 ± 1.7
FFB	58.8 ± 4.9	59.7 ± 5.5	60.7 ± 5.5

significant differences between the three methods for % fat or FFB. The greatest relative difference in % fat occurred between HW and NIR (22%) followed by HW and DXA (16%) and DXA and NIR (14%). % fat corrected for mineral content (9.8%) was significantly lower than the % fat from HW (p<.01). There was no significant difference between % fat corrected for water content (16.7%) and % fat from HW. In conclusion, the three body composition methods yielded similar % fat and FFB values. These findings suggest that HW, NIR, and DXA were effective in assessing the body composition of young adults.

FINDING PEAK FORCE AND VELOCITIES AT SELECTED 1-RM PERCENTAGES IN THE BENCH PRESS MANUEUR.

R. T. Ratliff, M. L. Moberly, J. L. Williams and R. A. Ratliff. DynaMetric, Inc., Oklahoma City, OK and Department of Health and Sport Sciences, University of Oklahoma, Norman, OK

**Introduction:** Finding a valid, practical and economical method to measure the components of power, i.e. force and velocity, at instantaneous as well as cumulative periods are critical if we are to explain and apply this muscular performance phenomenon in sport and clinical settings. Conventional testing methods have inherent limitations in discriminating relative force and velocity measures, including when they occur, during even simple power movements. However, our previous efforts have shown promise for merging the advancing technology of computers and accelerometers with exercise science to more accurately detect instantaneous force and velocity values with high sensitivity. Therefore, the purpose of this study was to demonstrate when peak force (PkF) and velocity (PkV) occur in simple linear movement patterns at varied percentage levels of 1-RM and to determine if differences exist among selected percentages (%'s) of 1-RM. **Methods:** Twelve male subjects with weight lifting experience, aged 19 - 32, performed a 1-RM on a Cybex Smith Bench Press Machine and then practiced performing weight lifting maneuvers at 30%, 50%, 70% and 90% of their previously obtained 1-RM while being exhorted to exert "maximum force and velocity". Approximately one week later each subject returned to perform 3 trials at each of the 1-RM %'s with an accelerometer attached to the barbell. The acceleration voltage signal was captured and processed by an IBM compatible PC to obtain PkF and PkV using a custom software program. Fast fourier transformation (FFT) was used to discriminate frequency characteristics of the acceleration signals at the respective PkF and PkV periods. ANOVA was used to determine if differences existed among the different percentages of 1-RM maneuvers for these variables. **Results:** The table below shows the mean absolute time (AT) required to complete the entire lift and the maximum PkF and PkV mean values along with the relative time (RT) expressed in % of the AT to achieve these values at each % of 1-RM:

% 1-RM	AT (sec)	PkF (N)	PkF-RT (%)	PkV (m/s)	PkV-RT (%)
30	.635	534	16.7	1.95	45.5
50	.873	691	13.3	1.48	61.2
70	.958	858	13.0	0.98	74.7
90	1.520	959	7.0	0.79	81.9

Each mean value in the respective columns above are significantly different (p≤ .05) except for PkF-RT at 50 and 70% of 1-RM. Separate analysis of the FFT showed differences (p≤ .05) among the frequency characteristic at each 1-RM%. **Conclusions:** The data indicate capability of this computer assisted accelerometry system to detect difference in the PkF and PkV values, including subtle frequency changes, during a simple muscular power movement pattern at a wide range of 1-RM%'s. The differences observed help provide the basis for further research to discriminate between the components of power development at various stages in a movement and at various %'s of 1-RM.

EFFECT OF CHROMIUM PICOLINATE ON BODY COMPOSITION AND NEUROMUSCULAR PERFORMANCE IN NCAA DIVISION I WRESTLERS

Lance S. Walker, Michael G. Bemben, Debra A. Bemben, and Allen W. Knehans. Department of Health and Sport Sciences, University of Oklahoma, Norman, OK 73019.

The purpose of this study was to assess the effects of a 14-week program of chromium picolinate supplementation combined with typical preseason resistance training and conditioning on body composition and neuromuscular performance in NCAA Division I wrestlers. This double-blinded, randomized placebo-controlled study involved twenty-one (21) NCAA Division I wrestlers from the University of Oklahoma. Subjects were assigned to either a treatment group (T) (n=7; 20.4 yrs±0.1), a placebo group (P) (n=7; 19.9 yrs±0.2), or a control group (C) (n=6; 20.2 yrs±0.1) using a stratified random sampling technique based on weight classification in order to account for the wide range of body weights seen in this study population. The T group received 200 µg of chromium daily, in the form of chromium picolinate, for the duration of the study while the placebo group received daily supplements containing inert sodium diphosphate. The control group received no supplementation. All subjects underwent the same preseason training stimulus consisting of a 4-day per week strength training program and a daily metabolic conditioning regimen. Measurements of body composition, neuromuscular performance, metabolic performance, and resting serum concentrations of insulin and glucose were made prior to and immediately following the supplementation and training period, while monitoring for dietary intakes with 3-day food records. Repeated measures Analysis of Variance (ANOVA) indicated that no significant differences in body composition were seen in the T group as compared to the P and C groups, with lean body mass remaining relatively unchanged for all groups and body fatness decreasing non-significantly for all groups from the pre-testing levels (T = 17.0%; P = 18.3%; C = 6.7%). Aerobic power (VO<sub>2</sub> peak) increased significantly in all groups as a result of training. However, all other measures of neuromuscular and metabolic performance parameters as well as resting serum concentrations of insulin and glucose were not significantly affected by the chromium supplementation. These results suggested that chromium picolinate supplementation coupled with a typical wrestling preseason training program does not enhance body composition or performance variables beyond improvements seen with training alone.

*Study partially funded by the Gatorade Sport Science Institute and the U. Oklahoma Graduate College.*

REPEATED MECHANICALLY UNLOADED BODY WEIGHT SUPPORT TRAINING IN A HEMIPARETIC SUBJECT: A CASE REPORT

S. Fuller, D. Kent, L. Mouw, K. Ormond, and R. Ratliff. University of Oklahoma, Norman, OK

**Purpose:** The purpose of this case study was to examine the effects of progressive Mechanically Unloaded-Body Weight Support (MU-BWS) rehabilitation training on a hemiparetic subject's physiological, biomechanical and functional mobility for one year. **Methods:** The subject was a medically stable 70 year old female with left hemiplegia, 31 months post stroke. She completed 2 nine week, 3 day per week training programs with a one year interlude between each. The MU-BWS training consisted of using a lower torso harness arrangement above a motorized treadmill with progressive increases in walking speed and duration and decreases in levels of BWS over the 9 week period. Prior to, and immediately following each training program, measurements of VO<sub>2</sub>, right/left (R/L) stance ratio, and the timed "Up and Go" test (TUG) were taken. The subject was interviewed after training regarding perception of performance of activities of daily living (ADL) skills, positive or negative, that may have resulted from the training. **Findings:** The effects of MU-BWS training, are shown below as percent change from pre to post for each 9 week period. While the subject improved similarly in every variable during each training program, only the improvement in walking duration was maintained from the end of year 1 to the beginning of year 2. All other improvements were at least partially sustained or showed no decline from the point of entry into the study. The subject attributed her perceived increased ability to perform ADL during the interlude to the MU-BWS training.

Year 1 Training		Year 2 Training	
Walking speed	25%↑	Walking speed	17.5%↑
Walking duration	40%↑	Walking duration	31%↑
MU-BWS	50%↓	MU-BWS	12.5%↓
VO <sub>2</sub>	7%↓	VO <sub>2</sub>	4%↓
R/L stance ratio	10%↑	R/L stance ratio	12%↑
TUG	23%↓	TUG	24%↓

**Conclusions:** This case study revealed that some improvement resulting from MU-BWS training could be maintained over a 1 year period. In addition, the apparent sustainability of these adaptations may transfer to efficiency in performance of ADL.

CORRELATES OF VERTICAL JUMP PERFORMANCE

BRYAN CHRISTIANSEN, CAROLE ZEBAS, JEFFREY POTTEIGER, ROBERT LOCKWOOD, UNIVERSITY OF KANSAS

Vertical jump performance is suggested to be related to several factors. Among them are strength, power, genetic muscle makeup, and coordination. It was the purpose of this study to determine the relationship, if any, between the kinetic factors of force production, muscle fiber type, and jump height. Thirty-three college age male and female students enrolled in a jump training class took part in the study. Each subject was asked to perform 3 vertical jumps while taking off from a Kistler force plate operating at 540 Hz while simultaneously being filmed with a Peak5 motion analysis system operating at 60 fields/sec. Subjects were asked to place hands on hips, step onto the force plate, crouch, and jump vertically as high as possible. The kinetic factors analyzed included: maximum force, normalized to body weight (BW) exerted at time of liftoff; peak power output; time to reach peak power as measured from the point of deepest crouch to takeoff; and time to reach peak power as measured from the first movement downward to takeoff. Muscle biopsies of the vastus lateralis yielded information on the percentage of fast and slow twitch fibers. Jump height was measured with the Vertec. The data were analyzed using the Pearson Correlation statistical procedure ( $p \leq .10$ ). Significant correlations found among the kinetic factors were: maximum force production normalized to BW related to peak power output ( $p < .0001$ ), time to peak from deep crouch ( $p = .085$ ), and time from start of movement downward to peak power (.068). The height of the jump was significantly related to peak power ( $p < .0001$ ) and maximum force production ( $p = .001$ ). No significant correlations were found between kinetic factors and percent fast twitch muscle fibers. The findings of this study suggest that no one factor can be used to predict vertical jump performance.

SYMMETRY DURING GAIT IN WOMEN WITH DEGENERATIVE KNEE JOINT DISEASE

JEFFREY DEGROOTE, CAROLE ZEBAS, JEFFREY POTTEIGER, UNVIERSITY OF KANSAS

Fifteen women, ages 40-84 y, who had been previously diagnosed with degenerative joint disease of the knee volunteered to participate in a study to compare the symmetry and asymmetry of their gait cycle. Kinetic variables analyzed included the vertical, anterior-posterior, and medial-lateral ground reaction forces (GRF). Kinematic variables analyzed were joint maximum flexion and extension; joint angular velocities; trunk lean; walking velocity; stride length; cadence; percent swing; and percent stance. Each subject walked the length of a path over a force plate at a prescribed rate of between 1.12 and 1.34 m/s while simultaneously being filmed with a Peak5 2-D motion analysis system. The Labview software package was used to reduce kinetic data while the Peak5 software was used to analyze the video data. Three trials were filmed and analyzed from each side of the subject. Paired t-tests showed statistically significant ( $p \leq .05$ ) asymmetries between the affected and unaffected side on the variables of vertical GRF at heel strike, medial-lateral GRF during pushoff, and maximum hip extension angular velocity. The affected side tended to have decreased vertical GRF, increased medial GRF, and increased hip extension angular velocity. It was concluded that asymmetries were evident in the magnitude and direction of pressures placed on the floor between the affected and unaffected sides of individuals with degenerative joint disease. The affected side tended to show less pressure being applied downward and more weight being applied toward the inside part of the foot compared to the unaffected side. Additionally, the affected side tended to show quicker hip extension velocity compared to the unaffected side of the subjects. These results would suggest that persons with degenerative knee joint disease compensate for the condition by attempting to control the forces of impact rather than to change the motion of the walk.

THOMPSON, C. J., M. G. BEMBEN, R. A. RATLIFF, AND E. L. TAYLOR

Human Performance Laboratory

Department of Health and Sport Sciences

University of Oklahoma

Norman, OK 73019

#### ABSTRACT

THOMPSON, C. J., M. G. BEMBEN, R. A. RATLIFF, and E. L. TAYLOR. A reliability and validity analysis of the accelerometer as a measure of upper body power. The purpose of this study is to determine the effectiveness of using accelerometers as a reliable and valid measure of upper body muscular power. Thirty male subjects, aged 19-25, from the University of Oklahoma volunteered to participate. Subjects performed a One-Repetition Maximum (1-RM) bench press on a linear bench press apparatus, followed by a single bench press trial of 60% 1-RM at maximal speed. Three trials were performed at minute intervals. The protocol was repeated the following day. Each trial was analyzed for average power (AP), average velocity (AV) and total displacement (TD) by three instruments: a uni-axial accelerometer mounted on the bench press apparatus, a 17 mm video camera that recorded the entire lift, and an infrared photocell and timer system arranged to analyze a 20 cm segment of the lift. Acceleration data collected at 60 Hz obtained a direct measurement of force and an integrated measure of velocity to calculate muscular power (Power=force · velocity). Repeated measures Analysis of Variance (ANOVA) and intraclass correlation coefficients indicated high trial to trial reliability ( $r=.99$ ) for all measurement variables. AP film was significantly different ( $p<.05$ ) than AP accelerometer and AP photocells in the 20 cm segment. Also, significant differences ( $p<.05$ ) between accelerometer and film measurements existed for AP, AV and TD. Pearson correlation coefficients indicated a significant ( $p<.05$ ) relationship between AP film and AP accelerometer values ( $r=.95$ ), with the accelerometer consistently underestimating AP compared to film. These results suggest that although minor data acquisition errors are present, accelerometers may provide a reliable and versatile means to assess muscle power.

#### THE EFFECTS OF PROTEIN SUPPLEMENTATION ON PLASMA AMMONIA CONCENTRATION DURING HIGH INTENSITY INTERMITTENT EXERCISE

Brett A. Dolezal, Khalid Almuzaini, Mark D. Haub, Jeffrey A. Pottleiger. Exercise Physiology Laboratory, University of Kansas

Protein supplementation is an ergogenic aid commonly used by many strength/power athletes. While the positive benefits of protein supplementation have been touted, negative aspects exist as well. Potentially negative aspects of protein supplementation include changes to acid-base balance, and increases in ammonia formation. The purpose of this study was to determine whether 7 d of acute protein supplementation altered power output, ammonia ( $\text{NH}_3^+$ ) concentration and acid-base balance during supramaximal exercise. Nine males ( $\text{VO}_{2\text{max}}$ ,  $49.8 \pm 1.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ) underwent two experimental conditions. During a control condition (CONTROL) subjects consumed their normal nutrient intake. During an experimental condition (PROTEIN) the subjects consumed their normal nutrient intake plus a protein supplement equal to  $0.5 \text{ g} \cdot \text{kg} \text{ body mass}^{-1}$ . Power output was measured on a cycle ergometer during 10 intermittent sprints (15 s work/120 s rest). The initial 5 sprints were at a workload equal to 125% of  $\text{VO}_{2\text{max}}$  with a pedal cadence of  $80 \text{ rev} \cdot \text{min}^{-1}$ . The final 5 sprints were at the same workload, but subjects pedaled as fast as possible. Blood was collected pre-exercise, post-sprint 5, and post-sprint 10 and analyzed for  $\text{NH}_3^+$ , pH, bicarbonate concentration ( $[\text{HCO}_3^-]$ ), and lactate concentration ( $[\text{La}^-]$ ). Protein intake was significantly higher during PROTEIN ( $1.82 \text{ g} \cdot \text{kg} \text{ body mass}^{-1}$ ) than CONTROL ( $1.31 \text{ g} \cdot \text{kg} \text{ body mass}^{-1}$ ). No significant differences were observed between treatments for peak or average power output,  $\text{NH}_3^+$ , pH,  $[\text{HCO}_3^-]$ , and  $[\text{La}^-]$ . The data indicate that ammonia concentration, acid-base balance and performance during intermittent supramaximal exercise will not be altered by a 7 d increase in protein ingestion.

- 9:00 - 10:00 AM **Oral Research Presentations**  
Jeffrey A. Potteiger, Ph.D.  
President-elect
- 10:00 - 10:30 AM **"Psychological Profile of Elite Athletes"**  
Steven W. Edwards, Ph.D.  
Oklahoma State University
- 10:30 - 11:00 AM **"Vibrational and Inertial Characteristics of Softball and Baseball Bats:  
Research and Practical Implications"**  
Larry Noble, Ph.D.  
Kansas State University
- 11:00 - 12:00 noon **"Physiological Training: Kearney's Ten Immutable Laws"**  
Jay T. Kearney, Ph.D.  
U.S. Olympic Training Center, Colorado Springs, CO
- noon - 1:00 PM **Administrative Council Meeting**  
Jeffrey A. Potteiger, Ph.D.  
President

