The Effects of Combined Creatine and Ribose Supplementation on High-Intensity, Resistance Exercise Performance

This study was conducted to determine if CreaRibose, a combination of creatine and ribose, has an effect on high-intensity, resistance exercise performance. Following human subject committee approval, twenty-one male and female subjects aged 18–29 were asked to participate in the double blind, placebo controlled study. Prior to testing, subjects came to the lab for two separate familiarization trials on the Biodyex isokinetic knee extension dynamometer. The pre- and posttesting consisted of five sets of thirty repetitions on the Biodyex performed at 180°/s; each set was separated by sixty seconds of rest. Between pre- and posttesting, subjects were asked to ingest their supplements (eight grams of CreaRibose (5 g creatine monohydrate + 3 g d-ribose) or placebo (8 g cellulose)) four times a day for five days. In an attempt to facilitate muscle uptake of the creatine and ribose, subjects also completed twenty minutes of intermittent cycling each day of supplementation. Differences in peak torque, total work, fatigue rate, and average power between pre- and posttesting for each group were compared using an 2 x 2 ANOVA. Data showed a significant (p < 0.05) interaction effect between treatment in total work (CreaRibose increased 5.5% compared to no change in the placebo group) and average power (CreaRibose increased 6% compared to no change in the placebo group) during set #1. These data suggest that one week of CreaRibose supplementation may result in erogenic effects during high-intensity resistance exercise, however, these effects appear to be confined to early stages of repeated sets.

Comparisons in Upper Body Strength of College Athletes Should be Based on Allometric Scaling
Lynne Borter, Amber Otte, and J.L. Mayhew. Truman State University, Kirksville, MO and Kirksville College of Osteopathic Medicine, Kirksville, MO.

The purpose of this study was to evaluate the efficacy of allometric scaling to compare the differences in upper body strength between college men and women athletes. Resistance-trained men (n = 97) and women (n = 74) were measured after a minimum of 6 weeks of heavy-resistance training for one-repetition maximum (1-RM) bench press (BP), body mass (BM), and lean body mass (LBM) from population-specific prediction equations. The commonality of slope of the relationship between BM and BP for the genders was evaluated using a multiple, log-linear regression model. The nonsignificant interaction term for gender x lnBM (p = 0.53) confirmed a similarity of slope and revealed the exponent for BM to be 0.82, significantly higher than the theoretical value of 0.67. Computing separate allometric equations for men (BP = 3.08 BM0.82) and women (BP = 1.74 BM0.82) indicated that men athletes were approximately 1.8 times stronger in the upper body than women athletes after the influence of BM was controlled. Nonsignificant correlations (p > 0.50) between BM and the ratio scale (BP/BM0.82) indicated this ratio was free of the confounding influence of body size. Comparing separate equations using LBM revealed that male athletes (BP = 0.80 LBM0.80) were approximately 1.6 times stronger than female athletes (BP = 1.25 BM0.82). Because the 95% confidence interval for the LBM exponent encompassed 1.00, it suggested that strength comparisons can be made using a ratio scale when considered relative to LBM (i.e., BP/kg LBM). However, when considering strength in college athletes relative to BM, an allometric scale appears preferable.

Comparison of Knee Acceleration EMG at Slow and Fast Velocities During an Isokinetic Movement
L. E. Brown, B. W. Findley, M. Greenwood, and M. J. Comeau. Human Performance Laboratory, Arkansas State University, Jonesboro, AR 72401.

Acceleration (ACC) on an isokinetic dynamometer offers only the inertial resistance of the limb and attachment. Nevertheless, the high-speed limb movement may be sufficient to act as a stimulus for neuromuscular adaptation. The purpose of this study was to investigate the differences between velocity specific ACC ROM EMG activity during an isokinetic knee extension repetition at two separate speeds. Eighteen subjects (7 men, 11 women, age 24.2 (2.6) years) volunteered for this study. Subjects performed three maximal concentric knee extension/flexion repetitions at speeds of 60 and 240 degrees per second (d/s) on a Kin-Corn isokinetic dynamometer. A single EMG electrode was placed over the rectus femoris and sampled at 1,000 Hz. The ACC ROM phase was separated from each repetition at each speed. In addition, the root mean square (RMS) EMG signal was collected over the same phase for each speed. ANOVA was used to analyze the RMS signal between speeds by phase. The ACC RMS measurements (mean(SE)) were not significantly different (p > 0.05) at 60 d/s when compared to 240 d/s (60 = 77.81±16.1 vs. 240 = 77.5±10.1 mv). However, the ACC ROM phase was significantly greater at 240 (13.6±1.3 dgs) than 60 d/s (11.1±1.1 dgs). These results demonstrate that rectus femoris EMG activity is not velocity specific relative to the ACC ROM phase of an isokinetic repetition. However, the distance traveled during high speed ACC exercise may be as much as 13 times greater. In conclusion, similar EMG activity coupled with greater ACC phase ROM at 240 d/s may increase the probability of neuromuscular adaptation at high speeds when compared to slow speeds.

Relative Contribution of Force and Velocity to Peak Power Across a Load Spectrum: A Preliminary Study

Active, weight trained male subjects (n = 24) from a variety of backgrounds were recruited to determine the relative contributions of force and velocity to peak power. Testing equipment consisted of an AMF (Jefferson, Iowa) leg press equipped with a Fityodore (Bratislava, Slovakia) dynamometer. Subjects were tested for one repetition maximum (1RM) and peak power (PP), force at PP (F@PP), and velocity at PP (v@PP) at 1RM, 70% 1RM, and 40% 1RM. Relative contribution was calculated using multiple linear-regression with peak power as dependent variable and F@PP and v@PP as independent variables at each load. Mean 1RM leg press strength was 19.7±4 kg. Percent of total variance for F@PP and v@PP are listed below.

<table>
<thead>
<tr>
<th>Load</th>
<th>PP (W)</th>
<th>F@PP (%)</th>
<th>v@PP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% 1RM</td>
<td>847,372</td>
<td>0.982</td>
<td>1,537,371</td>
</tr>
<tr>
<td>40% 1RM</td>
<td>1,151,617</td>
<td>0.978</td>
<td>1,215,381</td>
</tr>
<tr>
<td>RM</td>
<td>1,137,547</td>
<td>0.930</td>
<td>877,365</td>
</tr>
</tbody>
</table>

As expected, PP was greatest at low and moderate loads. These data indicate the relative importance of force and velocity to peak power. At high and low loads (100% and 40% 1RM), force and velocity contribute equally to PP. At a moderate load (70% 1RM), force contributes greater than velocity to PP although the relative contribution changes depending on load, these data suggest that both qualities should be emphasized during power training.

Funded in part by Royal Numico Research

Functional Assessment Following Acute ACL-Reconstruction Surgery

In addition to strength and power, adequate motor control and coordination are essential for proper knee rehabilitation. This study used four dynamic closed kinetic chain tasks performed on a force plate to investigate the functional status of 16 subjects following acute ACL-reconstruction surgery. The four tasks were weight bearing during a two-legged stabilization squat, single leg stance, stepping up and over an obstacle and forward lunging with immediate return. Force plate signals were analyzed by digital computer and the involved leg was compared to the uninvolved leg and correlated with a subjective clinical rating scale of functional capacity. The ACL to normal knee comparison results exhibited significant (p < 0.05) side-to-side differences (mean(SE) during the squat test (9.8±(8.5)), loss of landing control during the step down (14.5±(12.1)), step execution time (3.6±(3)), and lunge distance (3.1±(4.8)). Weight bearing (r = 0.73) and lunge distance (r = 0.81) measures showed the strongest correlation with the clinical rating scale of functional capacity. These results demonstrate a lack of proprioception associated with acute ACL-reconstruction surgery. In order to maximize muscular adaptation results, rehabilitative strength professionals should address this deficit prior to prescribing a periodized resistance-training program.

Examination of the Relationships Between Variations of the Flexed Arm Hang Strength Test With Absolute and Relative Strength Measures Obtained Through One Repetition Maximum Testing
Jim Clemons, Charles A. Duncan, Olivier Blanchard, and Wendel Gatch. University of Louisiana at Lafayette, Dan Hollander, Department of Kinesiology and Health Studies, Southeastern Louisiana University, Hammond.

The purpose of this study was to compare six variations of the flexed arm hang (FAH) test of arm and shoulder strength to absolute strength (one repetition maximum pull down exercise [1RM], relative strength [1RM - BW-1] and muscle endurance [repetitions to failure using 70% of a 1RM]). The study involved 60 college age, female volunteers from activity classes in the Department of Kinesiology at the University of
Acute Blood Glucose Response of Insulin-Dependent Diabetics to Resistance Training Sessions of Different Intensities: Preliminary Results

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Exercise and insulin therapy are used to control blood glucose levels in type I diabetic patients, and the most common form of exercise prescribed is aerobic in nature. Prior research from our laboratory has shown that anaerobic exercise, such as resistance training, can also lower glucose responses to insulin following training. However, the acute response to the exercise does create a transient insulin resistance. Therefore, the purpose of this study was to determine if exercise intensity could regulate the response. Insulin-dependent male subjects (N = 3) between the ages of 18–35 were recruited from the Muncie community. Following a medical exam and fitness assessment resting levels of glucose were determined and the subjects one repetition maximum (1RM) for 6 weight lifting machines determined. Each subject was required to complete a low intensity (65% of their 1RM) and high intensity (85% of their 1RM) exercise session. The protocols were randomized and separated by a week of rest. The exercise sessions consisted of a total body routine (6 lifting stations) that involved 3 sets of 8–10 repetitions per lift. They rested 3 minutes between sets and exercises. Nonexercise blood glucose values were stable in the morning, whereas, postexercise values were elevated and corresponded to finger stick data. The pre- to postexercise plasma levels of blood glucose were significantly elevated by exercise but unaffected by exercise intensity, being 30.0 ± 43.9 to 190.67 ± 35.5 (60 minutes) for the low intensity and 128.0 ± 110.2 to 192.0 ± 118.3 (60 minutes) for the high intensity. The finger stick values were 5–10% lower than the plasma measurements. The high intensity exercise produced a great deal more variation in glucose responses, which may have been due to the different insulin therapies of the subjects. Although only a few subjects have been tested to date the results suggest that high intensity can be safely utilized by diabetic subjects and that finger measurements are an adequate method of determining exercise responses.

Rated in part by the Geneology Institute of BSU.
University women’s gymnastic team (aged 18–22) were tracked during a 4-year longitudinal investigation. Baseline power assessments of the squat and counter-movement vertical jump power measures were obtained via force plate analysis (AMTI) prior to introducing a periodized sports-specific strength/power training program. Pretraining data were collected after the team had been performing single-set circuit-like workouts (12–15 RM for each exercise) over the past year. Power assessments were made at two time points during each academic year (February/November). Results showed significant (p ≤ 0.05) and continued increases in both peak power output and improvements in the time taken to achieve peak power within the squat and counter-movement vertical jumps at each biannual assessment over the 4-year period. On average, team power outputs improved 506 and 575 W over the 4 years for the counter-movement and squat jump power, respectively. Changes were greatest after the first year of strength/power training but performances continued to improve significantly but in smaller magnitudes. The time taken to achieve peak power was 0.238 and 0.145 second faster for each jump, respectively. Control data showed that test rest intraclass Rs for reliability of the measures were Rs ≥ 0.95. Furthermore, body mass parameters did not significantly change over the 4-year period, which resulted in the gymnasts significantly increasing their relative power-to-body mass ratio. It was concluded that power oriented, sports-specific resistance type training, in addition to a gymnast’s regular sport training, can significantly improve the gymnast’s potential to reproduce the explosive movements required for competitive performances.

The Effects of Competitive Wrestling Success on Acute Hormonal Responses


Previous research examining the effect of wrestling success (win vs. loss) on acute hormonal responses reported that winners exhibited a significantly greater acute testosterone (Tes) response compared to losers, although the physiological mechanism responsible was not known (Elias 1981). To study possible physiological mechanisms responsible, 14 men wrestlers from an NCAA Division I program wrestled 5 matches over a 2-day period. Serum samples were collected prematch (Pre) and immediately postmatch (Post) for the determination of Tes, cortisol (Cort), Tes/Cort, and epinephrine (Epi). The subjects had a combined record of 34 wins, 31 losses, and 4 ties. The hormonal responses are listed below (X ± SE vs. Pre, Yes, Losers, p < 0.05).

<table>
<thead>
<tr>
<th></th>
<th>Tes (nmol/L)</th>
<th>Cort (nmol/L)</th>
<th>Tes/Cort</th>
<th>Epi (nmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Win Pre</td>
<td>16.4 ± 1.2</td>
<td>283.5 ± 18.0</td>
<td>6.075 ± 0.428</td>
<td>933.1 ± 171.6</td>
</tr>
<tr>
<td>Post</td>
<td>23.2 ± 1.5Y</td>
<td>413.4 ± 24.4</td>
<td>6.154 ± 0.541</td>
<td>1675.4 ± 217.6</td>
</tr>
<tr>
<td>Lose Pre</td>
<td>14.8 ± 1.0</td>
<td>302.8 ± 26.0</td>
<td>5.844 ± 0.647</td>
<td>967.5 ± 133.3</td>
</tr>
<tr>
<td>Post</td>
<td>19.4 ± 1.2</td>
<td>402.3 ± 26.0</td>
<td>5.577 ± 0.537</td>
<td>1800.4 ± 374.1</td>
</tr>
</tbody>
</table>

The Tes responses for losers may be under sympathetic regulation based on circulating Epi concentrations (change; Tes & Epi, r = 0.91; Epi & Tes/Cort, r = 0.73; *p < 0.05), while winners did not exhibit similar relationships (change; Epi & Tes, r = 0.09). These data suggest that winners were using a different regulatory mechanism for their acute Tes responses, which is activated in response to the experience of winning.

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No Fatigue Perceived With Creatine Supplementation During the Collegiate Baseball Season of Division IA Players

L. Greenwood, M. Greenwood, R. Kreider, A. Byars, L.E. Brown, and K. Stahura, Department of HPESS, Arkansas State University, State University, AR 72467.

During the 1990s the continued search by athletes for an effective and legal ergogenic aid has led them to the nutritional supplement, creatine. While safety and health concerns raised by various professional groups regarding the effects of creatine supplementation on markers of clinical status have recently surfaced, to date, no clinical study has reported any side effects from creatine supplementation other than weight gain. Although there is no scientific data to support these concerns by the prompted many athletes and athletic organizations to reconsider whether to take or provide creatine to their athletes. Further, little is known about the athlete’s perceptions regarding the effects of creatine supplementation. The purpose of this study was to determine the perceived fatigue associated with creatine supplementation of Division I football players during competitive season.

Seventy-two Division I football players participated in this study completing a 15 item self-report Fatigue Status Inventory (Kreider, 1994). Thirty-eight (53%) of the seventy-two athletes reported ingesting 20 to 30 g/day of creatine for 5-7 days preceding training. For the purpose of analysis, comparisons of athletes were made between creatine users and non-creatine users. An alpha level of 0.05 was used for determining significance. Results of the analysis using chi-square and Fisher’s exact tests indicated six significant (p < 0.05) associations between creatine use of athletes and the fifteen self-report items on the Fatigue Inventory Scale over the 12 week training period. These associations included creatine users experiencing less leg fatigue (weeks 3 & 5), feeling physically stronger (week 5), and being more ready to perform at their personal best (week 8). Paradoxically, noncreatine users perceived themselves as being more physically fatigued while feeling less over trained (week 10). However, these associations were not demonstrated consistently throughout the entire training period. As the result of these findings, it was concluded that there are no perceived fatigue differences associated with creatine supplementation of Division IA football players.

Effect of Carbohydrate Ingestion on Volume Load Lifted During Acute Resistance Exercise

S.K. Grogan, A.J. Koch, and J.A. Potteiger, Human Performance Lab, Truman State University, Kirksville, MO 63501. Exercise Physiology Laboratory, University of Kansas, Lawrence, KS 66045.

The effect of carbohydrate supplementation (CHO) on volume load lifted during acute resistance exercise was examined. Ten resistance-trained male subjects completed a randomized double-blind protocol with sessions separated by 14 days. The exercise session consisted of a high intensity, short rest interval squat workout and was intended to elicit volitional fatigue. Seven subjects could not complete all repetitions and were grouped as responders (R) and three subjects completed all assigned repetitions and were grouped as nonresponders (NR). Only data for R was considered in the statistical analysis. Subjects consumed 1.0 g/kg body mass CHO (R) or a placebo (PLC) 10 minutes prior to exercise. Volume load was calculated as the product of total weight lifted (kg) times the total repetitions. Among R, a dependent t-test indicated no significant difference between volume load lifted with CHO (10,480.4 ± 1,044.9 kg) and volume load lifted with PLC (10,129.0 ± 1,358.8 kg). No correlations were found between rest to postexercise changes in serum cortisol and volume load lifted (p = 0.67). However, a trend towards significance (p = 0.07) was observed between the change in plasma glucose from rest to postexercise and volume load lifted (n = -0.492). These data do not support an ergogenic effect of carbohydrate supplementation on resistance exercise performance.

The Effect of Eight Weeks of Creatine and Glutamine Supplementation on Force-Time Curve Measures

G. Haff, M. Lehmkohl,* B. Justice, E. Pizzillo, G. Trone, M. Maloney, D. Vinci, A. Utter, and E. Haff, Neuromuscular Laboratory, Appalachian State University, Boone NC, 28608, and *Department of Nutrition and Food Science Auburn University AL, 36849.

The purpose of this investigation was to determine the effects of 8 weeks of creatine (Cr) and glutamine ingestion on force-time curve (FTC) measures in 30 intercollegiate track and field athletes (17 M, 13 F) randomly divided into a placebo (P, n = 10 age: 19.9 ± 0.6; height: 175.3 ± 2.8 cm, weight: 75.7 ± 6.2 kg), a creatine (C, n = 10 age: 19.4 ± 0.3 years, 175.8 ± 2.5 cm, 70.7 ± 3.2 kg), or a creatine and glutamine (GOM, n = 10 age: 19.2 ± 0.3 years, height: 175.3 ± 2.7 cm, weight: 73.3 ± 4.5 kg) group. The C group received 0.3 g·kg−1day−1 of Cr in a capsule form for 1 week, followed by 0.03 g·kg−1day−1 for 7 weeks. The COM group received the same Cr dosage scheme as the C group plus 4g glutamine/d. Subjects were involved in a preseason conditioning program consisting of multijoint large-muscle-group exercises using a periodized weight program. Pre- and posttesting FTC analyses were performed on a static
vertical jump (SVJ), a countermovement (CMJ) vertical jump, and an isometric mid-

thigh clean pull. All testing was performed on a 6.10 x 121.9 cm AMTI force plate. A G x T ANOVA indicated a significant time effect for take-off velocity for both SVJ and CMJ. A significant time effect also was determined for peak force (FP) during the isometric clean pull (ICP). No time effects or interactions were noted for peak force of development (PRFD), time to PRFD, or time to PF during SVJ, CVJ, or ICP. There were no differences between the C and COM groups for any of the FTC measures tested using SVJ, CVJ, or ICP. These data indicate that 8 weeks of C or COM sup-

plementation do not alter FTC measures during SVJ, CVJ or ICP tests in intercollegiate track and field athletes who were following a periodized resistance training program.

Metabolic Cost of a Multi-Set Exercise Protocol Performed on a Flywheel Ergometer

D. Hernandez, J.F. Caruso, J.L. Hamill, and M. Yamauchi. Department of

Health Ecology, University of Nevada, Reno, NV 89557-0036.

Twenty-three (11 men, 12 women) subjects performed three seated bilateral leg press workouts to note the net caloric cost of such exercise. Leg press, performed on a flywheel ergometer (YoYo Inertial Technologies, Stockholm, Sweden) proposed for in-

flight resistance exercise, provide convenient and eccentric knee extensor loading per repetition. Workouts consisted of a 3 x 8 protocol to volitional fatigue, with 60-second rests between sets. To prevent a training effect, workouts took place 7 days apart. Work-

outs started with a five-minute warm-up on a stationary bicycle, followed by subjects seated quietly on the ergometer until baseline O2 uptake values were established with a metabolic cart (ParvoMedics Corporation, St. Paul, MN). Once baseline O2 uptake was determined and while connected to the metabolic cart, subjects performed the 3 x 8 protocol. Subjects remained connected to the metabolic cart until O2 uptake returned to baseline values. Total work and net caloric cost were calculated from the ergometer and metabolic cart per subject’s workout. One-way repeated-measures ANOVAs showed no significant changes in total work and net caloric cost, suggesting reproducible results across workouts resulting from no training effect. A product-moment regression corre-

lation shows a significant (r = 0.62, p < 0.01) relationship yielding a prediction equa-

tion for net caloric cost as a function of total work as follows: Y = 33.2 + 0.0056X (X). More research into the physiological responses of work performed on the ergometer is warranted if the device is to be used during manned space flight.

Funding provided from The Junior Faculty Research Award at The University of Nevada.

Inseason Strength Comparisons Between Freshman and Senior Collegiate Football Players


The purpose of this study was to examine the effect of resistance training experience on the ability to improve strength during an inseason resistance training program for football. All subjects were members of NCAA Division III Collegiate Football Team. Comparisons were made between freshman (F) athletes (n = 14, mean ± SD 177.0 ± 5.1 cm; 87.3 ± 9.9 kg) that were in their first year of eligibility to senior (S) athletes (n = 16, mean ± SD 187.8 ± 7.6 cm; 95.5 ± 23.8 kg) that were in their third year of eligibility and final year of football eligibility. All players were tested for maximal strength (1RM bench press and squat) during the first day of summer training camp (PRE) and during the final week of the regular season (POST). The inseason resistance training program was performed using a 3 x 8 protocol. Subjects remained connected to the metabolic cart until O2 uptake returned to baseline values. Total work and net caloric cost were calculated from the ergometer and metabolic cart per subject’s workout. One-way repeated-measures ANOVAs showed no significant changes in total work and net caloric cost, suggesting reproducible results across workouts resulting from no training effect. A product-moment regression corre-

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Strength Changes During an Inseason Resistance Training Program for Football: Influence of Intensity and Volume of Training


The in season resistance training program for a team sports is generally considered a maintenance phase of the athletes annual periodized training program, in which primary focus is on maintaining the strength gains made during the earlier phases of training. Previous studies have indicated that strength increases can be made during this phase of training, but primarily in an untrained athletic population. In this study 53 NCAA Division III football players (mean ± SD 197.7 ± 14 years; 178.1 ± 6.4 cm; 91.4 ± 16.3 kg) were tested for maximal strength (1RM bench press [BP] and squat [SQT]) on the first day of summer training camp (PRE) and during the final week of the regular season (POST). The inseason resistance training program was performed using a 3 x 8 protocol. Subjects were required to perform 3 sets at 80% 1RM per exercise (~6-8 repetitions per set). Results of the study showed that SQT increased (p < 0.05) from PRE (155.0 ± 31.8 kg) to POST (165.3 ± 30.0 kg). However, no difference was seen between PRE (125.7 ± 21.0 kg) and POST (125.9 ± 18.6 kg) in BP. Significant correlations were seen between the average exercise intensity (% of 1RM) and strength improvement in both BP (r = 0.68) and SQT (r = 0.47). Volume of training did not appear to have any relationship to strength improvement. Further analysis revealed that athletes who effect also was the determined for peak force (FP) during the isometric clean pull (ICP). No time effects or interactions were noted for peak force of development (PRFD), time to PRFD, or time to PF during SVJ, CVJ, or ICP. There were no differences between the C and COM groups for any of the FTC measures tested using SVJ, CVJ, or ICP. These data indicate that 8 weeks of C or COM sup-

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The Knowledge Acquired as a Result of Specific Formal Instruction in Strength and Conditioning

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With the advent of the NSCA Educational Recognition Program, many schools are developing specific courses in strength and conditioning to supplement their exercise science curriculum. The purpose of this study was to identify the knowledge that students can acquire about strength and conditioning after completing one semester-long course in the principles of strength and conditioning. A 50-question, multiple choice test covering the six domains of exercise science, nutrition, program design, exercise techniques, testing & evaluation, and organization & administration, was administered to 26 undergraduate students before and after completion of the course. Descriptive statistics and t-tests were used to analyze the data. The data are presented as mean score (correct responses) in percent (%) for the total group (±SD). The mean change from pretest to posttest improved significantly (p < 0.05) only for the exercise science, and program design domains. No change was found in the testing & evaluation domain, and nonsignificant changes were found in the three remaining domains, with only the organization & administration section showing improvement. Mean changes were ±1.1%, ±2.4%, ±13.2%, ±1.7%, 0%, and ±5.7% for exercise science, nutrition, program design, exercise techniques, testing & evaluation, and organization & administration, respectively. These data indicate that formal instruction in strength and conditioning can improve test scores in students who were already capable of passing the certification examination for the Certified Strength and Conditioning Specialist credential. These data might serve to encourage institutions of higher learning to develop formal coursework specific to strength and conditioning in addition to their exercise science courses.

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Effects of Creatine Loading on Hydration, Whole Body Creatine Retention, and Urinary Creatinine Excretion

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Creatine has become a popular nutritional supplement for resistance trained athletes. However concerns have been raised that creatine loading may promote dehydration and/or increase renal stress. This study evaluated the effects of creatine loading on fluid intake, urine output, whole body creatine retention, and urinary excretion of creatine. 24 healthy men (182 ± 2 cm, 85.6 ± 11 kg) with no history of creatine supplementation participated in this study. Subjects donated 24-hour urine samples and recorded fluid intake for 4-days. After an initial control day, subjects ingested supplements containing 5 g of creatine three times daily for 4-days. Daily fluid intake, urine volume, urinary specific gravity, urinary creatine, and urinary creatinine concentrations were determined. Creatine retention was estimated by subtracting total urinary creatine excretion from total supplemental creatine intake over the 3-day period. Data were analyzed by repeated measures ANOVA and are presented as means ± SD for control day (D0) and day 1 (D1), day 2 (D2), and day 3 (D3) of creatine loading, respectively. Results showed that fluid intake (D0 3.1 ± 0.3, D1 3.5 ± 1.1, D3 3.6 ± 1.1, Lp = 0.01) and urinary output (D0 2.2 ± 1.0, D1 2.7 ± 1.1, D2 2.9 ± 1.4, D3 2.6 ± 1.1, Lp = 0.01) significantly increased during the loading period while urine specific gravity decreased (D0 1.016 ± 0.006; D1 1.025 ± 0.004; D2 1.035 ± 0.004; D3 1.0155 ± 0.004; p = 0.003). No significant differences were observed in the percentage of urinary output to fluid intake. These findings indicate that creatine loading does not promote dehydration. As expected, urinary excretion of creatine increased during creatine loading (D0 0.3 ± 0.3; D1 4.4 ± 2.3; D2 6.3 ± 6.3; D3 6.7 ± 4.4 g/24 hour, p = 0.001) with an estimated creatine retention of 42.6 ± 2 g (71 ± 3% of creatine consumed) during the 3-day loading period. However, creatine loading had no effect on creatine excretion (D0 2.8 ± 2.0; D1 2.3 ± 0.7; D2 2.8 ± 2.5; D3 2.9 ± 1.3 g/24 hour, p = 0.57) which is often used as a marker of renal function.

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Contribution of Anthropometric Dimensions to Expressions of Upper Body Strength at Different Levels of Training

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The purpose of this study was to assess the degree to which training experience influenced the contribution of anthropometric dimensions to bench press strength. Men athletes (n = 155) volunteered to perform a 1-RM bench press (BP) and be measured for selected anthropometric dimensions. The three levels of training involvement were: college athletes (n = 46) participating in the sports of track, wrestling, basketball, and football, college athletes (n = 55) with extensive background in powerlifting, and elite European competitive powerlifters (n = 61). Each group was significantly different in absolute strength (108 ± 18, 157 ± 22, 203 ± 41, respectively) and strength relative to body mass (1.30 ± 0.24, 1.45 ± 0.21, 1.97 ± 0.37), lean body mass (1.45 ± 0.25, 1.57 ± 0.30). The following conclusions were drawn: The influence of upper body strength was greatest in college athletes with the least amount of training experience, and decreased in both college athletes with extensive powerlifting experience, and elite European competitive powerlifters with the most training experience.
Relationship Between Lower Body Strength and Bone Mineral Density in Postmenopausal Women With Long-Term Exercise Training

Woon-Ju Lee, Bruce W. Craig, Robert Newton, and William Kraemer, Human Performance Laboratory State University, Muncie, IN 47306.

Introduction. Long-term low intensity training has received little attention in the literature, therefore the purpose of this project was to examine the relationship between muscular function and the bone mineral density (BMD) of trained and untrained postmenopausal women. Methods. Postmenopausal women (N=17) between the ages of 60-80 were recruited from the Muncie community and Ball State University Retirees Fitness (BSURF) program. They were divided into exercise (EX, N=9) and control (CON, N=8) subgroups. The exercise group had been participating (<5 years) in a low intensity (30-40% of the maximal capacity) exercise program, whereas, the CON were only recreationally active. The control group was weight and age-matched to the exercise group. All subjects were prescreened with a Health History & Activity Questionnaire, and height, weight, % body fat measured. Their resting blood pressure was taken prior to each exercise session and they were not allowed to participate if pressure was over 140 mm systole. Muscle power was measured with a seated chair raise, and muscle strength was measured using a one repetition (IRM) leg press. The BMD was measured during a dual energy x-ray absorbometry that employed a Lunar Prodigy DXA scanner with appropriate software (Lunar Corporation, Madison, Wisconsin). Results. Although the muscle power of the trained EX was not significantly different from the CON, being 28.88 ± 6.81 vs. 22.94 ± 5.67 (mean ± SD), respectively it did approach significance (p<0.07). Leg strength of the EX was slightly higher than the CON, being 45.93 ± 3.62 vs. 40.21 ± 2.26, respectively. The BMD of the two groups, however, did not differ between the two groups, being 0.853 g/cm^2 for the EX and 0.858 g/cm^2, but the trochanter BMD of the EX was 7% (left) and 6% (right) higher than the CON. Conclusions. Based on the results from this study long-term low intensity training is no more effective in maintaining lower body BMD than normal recreational activity. Current research is aimed at determining prolonged upper body training has a similar effect on upper body BMD.

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The Effect of Weeks of Creatine and Glutamine Supplementation on Body Composition and Performance

M. Loebahk,* R. Justice, E. Patilli, G. Trone, M. Malone, D. Vinci, A. Utter, J.L. Kilgore,* E. Haaf, and G. Haaf, Neuromuscular Laboratory, Appalachian State University, Boone NC, 28608,* Exercise Science Laboratories, Midwestern State University, Wichita Falls TX, 76308, and *Department of Nutrition and Food Science, Auburn University, AL, 36849. The purpose of this investigation was to determine the effects of 8 weeks of creatine (Cr) and glutamine (Gln) supplementation and performance measures in 30 collegiate track and field athletes (17 M, 13 F) randomly divided into a placebo (P; n=10), a creatine (C, n=10), or a creatine and glutamine (COM, n=10) group. The C group received 0.3 g·kg^-1·day^-1 of Cr in a capsule form for 1 week, followed by 0.2 g·kg^-1·day^-1 for 7 weeks. The COM group received each of the above supplements at the same dosage scheme as the C group plus 6 g·kg^-1·day^-1 of Gln. Subjects were involved in a pre season conditioning program consisting of multijoint large-muscle-group exercises using a periodized weight program. Pre- and posttesting consisted of a 7-site skinfold analysis, and static and countermovement (CMJ) vertical jump test. A G* power ANOVA indicated a significant time effect for all variables. There was a significant interaction effect for body mass (C: pre 70.7 ± 3.2, post 72.4 ± 3.3 kg; COM: pre 73.5 ± 5.6 kg; CE: pre 75.5 ± 4.5 kg; P: pre 77.5 ± 6.2, post 77.6 ± 5.9 kg). LBM (C: pre 61.5 ± 4.2, post 63.9 ± 4.1 kg; COM: pre 62.6 ± 3.6, post 65.5 ± 4.0 kg; P: pre 68.7 ± 5.9, post 67.9 ± 5.1 kg) and CMJ peak power (C: pre 5069.3 ± 822.3, post 5148.4 ± 663.0 W; COM: pre 5491.8 ± 571.3, post 5806.9 ± 556.0 W; P: pre 5351.6 ± 503.2, post 5325.7 ± 523.8 W). There were no differences between the C and COM groups for any variables tested. The data indicate that 8 weeks of C or COM supplementation favorably altered LBM and CMJ peak power output in collegiate track and field athletes who were following a periodized resistance training program.

Gender Differences in Perceived vs. Actual Strength

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This study examined the degree to which perceptions of muscle strength influenced actual physical performance. Perceptions of muscle strength, weight training experience, and self-prediction of a 1-RM bench press were obtained from 383 college students (16 M, 216 F) during the first week of a university required wellness course. 1-RM bench press performance was assessed one week later. While a large percentage of men and women felt that both genders should possess muscular strength, women, more so than men, were likely to view public displays of strength by both genders as appropriate. Further, both genders felt that society expected men to be strong but did not place similar expectations on women. A smaller proportion of men and women (M—3%; F—4%) overestimated their strength by 20% than underestimated it by 20% (M—9%; F—49%). Finally, no relationship was evident between years of training experience and the ability to accurately predict 1-RM for males (r = –0.08, p > 0.05) and only a small relationship for women (r = –0.26, p < 0.01). In conclusion, college-aged men are more likely to underestimate their strength than are college-aged men, and the ability to accurately predict 1-RM does not appear to be related to years of training experience.
Impact of Acute Resistance Exercise on Two Bioactive Human Growth Hormone Bioassays

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Growth hormone (GH) exists as a family of related proteins of different molecular weights (GH isoforms differ in their respective bioactivities). No study has yet compared the impact of acute heavy resistance exercise on two different bioassays of GH to see if the response patterns are comparable. The immunofunctional bioassay (IFBA) has been related to the NB2 lactogenic bioassay but not to the classical rat tibial line bioassay (TLBA). Therefore, the purpose of this study was to determine the effects of resistance exercise on GH using these two different bioassay methods. Whole blood was obtained from 18 nontrained women (mean ± SD age = 22.1 ± 2.7 years, body mass = 63.9 ± 8.65 kg, height = 161.3 ± 6.67 cm) pre- and postexercise resistance (6 sets of 10RM squats). Subsequently, total plasma was then assayed for bioactive GH using the TLBA that measured the effects of GH on growth at the tibial growth plate and the IFBA. Significant (p ≤ 0.05) increases (mean ± SD) pre- to postexercise were observed for the IFBA (2.8 ± 0.9 to 6.9 ± 1.4 mg/L) but not for the TLBA (p ≤ 0.001). These new data show that while both assays examine the bioactive forms of GH not all bioactive forms are sensitive to the stimulation by the acute exercise protocol used in this study. This is the first study to make a direct comparison between two different bioassays of GH and show that each is different. Such basic data also implicate the potential importance of the exercise protocol to stimulate the body’s various forms of GH that represent part of a natural anabolic system. Further work will be needed to address differences due to various protocols and training.

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Drop Jump Performance in Talent-Selected Female Gymnasts


Young, female gymnasts in the United States have the opportunity to be evaluated for potential in high-level gymnastics through the Talent Opportunity Program of U.S.A. Gymnastics. The purpose of this study was to evaluate the efficacy of the drop jump test with the TNSEL gymnasts compared to the SEL gymnasts who achieved high regional testing scores (NSEL, n = 40) and those who did not achieve high regional testing scores (SEL, n = 122). The SEL gymnasts achieved significantly greater AIR than the NSEL group (0.57 vs 0.55, p < 0.001) after 8 weeks of training while resting testosterone concentrations did not significantly change (p = 0.51). The subject’s improved strength after training did not significantly correlate (r = 0.08 ± 0.29) with their initial resting testosterone concentrations or their reduced cortisol concentrations (r = 0.09 to 0.27). The subject’s hormonal responses were similar to studies found in adults who have participated in high intensity resistance training. The data provide information on the endocrine responses of high school male athletes after a resistance exercise bout and provide insight on the trainability of adolescent athletes.

Comparison in Upper and Lower Body Strength of College Men and Women Based on Allometric Scaling

Amber Otte, Lynae Borter, and J. L. Mayhew, Truman State University, Kirksville, MO and Kirksville College of Osteopathic Medicine, Kirksville, MO.

The purpose of this study was to evaluate the efficacy of allometric scaling to compare the differences in upper and lower body strength between college men and women. Untrained men (n = 190) and women (n = 271) were measured for one-repetition maximum (1-RM) bench press (BP) and single-leg extension (LE), body mass (BM), and lean body mass (LBM) from population-specific skinfold prediction equations. The Kolmogorov-Smirnov test for normality on log-transformed variables revealed that only BP and LE in women were not normally distributed. Multiple log-linear regression indicated a commonality between men and women (p = 0.25) for the slopes of the relationship between LBM and LE but not for that between LBM and BP (p < 0.0001). Despite the difference between normal distributions, the exponent for BM relative to BP (aBMBP) was very similar to that for BM relative to LE (aBMLE). How- ever, the correlation between the scaled physiological variable for bench press (BPBM) and BM was significant in both genders, indicating that the scaled variable is not free from the influence of body size. For the relationship between the LE scaled variable (LEBM) and BM, the correlation was nonsignificant in both genders, indicating there was no influence of body size. From these comparisons, it appears that men were approxi- mately 1.96 times stronger in the arms and 1.46 times stronger in the legs than women. Perhaps a more precise view of the gender difference between upper and lower body strength could be obtained by using local muscle cross-sectional areas as the allometric scaling quantity due to the difference in the distribution of muscle in men and women.

Comparison of Absolute and Relative Muscular Endurance Techniques for Predicting Strength in High School Athletes

Sydney Palmer and J. L. Mayhew, University of Georgia, Athens, GA, Truman State University, Kirksville, MO and Kirksville College of Osteopathic Medicine, Kirksville, MO.

The purpose of this study was to determine the accuracy of predicting one-repetition maximum (1-RM) bench press strength in high school athletes from absolute and relative muscular endurance measurements. Forty-three high school football players (age = 16.1 ± 1.0 years) were evaluated at the beginning of their winter conditioning training for 1-RM free-weight bench press, repetitions-to-fatigue (RTF) using an absolute load of 135 lb, and the load used to complete a 7–10-RM. Each test was administered on separate days. The 7–10-RM technique employed 81.7% (±2.0% of 1-RM, with two of the four equations producing accurate results. A 135-lb absolute endurance equation, performed at 65.4% (±18.3% of 1-RM, was less effective in predicting 1-RM. A relative endurance test may be better than an absolute task for estimating 1-RM strength amount high school football players.

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Twenty-five high school male athletes (mean age of 15.96 ± 0.82 years) completed a pretest and posttest that consisted of a heavy and intense resistance exercise bout (3 sets of 10 repetitions at 70-75% of the participant’s 1RM, 1-minute rest period between sets). Saliva samples were collected at rest and immediately after the exercise to analyze testosterone and cortisol concentrations. The subjects trained for 8 weeks after alternating the training sessions 2–3 days-week–1. During the first 2 weeks of training, the subjects performed 3 sets of 10 repetitions at 70–75% of their IRM followed by 6 weeks of training with 3 sets of 5 repetitions at 75–85% of their IRM. The bench press, parallel squat, shoulder press, and power clean were performed with free weights during the pretest, posttest, and all training sessions. Salivary testosterone (p = 0.001) and cortisol (p = 0.003) concentrations significantly increased above resting levels in response to the exercise test protocol. Resting cortisol concentrations were significantly reduced (p = 0.03) after 8 weeks of training while resting testosterone concentrations did not significantly change (p = 0.51). The subject’s improved strength after training did not significantly correlate (r = 0.08 ± 0.29) with their initial resting testosterone concentrations or their reduced cortisol concentrations (r = 0.09 to 0.27). The subject’s hormonal responses were similar to studies found in adults who have participated in high intensity resistance training. The data provide information on the endocrine responses of high school male athletes after a resistance exercise bout and provide insight on the trainability of adolescent athletes.
Number of Repetitions Completed for One Set at Intensities Associated With the Three Phases of the Preparation Period of a Periodized Strength Training Program

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Literature supports an optimal intensity and volume to accomplish the objectives of each phase of a periodized strength-training program, i.e., to increase mass, strength and power respectively. The suggested intensity range of hypertrophy averages ~75% of one repetition maximum (1RM), basic strength’s average intensity is ~85% of 1RM, and maximum strength/power’s average intensity is ~95% of 1RM. The purpose of this study was to compare the number of repetitions that could be completed for one set at 75%, 85%, and 95% of 1RM, on 8 different strength-training exercises, with the number of repetitions the literature predicts is attainable at those intensities. Twenty-one strength-trained males consented to participate in the study. The 8 tested exercises included: (1) back parallel squat; (2) leg extension; (3) leg curl; (4) lat-pull-down; (5) barbell bench press; (6) dumbbell shoulder press; (7) biceps curls; (8) supine triceps extension. Subjects were first tested for 1RM on all 8 exercises. Subsequent to the 1RM test, subjects were evaluated on the number of repetitions completed at 75%, 85%, and 95% of 1RM. All exercises were tested on separate days allowing a 48 to 72 hour rest between each test day. A repeated measure analysis of variance and Bonferroni post-hoc procedures found that at the intensity of 85% of 1RM, the number of repetitions completed was significantly greater than the predicted range of 5 to 6 repetitions for the back parallel squat, lat-pull-down, barbell shoulder press and biceps curls exercises (p < 0.05). Similar patterns were also observed at different intensities but were not significantly different from the predicted range of repetitions. In attempt to enhance periodized resistance training, strength-training professionals may optimize the objective of each phase by adjusting the intensities according to each resistance exercise.

In-Season Strength and Power Changes in Female NCCA Division I Volleyball Players Accompanying Periodized Strength and Ballistic Training

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Fourteen female college volleyball players participated in a study to examine the effects of ballistic training during the competitive season on strength and power measures. The subjects trained for seven weeks using traditional strength training, and trained with traditional strength training and ballistic training for the final four weeks of the in-season. Subjects were tested at the start of the season (PRE), prior to the start of ballistic training (MID), and at the conclusion of the ballistic training (POST). Average power in weighted jump squats was not significantly affected from PRE to MID, but was significantly higher than MID to POST, and PRE to POST (9% and 12%, respectively). Average force responded similarly, with no significant difference PRE to MID, but significant increases MID to POST and PRE to POST (10% and 12%, respectively). There were also no significant decreases for any force or power measures from PRE to POST during the in-season period. The implication is that force and power measures can be maintained or increased with ballistic training during the competitive season.

The Effects of a Preseason Strength Training Program on a Division II Collegiate Women’s Basketball Team

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An eight-week preseason strength-training program was developed and implemented for 16 women basketball players at the University of West Florida. The purpose of the program was to increase the overall strength of the athlete as well as to enhance sport specific performance. Two testing sessions were administered throughout the eight-week training program. Testing session one was given one week prior to the initiation of the training program, while testing session two was given one week prior following the conclusion of the eight-week training program. Each of the two testing sessions included the following battery of tests: one repetition maximum (1RM) for the bench press and the squat, anthropometric measurements (i.e., body composition), agility, and vertical jump tests (i.e., standing and approach). A separate paired t-test was computed for each of the six dependent variables. Following the eight-week strength-training program there was a significant increase (p < 0.05) for the bench and squat 1RM, the standing and approach vertical jump scores, and the agility scores. There was also a significant decrease in body composition. While eight weeks may not be enough to significantly affect muscle hypertrophy, these results provide evidence that it is sufficient to significantly improve the neuromuscular dynamics related to overall strength as well as enhancement of sport specific performance.

Fitness Profile Comparisons: USA Women’s Junior, Senior, and Olympic Gymnastics Teams


Physical abilities profiles of Junior (JR) (n = 15, 13.9 ± 1.2 years, 144.8 ± 6.5 cm, 42.5 ± 9.0 kg), Senior (SR) (n = 19, 17.4 ± 1.9 years, 153.7 ± 4.3 cm, 49.7 ± 5.6 kg) and the Olympic Team (OT) (n = 6, 17.3 ± 2.1 years, 150.3 ± 6.7 cm, 47.3 ± 6.6 kg) were assessed during the 2000 Olympic Games preparation period. Tests included: straddle L, press to handstand/rep, leg lift (sec to complete 20 reps), cast to handstand on uneven bars (sec), rope climb (speed), average power and flight time intercept (Bosco 60 j sprint test), and body mass index (Mass/Height2). Multiple one-way ANOVAs were calculated followed by the Dunnett T3 post hoc procedure. JR’s were statistically different in age, mass, and height from the SRs and OT while the SR and OT did not differ. OT performed statistically better on the flight time intercept than JR’s but not SRs. JR athletes performed statistically better on casts than SRs but not better than OT. In addition, while not reaching statistical significance, the OT was leaner (BMI), showed higher average power (Bosco Test), and faster rope climb speeds. JR athletes were superior, but not statistically, in straddle L press handstands. The results indicate that OT athletes differ from non-Olympians and JRs in some physical abilities tests. This information can be used to model training and conditioning for those gymnasts with Olympic aspirations.

Myosin Heavy Chain Expression and Rate of Force Development in Weight Trained Males and Females


The purpose of this study was to examine isometric force time variables in weight trained males and females. Five females (MSD; 25.6±6.0, 74.5±12.8 kg) and seventeen males (MSD; 2787.0y, 86.8±12.7 kg) who had been weight trained for a minimum of 12 weeks performed maximal isometric contractions on a customized leg extension machine. No significant gender differences were found for any force development variables (p > 0.05). Mean relative MHC expression for I, IIA and IIB were 4.614.1%, 46.113.0%, and 12.55.1%. Force and EMG measurements were recorded at 500 Hz with the APAS analysis system. Force variables include isometric rate of force development (IRFD), rate of EMG development (REMGD), and peak force. Other variables examined include starting curve IRFD (S-Curve), acceleration curve IRFD (A-Curve) as described by Zborovski (1995). Biopsies were taken from the vastus lateralis at the midpoint of the thigh. Myosin heavy chain isoform expression was determined via 4–8% gradient sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE). Correlational results are as follows:

<table>
<thead>
<tr>
<th>IRFD</th>
<th>S-curve</th>
<th>A-curve</th>
<th>Peak force</th>
<th>REMGD</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHC I</td>
<td>0.524*</td>
<td>-0.508*</td>
<td>-0.449*</td>
<td>-0.078*</td>
</tr>
<tr>
<td>MHC IIA</td>
<td>0.613**</td>
<td>0.562**</td>
<td>0.653**</td>
<td>0.304*</td>
</tr>
<tr>
<td>MHC IIB</td>
<td>-0.99</td>
<td>-0.25</td>
<td>-0.396</td>
<td>-0.514*</td>
</tr>
</tbody>
</table>

* p < 0.05 ** p < 0.1

Results indicate that relative expression of MHC IIA may be an important factor in the ability to quickly develop isometric force.

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Changes in Body Composition, Strength, and Power in NCAA Division III College Wrestlers

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The purpose of this study was to investigate changes in body composition, muscle strength, and muscular power in NCAA Division III college wrestlers from preseason to midseason. Ten college aged wrestlers were assessed in late October, four weeks prior to the beginning of the competitive wrestling season (preseason) and in late January (midseason), three days after a tournament and three days before the next match. Measurements included body weight, body composition (skinfolds and bioelectrical impedance), strength (power cleans, squats, and bench press), and muscular power (vertical jump and seated medicine ball put). Weight, percent body fat, and fat free mass decreased significantly (p < 0.05) from pre- to midseason in the wrestlers as did all three strength measures (p < 0.05). No statistically significant difference in muscular power was observed for either measure from pre- to midseason however, the seated medicine ball put values were slightly higher at midseason while the vertical jump scores were slightly lower. The results of this study suggest that Division III wrestlers who lose a significant amount of fat free mass throughout a competitive wrestling season may also lose muscular strength. The possible effect of a decline in fat free mass on muscular power in these wrestlers is yet to be defined.

Dietary Manipulations For Conditioning in Collegiate Athletes


S college carries out the ocean swimming camp for 5 days in mid July at the northern part of Japan every summer. The purpose of this camp is to train students to become capable of swimming 5 km without rest by the end of the camp. We conducted a study looking at the effect of protein supplements on physiological and psychological response in college students. Eight study subjects were selected from students who could...
not swim 25 m. The subjects in the intervention group consumed the protein supplements within 30 minutes after exercise (twice per day). All the outcome measures include heart rate, body weight, Rating of Perceived Exertion (RPE), Category ratio Pain Scale (CPS), Profile of Mood State (POMS), and testosterone, cortisol, urinary nitrogen, and CK level were measured pre and post summer camp. The CPS level did not increase in the intervention group, however, CPS increased dramatically in control group ($p < 0.05$). The main finding of the present study was that the protein supplements was associated with CPS. These elements will become index to program design and subject's physical condition.

Comparison of Varying Rest Intervals at Sixty and Ninety Percent Maximal Bench Press Performance


The optimal rest interval following high intensity (85% one-repetition maximum [1-RM]) multiple set bench press performance has been reported to progress from 3 to 6 minutes (Todd et al., 2000, MSSE, 52:5) however, whether or not this applies to other intensities is unknown. Therefore, the purpose of this study was to compare the effect of varying rest intervals on 3-set bench press performance at 60% and 90% 1-RM in the same subjects. Twenty-two healthy men (mean ± SD: age = 20.1 ± 3.0 yr, height = 179.1 ± 6.4 cm, mass = 88.20 kg, body fat = 12.1 ± 4.3%) with recreational weight training experience (minimum of 1 year experience, 1-RM bench press = 110.64 ± 22.51 kg) completed 3 sets of repetitions (reps) to exhaustion using 1, 2, 3, 4, and 5 reps (PR) min rest intervals. Subjects were randomly assigned to intensities and completed two 3-set bench press routines per week with a minimum of 48 hours between testing sessions. The two-way (intensity by rest interval) repeated measures ANOVA indicated a significant difference in optimum rest intervals for bench press performance at 60% vs. 90% 1-RM. At 60% 1-RM, bench press performance using 1 (mean ± SD = 10.6 ± 2.0 reps), 2 (13.2 + 2.2 reps), and 3 (14.7 ± 2.5 reps) min rest intervals was significantly less ($p < 0.05$) than 4 (15.8 ± 2.4 reps), 5 (16.8 ± 2.1 reps), and PR (16.4 ± 3.0 reps) min rest intervals. In contrast, at 90% 1-RM, 1 (2.1 ± 0.7 reps) min rest interval was significantly less ($p < 0.05$) than 2 (3.1 ± 0.8 reps), 3 (3.7 ± 2.0 reps), 4 (4.0 ± 1.1 reps), 5 (4.0 ± 1.3 reps), and PR (5.5 ± 1.2 reps) min rest intervals. The average PR was not significantly different for 60% (4.3 ± 1.6 min) versus 90% (4.1 ± 1.7 min) 1-RM intensities and average single set PR rest increased significantly ($p < 0.05$) across all 3 rest intervals for both intensities. We conclude optimal multiple set bench press performance for: (a) 60% 1-RM is produced using 4, 5, and PR min rest intervals; and (b) 90% 1-RM is produced using 2 to 5 and PR min rest intervals.

Evaluation of a Strength Analysis @ Black Box® Dynamometer

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Relatively inexpensive strength testing devices that purportedly measure an assortment of seemingly relevant variables are becoming increasingly available. Their capabilities are of interest as they may provide useful information pertaining to performance capacities of individuals. They may also be used in comprehensively ascertaining the efficacy of various training interventions. However, prior to using them for the previously-stated purposes, they should be objectively evaluated. One such device, the FitoDyne® may be attached to a barbell or weight stack by means of a strap or hook at one end of a tether with the other end coupled to a retractable reel. An analog velocity transducer (Model 1641, Computrac, Paintsville, KY) is used to determine the velocity of the load as it is moved through the system. The load (lg) in kg is defined as: lg = (mg + M) (g), where the constant of gravity is 9.81 m/s^2. The mass (M) is defined as the sum of the sum of all weights applied to the cable system. The system allows the subject to apply a variable load by either changing the mass (M) applied to the system or changing the cable length. The measurement of force and power output is automatically calculated by the device. The obtained force output just prior to ground contact was acceptable (7.0%), although the mean value ($\theta = 8.77$, $SD = 0.59$) was less ($p < 0.001$) than expected. The CV for the obtained force output just prior to ground contact was also acceptable (7.0%), although the mean value ($\theta = 222.8$, $SD = 15.7$) was less than ($p < 0.001$) expected (240.0 W). It was concluded that the mechanism for measuring acceleration in this device may need to be enhanced. Although the potential value of this and similar devices is great, each must be evaluated so that their capabilities and limitations may be clearly elucidated.

Attenuating Calcaneal Bone Mineral Density Loss During Long Term Unloading


Eight (4 men, 4 women) healthy subjects performed 40 days of unilateral limb suspension (ULLS) to simulate the effect of an equal duration of space flight on the calcaneus of the unloaded (left) limb. During unloading subjects performed unilateral seated leg and calf presses on a flywheel ergometer (YoYo Inertial Technologies, Stockholm, Sweden) –2 –3 times/week with their left leg and consumed the maximal therapeutic dosage of albuterol (16 mg·cm⁻²) daily. The two treatments were intended to act as countermeasures to attenuate calcaneal bone mineral density (BMD) loss during unloading. On days 0 and 40 of ULLS subjects underwent bone densitometry scans (Holistic Corporation, Bedford, MA) and, using region of interest software, their left (unloaded) calcaneal BMDs were determined. Results: mean ± SEM with data in (mg·cm⁻²) showed no significant difference between day 0 (865.6 ± 44.05) and 40 (825.38 ± 51.45) values. A lack of load-bearing and heel-strike activities during a space flight of this duration normally result in significant calcaneal BMD loss. Study implications suggest a resistance exercise-albuterol countermeasure may attenuate calcaneal BMD loss during an equal duration of space flight.

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A Comparative Electromyographical Investigation of the Trunk and Leg Muscles Involved in the Parallel Squat and Smith Machine Squat


This study investigated the differences in electromyographical (EMG) patterns for the trunk and leg muscles during free weight squats and smith machine squats. Nine weight-trained males performed 10 repetitions of both a conventional parallel squat (CS) and a smith machine squat (SM) using fifty percent of their CS one repetition maximum with a smith machine versus free weight squat. This may reflect a decreased need to stabilize the similar loads. However, the ankle plantarflexors/dorsiflexors have lower activity during the parallel squat than the Smith machine squat (SS) using fifty percent of their CS one repetition maximum with a Smith machine versus free weight squat. This may reflect a decreased need to stabilize the similar loads. However, the ankle plantarflexors/dorsiflexors have lower activity during the parallel squat than the Smith machine squat (SS) using fifty percent of their CS one repetition maximum. Normalized root mean square (rms) EMG for the right vastus lateralis (VL), rectus femoris (RF), biceps femoris (BF), gluteus maximus (GM), lateral gastrocnemius (LG), tibialis anterior (TA), erector spinae (ES) and rectus abdominus (RA) were recorded using surface electrodes. Repeated measures analyses of variance detected significant differences ($p < 0.05$) across conditions for either the eccentric or concentric phases of the lift. During the eccentric phase, greater normalized rmsEMG was observed for the TA and LG during the CS ($F_{1, 1} = 0.52$, $p < 0.037$, respectively) as compared to the SS ($F_{1, 1} = 0.84$, $p < 0.037$, respectively). Also, during the concentric phase, the LG demonstrated greater normalized rmsEMG activity during the CS ($F_{1, 1} = 0.044$, $p < 0.001$) than the SS ($F_{1, 1} = 0.072$, $p < 0.037$). No other significant differences between CS and SS were detected for either the eccentric or concentric phases of the lifts. Results indicate that the rmsEMG of the muscles controlling the trunk, hip and knee joints have similar activity patterns during conventional free weight squat and the smith machine squat when using similar loads. However, the ankle plantarflexors/dorsiflexors have lower activity during the smith machine versus free weight squat. This may reflect a decreased need to stabilize the ankle during the smith machine squat. These results show that, if the same loads are used, the smith machine squat and free weight squat produce similar muscle utilization patterns except for the muscles of the lower leg.