Abstracts
A – C
The Effect Of Daily Undulated Periodization As Compared To Linear Periodization In Strength Gains Of Collegiate Athletes

Brent Alvar, Rich Wenner, Daniel J. Dodd

Strength and conditioning coaches are always looking for ways to optimize gains in muscular strength. Previous resistance training research has examined the efficacy of non periodized multiple-set versus single-set, and linear as compared to non periodized multiple-set models on gains in muscular strength. Conversely, less research has examined the linear and undulating periodization models, especially when equating for volume and intensity.

Purpose: This study was designed to examine the effects of a linear periodization intervention as compared to a daily undulating periodization intervention on maximal strength gains in Division I athletes while controlling for volume and intensity. Methods: Twenty subjects were recruited from a Division I athletic program. All subjects performed a one repetition maximum (1RM) bench press test prior to beginning the training program and immediately upon completion of the six week training program. Participants were assigned to one of two groups, Linear Periodization (LP) or Daily Undulated Periodization (DUP). The LP group followed a plan that decreased volume of repetitions performed while increasing intensity (percent of 1RM) over the course of six weeks. The DUP group performed a high volume, low intensity workout; a medium volume and medium intensity workout; and a low-volume, high intensity workout each week. Results: Statistical analysis showed that there was a significant difference between the pre and post test results for both training models (p<0.05), with the DUP group producing a slightly higher strength increase as compared to the LP group, however there was no statistically significant difference found between the training interventions (p>0.05). Conclusions: DUP as well as LP will produce a significant training effect when implemented in a collegiate strength training program in a six week training cycle. Practical Applications: This research study provides strength coaches scientific affirmation that different periodization models are an effective means of resistance training design for collegiate athletes. Both DUP and LP have been shown to increase muscular strength in the bench press in this population. This information gives the strength and conditioning coach some latitude in program design. Theoretically, variety in program design can alleviate the monotony that may occur during strength training for advanced athletes.

1Rm Prediction From The Linear Velocity And The Rate Of Perceived Exertion In Bench Press And Parallell Squat.

Fernando Ayllon, Eneko Larumbe, Alfonso Jiménez, Brent Alvar

PURPOSE: The goal of this study was to determine the accuracy of the Scale of Perceived Exertion (RPE) OMNI RES 0-10 and the Linear Velocity (V) to predict the 1RM value in two resistance training exercises: Bench Press (BP) and Parallel Squat (PS), in a group of young baseball players. METHOD: 32 young men baseball players (15.6±0.7 yr) performed a progressive test (PT) in BP and PS with incremental load until reach the maximum load that can be mobilized (1 RM). The RPE OMNI-RES 0-10 Scale was used to assess the effort's perception experienced at the end of the PT set and a rotating encoder was used to get the average lineal velocity reached with each load. Two linear regression analyses were made to predict the 1 RM percentages and calculate the 1 RM. 1) One between the V (as independent variable) and % 1 RM (as dependent variable) 2) The other one between the RPE (as independent variable) and % 1 RM (as dependent variable). RESULTS: The averaged 1 RM achieved were 66.8±12.8 and 153.8±22.6 for BP and PS respectively. The 1 RM prediction models were statistically significant (p<0.01) for either velocity (r = 0.97 SEE 12.2 and r = 0.93 SEE 14.6) or RPE (r = 0.90 SEE 6.4% and r = 0.97 SEE 6.7%) for BP or PS respectively. The regression equation developed for each model were: 1 RM BP = 100 x kg / (1.050x+(-0.517)x) and 1RM PS = 100 x kg / (0.266x+0.075)(RPE); 1 RM PS = 100 x kg / ((1.094x+(-0.388)x) and 1RM PS = 100 x kg / (0.572x+0.043)(RPE). The covaried analysis showed significant differences (p<0.05) between the regression RPE-%1RM regression line developed for BP and PS, but not for the two BP or PS v-%1RM regression. CONCLUSIONS: For both exercises (BP and PS), we can estimate the 1 RM value from the velocity or the RPE determined during or at the end of a short set of only 1 to 3 reps with a submaximal load mobilized with the maximal possible velocity. PRACTICAL APPLICATIONS: These equations allow a continuous control of the strength evolutions during the training process, although when the V is utilized as the predictive variable we can assign the same equation for BP or PS, but when you uses the RPE we have to develop a specific equation for each different exercise. Furthermore, from the SEE% the RPE equation shows a more accurate value than the V equation.

Application Of Gps Technology To Assess The Demands In Soccer Competition At College-Aged Level

Fernando Ayllon, David Viejo-Romero, Alfonso Jiménez, Brent Alvar

PURPOSE The main objective of this study was to describe and quantify the total distance crossed by a group of the College-aged Soccer players during different competition matches, differentiating between the positions in field (defence, midfielder and forward). As second objective, we compare the distance measures in this category with those registered in first class soccer Spanish players (Spanish League and European Champions League). METHODS: Male college-aged soccer players led a global positioning satellite (GPS) device (SPI Etron) for 14 league matches of the season 2008/2009. These devices can measure the distance and calculate the running speed and acceleration made by each player along the match RESULTS: There were 140 entries total. The average distance completed by all players without differentiating the position was 8920.33 ± 250.4 m, with a range between 7963.5 m and 11161.1 m. When the sample was classified by the position, midfield players completed 9271.34 ± 130.99 m (p <0.05), an 8% increase over the defense players (8565.6 ± 309.5 m) and 4% compared to the forwards players (8870.6 ± 871.0m), with no significant differences identified between the last two groups (p <0.05). The distance completed by college-aged soccer players was significantly lower (p <0.05), than the distance registered from elite level players (Spanish League and European Champions League), where midfield players ran 12088.3 ± 776 m (+22%), the defense players 11405.3 ± 893 m (+25%) and the forwards players 11245.8 ± 894 m (+21%) CONCLUSION: Our results are similar to the data shown by other studies which had used other tools, as cameras and tracking system (computerized tracking system) regarding the distance crossed by grade or competition level. Independently of the competition level, the midfielders covered the major distance during the matches PRACTICAL APPLICATIONS: The midfielders will require greater attention to Conditioning, especially for the specific endurance capacity, to enable them to cope with the game demands.
Rate of velocity development is measured as the range of motion traveled from 0 to the target velocity, therefore, a lower value equates to greater limb acceleration. The time it takes to reach max velocity is a critical component for success of athletes. This may contribute to the development of strength into performance velocity, which is essential in sport performance. PURPOSE: The purpose of this study was to examine whether training at a low velocity with single versus multiple set protocols had a differential effect on rate of velocity development in the knee extensors at a faster isokinetic speed. METHODS: Forty subjects were randomly assigned into one of three groups: control (C, n=7), single set (SS, n=4), or multiple sets (MS, n=9) to perform 8 maximal knee extensions at 60 d/s on an Biodex System 3 isokinetic dynamometer twice a week for eight weeks. The SS group performed one set while the MS group performed three sets. All groups were tested pre, mid (4 weeks), and post tested at 60 d/s and 180 d/s. RESULTS: A 3x3x2 (Group x Time x Speed) mixed factor repeated measures ANOVA revealed a Group x Time interaction (p < 0.05). A Tukey post hoc comparison determined that the MS group demonstrated significant increases in rate of velocity development at 180 d/s as compared to the control group at the final testing period (8 weeks). There were no significant group differences at baseline or mid testing (4 weeks); however, there was a trend toward improvement in both single and multiple set groups from baseline (SS, 6.98 ± 1.37; MS, 6.73 ± 1.03) to 8 weeks (SS, 6.88 ± 1.41; MS, 6.36 ± 1.66). The control group showed increases in rate of velocity development from baseline (7.44 ± 1.31) to 8 weeks (8.20 ± 1.58). There were no significant differences at any time in any group at 600 d/s. CONCLUSIONS: It was concluded that both single and multiple sets of isokinetic knee extension were superior to the non-trained control condition in non specific velocity training for improving rate of velocity development, however, only multiple set training incurred a significant decrease from the control group. PRACTICAL APPLICATIONS: Rate of velocity development is essential in sport performance as the goal of athletes should always be to reach maximal velocity in the shortest amount of time. This study suggests that while both multiple and single set protocols decreased rate of velocity development, multiple set training may be more efficacious for eliciting greater changes in the given training period.

Comparison Of Acute Exercise Responses During Single Versus Competitive Bouts Of Isometric Resistance Exergaming

Anthony J. Bonetti, Dan Drury PhD, Jerome Danoff PhD, Todd Miller PhD

Purpose: Exergaming is a relatively new area of entertainment that couples physical activity and video gaming. To date, research that has focused on the physiological responses to Exergaming has been focused exclusively on aerobic-type activities. The purpose of this project was to describe the acute exercise responses (i.e. VO₂, Heart Rate, & RPE) during Exergaming using full body isometric muscle resistance, and to determine whether these responses are different during single versus opponent based play. Methods: Male subjects (n=32) were randomly and equally divided into either an Experimental (EXP) or Control (CON) group. Acute exercise responses (VO₂, Heart Rate, and RPE) were measured in all subjects during both solo and opponent-based video game play. Subjects in the EXP group used a game controller that relied on full body isometric muscle resistance to manipulate the on screen character, while CON subjects used a conventional hand held controller. Results: There were no differences in the exercise response within groups between single and competitive play. Results between groups during solo play are presented in the following table, and are expressed as means±SD:

<table>
<thead>
<tr>
<th></th>
<th>VO₂ (mL/kg/min)</th>
<th>Heart Rate (BPM)</th>
<th>Rate of Velocity Development (kcal/min)</th>
<th>RPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXP</td>
<td>9.60±0.50*</td>
<td>106±5.2</td>
<td>3.50±0.14*</td>
<td>10.06</td>
</tr>
<tr>
<td>CON</td>
<td>5.05±0.16*</td>
<td>89±4.3</td>
<td>1.92±0.07</td>
<td>7.56</td>
</tr>
</tbody>
</table>

*Represents significant difference between CON

Conclusion: These results suggest that whole body isometric exergaming results in greater energy expenditure than conventional video gaming, with no increase in perceived exertion during play. This could have important implications regarding long term energy expenditure in gamers. Practical Applications: The results of this study provide support for the use of low intensity isometric activity as a viable means of increasing energy expenditure during video gaming.

The Effect Of Music Listening On Running Performance And Rating Of Perceived Exertion Of College Students

Randy Bonnette, Morgan C. Smith III, Frank Spaniol, Don Melrose, Liette Ocker

PURPOSE: To investigate the effect of music on running performance and rating of perceived exertion of college students. METHODS: Twenty-eight undergraduate kinesiology students (17 males, 11 females; age = 22.9 +/- 5.9 yrs) were studied to determine if running performance and rating of perceived exertion were affected by listening to music. Running performance (RP) was measured by a 1.5 mile run. Two trials were performed, the first was a running performance without music listening (RPWML = 12.94 +/- 3.35 min) and the second trial was a running performance while music listening (RPML = 12.50 +/- 2.48 min). The second trial was measured five days post the initial trial. Listening to music (music listening) was defined as the subject's self selection of music tracks and use of a personal digital audio player (e.g., Ipod and MP3) during exercise. Perceived exertion without music listening (PEWML = 14.7 +/- 1.3) and perceived exertion with music listening (PEWML = 15.2 +/- 2.4) was measured by the Borg 6 to 20 RPE scale. RESULTS: Data analysis was performed on the raw data by utilizing dependent t-tests to calculate and compare sample means. Statistical analyses determined a significant difference (p < 0.05) between running performance without music listening (RPWML = 12.94 +/- 3.35 min) and the second trial was a running performance while music listening (RPML = 12.50 +/- 2.48 min). The second trial was measured five days post the initial trial. Listening to music (music listening) was defined as the subject's self selection of music tracks and use of a personal digital audio player (e.g., Ipod and MP3) during exercise. Perceived exertion without music listening (PEWML = 14.7 +/- 1.3) and perceived exertion with music listening (PEWML = 15.2 +/- 2.4) was measured by the Borg 6 to 20 RPE scale. CONCLUSIONS: The results of this study indicate that music listening has a significant effect on running performance during a maximal 1.5 mile run. However, music listening had no significant effect on rating of perceived exertion during a maximal 1.5 mile run. PRACTICAL APPLICATION: Coaches, athletes, and traditional exercisers should consider music listening to enhance aerobic running performance.

Segmental Limb Length And Vertical Jump Height

Tony Black, Bryan Messick, Daniel Cipriani

PURPOSE: To examine the role that lower extremity segmental lengths play on vertical jump displacement. Previous research examining the relationship between segmental limb length and vertical jump ability revealed poor correlations. However, prior research did not use a reliable method to measure jump height (Davis et al., 2006). METHODS: Thirty-one subjects participated (males = 21, females = 9) with a mean ± 21.3 ± 3.5 years. All subjects were physically active and engaged in general exercise. Measurements included height, weight, thigh length, shank (tib) length, trounced foot length, total foot length, and maximum vertical jump height. Segmental limb lengths were measured according to methods previously described. All measures were repeated three times for reliability analysis. The Just Jump mat (Prodott Inc.) was used to measure vertical jump height. This jump measure yields reliable and valid data. The Just Jump estimates vertical jump height, based on the gravitational affect of a projectile using the following: y = 20 fi g / 2fi , where y = vertical displacement, g = acceleration from gravity (9.81 m/s2), and t = time of fall from peak height. Subjects were instructed to jump as high as possible three times on the Just Jump mat. Each of the scores were recorded and the highest vertical jump value was used in the analysis. Statistical analysis included reliability analysis using the intraclass correlation coefficient (ICC) as well as Pearson’s correlation to test the relationship between maximum vertical jump height and the different segmental limb lengths. In addition, segmental length ratios (e.g., thighbja, thigh-foot, height-foot, etc.) were also tested for relationships with vertical jump height. RESULTS: Reliability of the segmental data and the vertical jump data were very good with all ICC values exceeding 0.71. The ICC for vertical jump measures was 0.96. Statistical analysis demonstrated that maximum jump height and segmental lengths were gender dependent. Therefore, analysis was separated by gender. For males, maximum jump height was significantly greater (p < 0.05) correlated with tibial length (r = 0.33) as well as the ratio of femur tibia length (r = 0.39) and height/tibial length (r = 0.42). For females, trounced foot length was correlated with jump height (r = 0.44), as well as the ratios of femur subtalar foot length (r = 0.43); tibial foot length (r = 0.44) and height and tibial foot length (r = 0.48). DISCUSSION: While long limb segments potentially produce greater torque, this is offset by an increase in angular inertia. Long segments may create a challenge to generate angular velocity for vertical jumping. The fact that trounced foot length (females) and tibial length (males) were negatively correlated with jump height suggest that limb length may influence vertical jump ability. These findings contradicts earlier research. However, this present study used a reliable method of vertical jump height, while the previous research used a questionable method to measure this key outcome. PRACTICAL APPLICATION: Athletes with long feet (relative to height) and/or long tibia length (relative to height) may be at a mechanical disadvantage for vertical jump ability. Screening such athletes in order to consider additional jump training may allow these athletes to maximize their jumping potential.
Physiological Differences in Mixed Martial Artist and Traditional Martial Artists: A Pilot Study


PURPOSE: To determine the difference, if any, in the physiological characteristics of mixed martial artists and traditional martial artists. METHODS: Twelve male participants age 18 to 36 yr volunteered for the study. Group 1 (n = 6) was comprised of professional and amateur mixed martial artists from northern Louisiana. Group 2 (n = 6) was traditional martial artists recruited from a local karate tournament. Each group performed the same tests. Tests included height, weight, body composition (TanitaTM bioelectrical impedance device), flexibility (sit and reach), leg power (vertical jump), muscular endurance (1-minute push-up and 1-minute sit-up), grip strength (20.5 kg plates held), muscular strength (1 rep max bench press), and VO2 max. RESULTS: Body composition was the only significant difference (p < 0.05) between the 2 groups. CONCLUSION: The mixed martial artists were significantly leaner than the traditional martial artists. This was not surprising because class separation for traditional martial artists goes by age rank, while mixed martial arts competition is broken down into weight classes. In order to compete in a lower weight class, mixed martial artists reduce their body mass to make a specific weight class. In doing this, percent body fat is typically reduced. PRACTICAL APPLICATION: There were 2 major limitations to this study. One was the timing of testing. The traditional martial artists were tested 1-2 hr after competing in a karate tournament, while the mixed martial artists were tested weeks before their next fight. The other limitation was the number of participants. Though only one significant difference was found between the groups, it can be suggested that a high level of physical fitness is essential for performance in mixed martial arts and traditional martial arts competitions. Mixed martial artists usually train at high intensities with various forms of interval training to improve their aerobic capacity. This helps condition them for their fights. Although VO2max was not found to be significantly different between the 2 groups, there was a trend for the mixed martial artists having higher aerobic capacities. Had there been more participants and lower standard deviations for VO2max, this variable may have been significantly different. Future studies should attempt to test the groups during the same time frame, have more participants, measure psychological characteristics, and consider using a DXA scan to measure bone mineral density. Acknowledgments: We would like to thank Dr. David Jordan for letting us use his tournament to recruit participants.

Exercise As A Factor In The Job Satisfaction Of Law Enforcement Officers

Eric Bruce, MS

It is generally known that exercising is a factor in the improvement of an individual's well-being. Physical activity has been shown to have a positive impact on an individual's job satisfaction. But there is no literature that has investigated the impact of physical activity and job satisfaction on law enforcement officers. PURPOSE: To determine if exercising is a factor in the job satisfaction of law enforcement officers. METHODS: A questionnaire was constructed using extant theory of job satisfaction and exercise. The demographics questions will ask the officers to evaluate themselves on a nominal scale of yes/no on whether they exercise or not. The researcher developed the demographics and exercise sections of the survey. The job satisfaction section of the survey (which contains seven statements about job satisfaction) was developed and adapted from an online job satisfaction survey found on www.careervision.com. The researcher distributed an anonymous survey entitled, "Law Enforcement Officers Exercise and Job Satisfaction Survey" to law enforcement officers who volunteer to be part of the study. Distribution of the survey took place at the end of each briefing before the officer goes on patrol, within a twenty-four hour period. During that period, there will be five patrol shifts of officers (various day and swing shifts), one shift called, "Community Response Team" which deals under undercover drug crimes (vice squad), and a shift of "Criminal Investigations Unit", (better known as detectives unit) that will be voluntarily asked to take part in the study. The twenty-four hour window to distribute the survey is to ensure that an officer will not fill out a survey twice. RESULTS: Fifty-six surveys were successfully completed for results and analysis. Forty-six (82.1%) subjects answered, "yes" to being current exercisers and ten (17.9%) subjects answered "no" to being current exercisers. A high frequency of positive responses from the subjects to job satisfaction statements was noted. CONCLUSIONS: Three key findings were in regards to the answers supplied by law enforcement officers in this study. First, the rate of physical activity adherence by law enforcement officers compared to the general population of the United States. Second, that a majority of law enforcement officers are satisfied with their jobs. Finally, survey items that measured job satisfaction indirectly did not directly correlate with the officer's exercise and job satisfaction responses. PRACTICAL APPLICATIONS: These findings suggest that law enforcement agencies should promote officer participation in regularly scheduled physical activity to increase job satisfaction. For an officer, physical activity can improve quality of life and reduce the risk of injury during stressful situations on duty. From an administrators view, increased physical activity and increased job satisfaction are linked to decreased use of benefit dollars for sick leave and overtime pay.
Effects Of Four Weeks Of Arginine Supplementation On The Physical Working Capacity At The Fatigue Threshold
Clayton Camic, T.J. Housh, J.M. Zuniga, C.R. Hendrix, M. Mielke, G.O. Johnson, R.J. Schmidt, and D.J. Housh

The purpose of the present study was to examine the effects of daily administration of two different arginine-based supplements for four weeks on the physical working capacity at the fatigue threshold (PWCFT). The PWCFT test estimates the highest power output that can be maintained without neuromuscular evidence of fatigue. The study used a double-blind, placebo-controlled design. Fifty college-aged males (mean age = SD = 23.9 ± 3.0) were randomized into one of three groups: 1) placebo (n = 19); 2) 1.5 gm arginine (n = 14); 3) 3.0 gm arginine (n = 17). The placebo was microcrystalline cellulose. The 1.5 gm arginine group ingested 1.5 gm of arginine and 300 mg of grape seed extract, whereas the 3.0 gm arginine group ingested 3.0 gm of arginine and 300 mg of grape seed extract. All subjects performed an incremental test to exhaustion on a cycle ergometer prior to supplementation (PRE) and after 4 weeks of supplementation (POST). Surface electromyographic (EMG) signals were recorded from the vastus lateralis using a bipolar electrode arrangement during the incremental tests for the determination of the PRE and POST supplementation PWCFT values. There were significant mean increases (PRE to POST) in PWCFT for the 1.5 gm (22.4%) and 3.0 gm (18.8%) supplement groups, but no change for the placebo group (-1.6%). These findings supported the use of the arginine-based supplements for improving neuromuscular performance and delaying the onset of fatigue during cycle ergometry.

Comparison Of Muscular Strength Gains Utilizing Eccentric, Standard And Concentric Resistance Training Protocols
Kyle Carothers, Kyle F. Carothers, Brent A. Alvar, Daniel J. Dodd, Jeremy C. Johanson, Brian J. Kincade, and Stephen B. Kelly

PURPOSE: The purpose of this study was to examine the strengths benefits of an eccentric-only protocol versus a standard and concentric-only protocol in a multi-joint lift (bench press). Additionally, a secondary purpose was to examine the same protocol's ability to elicit power benefits (weighted medicine ball put). METHODS: Forty-two men (mean±SD; age 24.8±5.1 yr; height 71.0±3.0 in; weight 189.2±31.1 lbs) with recreational training experience (≥6 months at twice per week) performed two sessions a week for 6 weeks utilizing the bench press exercise. Subjects were tested for concentric, standard and eccentric 1-RM pre and post study. Subjects were randomized into one of three groups, eccentric-only (ECC), standard-only (ECCON) or concentric-only (ECN). Subjects performed 4 sets of 4 repetitions with 80% of their 1-RM in the repetition type characterized by their group. Subjects moved up 5% when 4 sets of 8 repetitions were completed successfully. Rest time between sets was fixed at 3-5 minutes. Subjects were also tested for power using a 3-kg seated medicine ball put for distance pre and post study and for body composition using air density plethysmography (Life Measurement Inc., Bod Pod, Concord, CA). All statistics were analyzed using SPSS for Windows 15.0 (Chicago, IL). Paired sample t-tests were used to test differences pre to post study. One-Way analyses of variance (ANOVA) was used to analyze percentage differences between groups. Tukey HSD test was used as a post hoc when necessary. The level of significance for statistical analysis was set at p<0.05. RESULTS: All three groups significantly increased their strength from pre to post study (p<0.05). No significant between group differences were seen in standard or concentric 1-RM. Group ECC showed a significantly greater increase in strength overall (ECCON in eccentric 1-RM 22% vs 9%). No significant increases were seen pre to post study or between groups for power. CONCLUSIONS: The significant finding of this study was a between group difference between group (ECC) and (ECCON) in the eccentric 1-RM. This finding suggests that eccentric-only protocols preferentially increase strength development over standard protocols. Standard protocols are commonly utilized in athletic resistance training protocols. This finding becomes even more significant when considering the magnitude of the gain (22% in only 6 weeks) with a recreationally-trained group of participants. Increases of this magnitude are usually attributed to neural changes in untrained subjects. PRACTICAL APPLICATIONS: These results suggest that eccentric muscle actions are underutilized in standard resistance training protocols. This evidence could indicate that athletes possessing low levels of eccentric strength may have a diminished capability to perform the stretch-shortening cycle (SSC). The SSC is a sequence of movements utilizing an eccentric muscle action immediately followed by a concentric muscle action in order to produce a more powerful concentric muscle action. The SSC is commonly used in athletic activities like running, jumping and throwing. Future research should examine the ability of eccentric-only resistance training protocols to elicit performance benefits in athletic populations especially as it relates to increasing the capacity of the SSC.

Responses Of Serum IGF-1 After An Acute Bout Of Lower-Body Resistance Exercise
Bill I. Campbell, Paul La Bounty, Austin Oetken, Mike Greenwood, Richard Kreider, Darryn Willoughby

The acute response of IGF-1 to resistance exercise remains unclear. Most studies have shown no change in IGF-1 during or immediately following an acute bout of resistance exercise, whereas a few studies have shown acute elevations during and following resistance exercise. PURPOSE: To determine the serum free IGF-1 response to an acute bout of intense, lower body resistance exercise. METHODS: Ten healthy and physically active males (21±2 yrs, 83±11.2 kg, 176±8.7 cm) engaged in an acute bout of lower body RE which consisted of four sets of four leg press and leg extension at 80% 1RM to failure. Rest periods between sets and exercises were approximately 150 seconds. Immediately prior to the resistance exercise bout, but following an 8-12 hour fast, participants underwent an isokinetic baseline blood draw. Blood was also obtained immediately, 30 minutes, two and six hours after the resistance exercise bout. Serum free- IGF-1 was analyzed via ELISA (Active® Bioactive ELISA by Diagnostic Systems Laboratories Inc. (DSL-10-9400; Webster, TX)). A one-way ANOVA with repeated measures was utilized to analyze the data. Following the ANOVA, the a priori of paired samples t-tests (one for each time point compared to baseline value) was conducted. RESULTS: Data are presented as means ± standard deviation utilizing ng/mL as the units of measure- ment. Baseline free IGF-1 was 1.2 ± 0.43 ng/mL. Following exercise, free IGF-1 concentrations were 1.6 ± 0.54, 1.5 ± 0.57, 1.4 ± 0.46, and 1.1 ± 0.53 ng/mL immediately post, 30 minutes, 2 hrs, and 6 hours post exercise, respectively. The ANOVA analysis indicated a significant difference across time for IGF-1 (p < 0.01). Subsequent paired-samples t-tests revealed a significant difference between the baseline and immediate post-exercise resistance IGF-1 levels (p = 0.01). Statistical trends were observed between baseline and 30 minutes post-exercise (p = 0.053) and baseline and 2 hours post-exercise (p = 0.052). CONCLUSIONS: An acute bout of lower body resistance exercise in which each set is performed to failure significantly increases serum IGF-1 levels. The findings from the present study support those from other studies but are in contrast to others. Possible differences accounting for the discrepancies of the acute IGF-1 response to resistance exercise include training on failure on each set, rest periods between sets, exercise selection, or other variables. More investigations involving the response of IGF-1 to intense resistance exercise are needed to further elucidate the responses of this anabolic hormone. PRACTICAL APPLICATIONS: Resistance training improves muscular strength, muscular endurance, and increases lean body mass. Serum IGF-1, which increases in response to intense resistance exercise, may (at least in part) responsible for some of these functional and physi- cal adaptations in skeletal muscle.
The vertical jump is a common movement performed in several sports. Considering the importance of this movement, an optimal warm-up protocol may help athletes perform at their maximum level. PURPOSE: The purpose of this study was to investigate the potentiating effects of different levels of external resistance (weight vest) during box jumps on vertical jump performance. METHODS: Twenty resistance trained males (22.45 yrs ± 1.73, 176.83 cm ± 6.67, 76.98 kg ± 8.56) participated in this study. Each subject's height, mass, and lateral femoral condyle height were measured on day one. Warm-up was performed by cycling for 5 minutes at a self selected pace. After the warm-up, subjects performed 5 jumps onto a box equivalent in height to their lateral femoral condyle. Following a 2 minute rest period, subjects performed 3 vertical jumps with the greatest height being recorded. On day one each subject performed a control condition with no external resistance to establish a baseline vertical jump height. On the following day they performed four random jump conditions with a weight vest equivalent to 5, 10, 15, or 20% of their bodyweight then rested for two minutes before performing 3 post-vertical jumps. RESULTS: There was no significant interaction of condition by time for vertical jump height. However, there was a significant main effect for time (P < 0.05) with post-test scores (22.99 ± 3.35 inches) being greater than pre-test scores (22.69 ± 3.37 inches). CONCLUSIONS: Regardless of condition, post-test vertical jump performance was significantly greater than pre-test performance. Performing an active dynamic warm-up with or without a weight vest produced significantly greater post vertical jump performance. PRACTICAL APPLICATIONS: Findings from this study demonstrated that performing an active dynamic warm-up, with or without external resistance, can elicit a significant gain in vertical jump performance. This may allow athletes to perform at their maximum level in a performance environment. Future research should investigate the effects of different box heights, external loads, and volume on post vertical jump performance.

Assessing Weightlifting Bar Mechanical Characteristics
Loren Chiu, PhD, CSCS

Weightlifting bars are among the most versatile implements in strength and conditioning, allowing numerous exercises, such as squats, cleans and snatches to be performed. Although generally considered a rigid object, empirical evidence and recent research indicates that the weightlifting bar deforms when loaded and/or is lifted with sufficient velocity. PURPOSE: The purpose of this investigation was to assess the mechanical characteristics of eight weightlifting and one general purpose weight training bar. METHODS: Bar deformation was tested using a modified four-point bending method. Portable squat stands were placed 66.2cm apart and bars centered across the stands to simulate the pulling phase of the clean. Bars were loaded and unloaded in two cycles by adding 25kg rubber bumper plates. Plates were added in pairs (i.e. left and right ends), allowed to settle for 1 minute, and an image was taken using a digital camera. Deformation of bars was determined as the difference in height between the center of the bar and a horizontal line through the left and right ends of the bar. Bar bending moment about the center of the bar was estimated using static calculations. Apparent barbell stiffness was calculated as the slope of bar deformation (x-axis) versus bending moment (y-axis) plots. RESULTS: All bars displayed linear hysteresis plots, characteristic of elastic (such as steel) rather than viscoelastic materials. Three of the bars, the make of which have been used in elite international competition (i.e. world championships and Olympics) were seen as criteria for appropriate stiffness. These bars had an apparent stiffness of 2998Nm/cm-1, 3479Nm/cm-1 and 3510Nm/cm-1. The latter two bars were identical model bars from one manufacturer. Four other bars tested had an apparent stiffness between the low and high end of the criterion (313Nm/cm-1, 321Nm/cm-1, 335Nm/cm-1 & 338Nm/cm-1). Two bars had an apparent stiffness greater than the high end of the criterion (3598Nm/cm-1 & 3848Nm/cm-1). The latter bar also had a larger diameter than the other bars (20mm vs 28mm). DISCUSSION: Anecdotally, the bar with the lowest apparent stiffness is reported by weightlifters to have the greatest spring. Alternately, the bars used for the high end of the criterion are reported to have a high stiffness, thus the current data support these subjective reports. As these bars have been used in elite international competition, they can be used as a criterion for bar mechanical characteristics. Bars with an apparent stiffness between these bars would be appropriate for use when performing weightlifting exercises, such as an athletic performance training program. Bars with greater apparent stiffness may not be appropriate for weightlifting exercises, but may be used when less bar deformation is desired. PRACTICAL APPLICATIONS: As the mechanical properties of bars differ between manufacturers, not all bars are appropriate for weightlifting exercises. Appropriate equipment should be used for exercises such as cleans, snatches, and jerks; to allow proper execution and technique, and possible minimize the risk of injury. ACKNOWLEDGEMENT: This research was funded by an investigator-initiated grant from Iron Grip Barbell Company (Santa Ana, CA).

The Long-Term Effects Of Resisted Sprint Training Using Weighted Sleds Versus Weighted Vests
Kenneth Clark, Cory Walts, Anthony Miller, David Steane

Linear sprinting is composed of acceleration and maximum velocity (MV) phases, and improving performance in each phase may require specific training methods. Although resisted sprint training using weighted sleds (WS) or weighted vests (WV) has recently become common practice, empirical evidence supporting their effectiveness for improving MV sprint performance is lacking. Furthermore, it has been suggested that these modalities may have different short-term effects on sprint kinematics, with WS potentially increasing stride length and WV decreasing ground-contact time and thus increasing stride rate. PURPOSE: To determine the long-term effects of WS and WV training on MV sprint performance and kinematic parameters. METHODS: 20 male NCAA Division II lacrosse players (age: 19.82 ± 0.95 years, mass: 83.13 ± 11.68kg) voluntarily participated as part of their off-season training program. Subjects were randomly divided into a WS group (n = 7), a WV group (n = 6), and an unresisted (UR) active control group (n = 7). All subjects completed 18 60-minute training sessions over a 7-week period. WS subjects towed loads of 10% body mass, and WV subjects were loaded with 18.5% body mass. Pilot testing indicated these loads elicited acute decreases in MV approaching 10% and thus were appropriate for long-term training based on recommendations from the literature. Pre- and post-test measures of sprint time and average velocity across the distance interval of 18.5-54.9m were used to assess MV sprint performance, while high-speed video (300 Hz) and motion-analysis software were used to analyze kinematic measures of stride length (SL), stride rate (SR), average step-ground time (GT), and average step-flight time (FT). RESULTS: A 3 (training group) x 2 (time) repeated measures ANOVA revealed no significant between-group differences for either 18.3-54.9m sprint times or average velocities. Effect size statistics (ES) suggested small improvements in average velocity for the UR group (ES = 0.13) but only trivial improvements for the WS (ES = 0.02) and WV groups (ES = 0.26). A 2 x 2 repeated measures ANOVA also revealed no significant between-group differences for any of the kinematic stride cycle variables. Effect size statistics suggested small increases in SR (ES = 0.42) and decreases in GT (ES = 0.38) for the UR group, small decreases in SL (ES = 0.42) for the WS group, as well as small decreases in SL (ES = 0.37), moderate increases in SR (ES = 0.78), and large decreases in FT (ES = 1.19) for the WV group. CONCLUSIONS: The results indicate that WS and WV training had no beneficial effect compared with UR training. In fact, for the loads employed by WS and WV in this study, UR training may actually be superior for improving MV sprint performance in the 18.5-54.9m interval. Also of note, the WS group did not demonstrate significant increases in SL and the WV group did not demonstrate significant decreases in GT as expected. PRACTICAL APPLICATIONS: For the loading schemes employed in this study, the results suggest that WV sprint performance might be most effectively enhanced by UR training protocols. Future research should be directed at manipulating the resistance load for the WS and WV groups to explore the effects of lighter loads that more closely match the kinematics of UR sprinting or heavier loads that increase the resistive training stimulus. ACKNOWLEDGEMENT: This investigation was supported by an NSCA Student Research Grant.
When using a typical leg press machine there is no way of knowing the actual weight that is lifted. The only information available to the lifter is the added plate mass and perhaps sled weight if the manufacturer’s specifications are available. Unfortunately, knowledge of sled weight is not very helpful because a portion of that weight is supported by the frame. The purpose of this study is to determine accurate resistance loads beginning first with only the sled and then progressively adding 4.54 kg up to a maximum load of 45.45 kg. A load cell was attached to the frame of an LE408 BM Leg Press Machine and oriented so that it was in the same slide plane as the sled. It was calibrated by the manufacturer to the control unit that accompanied it and, according to specifications, is accurate to ±0.2 kg and has a maximum capacity of 453.5 kg. The sled was pushed from its supports and hooked to the lower portion of a chain serially attached to the load cell and upper frame. The data acquisition system was zeroed out to eliminate the weight of the load cell and the lower chain. The sled was slowly lowered until the weight of the sled and any added weight was fully supported by the load cell. Once motorless, the measurement system was subsequently activated at a sampling rate of 40 measurements/sec. Peak measurements were captured by the control unit. Pearson Product Moment correlation was used to determine the relationship between plate mass and the associated peak force measures captured from the system beginning with 4.54 kg up to 45.45 kg (r=1, P=0.000). Results indicated that when 0 plates were on the machine, the lifter must overcome 49.6 kg of resistance to move the sled. As plate mass increased, resistance also increased. The ratio of plate mass to load lifted began at 0.086 with two 2.27 kg plates on the apparatus and gradually increased to 1.00 with 140.9 kg of plate mass and a measured resistance of 140.7 kg. Up to this point, the measured resistance exceeded total plate mass due to the additive sled component; however, beyond 140.9 kg of plate mass ratios began to exceed 1 presumably due to progressively more weight being transferred to the frame. At 454.55 kg (1000 lbs) on the machine, the actual resistance that would be overcome by a lifter would be 34.21 kg (75.26 lbs) at a ratio of 1.329. The linear regression formula generated was: Mass lifted = (0.64 * total plate mass in kg) + 0.5026. Obtaining accurate knowledge of lifting loads will have testing benefits and will likely produce better estimates of free weight squatting ability.

### Influence Of Training Status On Power Absorption & Production During Lower Body Stretch-Shorten Cycle Movements

**Prue Cormie, Michael R. McGuigan, Robert U. Newton**

It has been well established that the utilization of a stretch-shorten cycle (SSC) results in more powerful movements. Extensive investigation has focused on how concentric phase performance (i.e. maximal power) respond to training interventions. However, there is little research that explores the impact of training on eccentric phase variables of SSC movements. PURPOSE: To examine if training status affects power absorption (i.e. negative work, energy flow into the muscles) and production (i.e. positive work, energy flow to the rigid segments); and 2) identify if factors commonly associated with a SSC (i.e. time between eccentric and concentric phases, rate and magnitude of stretch) affect power absorption and production. METHODS: Thirty-two men with previous resistance training experience were randomized into one of four groups based on their squat one repetition maximum to body weight ratio (1RM:BM): stronger power training group (SP, n=8, 1RM:BM=1.97), weaker power training group (WP, n=8, 1RM:BM=1.32), or control group (C, n=8, 1RM:BM=1.37). The 3rd and 8th groups completed 10 weeks of ballistic training while the control group maintained their normal level of activity. Training involved 2 sessions/week consisting of 7 sets of 8 maximal effort squats at 90% 1RM (i.e. body mass only) and 1 session/week consisting of 5 sets of 5 jump squats at 90% 1RM. One week prior to initiating training all subjects underwent a familiarization and testing session involving a squat 1RM and a series of countermovement jumps (CMJ). Testing was conducted again after week 5 (mid-test) and week 10 (post-test). To examine the time course of adaptations, experimental subjects were assessed with a CMJ test prior to the first training session in weeks 2, 3, 4, 7, 8 and 9. Data was collected using a linear position transducer and a force plate sampling at 1000Hz and analyzed using previously validated protocols. RESULTS: It had significantly (p<0.05) greater power output in the CMJ than the weaker group at baseline, mid- and post-testing sessions (Table 1). The change in peak power output relative to body mass (PP) from baseline for S was significant (p<0.05) in weeks 3, 4, mid-test, 7, 8 and post-test (Table 1). For W, the change in PP from baseline became significant (p<0.05) in weeks 7 and 9 and post-test (Table 1). S displayed a non-significant but practically relevant decrease in 1RM (in BM) effect size = 0.91) after the 10 week power training program. No differences in any parameters were observed for C following the 10 week period. CONCLUSIONS: These findings suggest it takes less time for stronger individuals to show performance improvements in response to power training than weaker individuals. However, following approximately 4 weeks there were no additional increases in the magnitude of performance improvements for the stronger individuals. In contrast, the plateau in jump performance improvement occurred only at the end of the 10 week program for weaker individuals. It remains unclear whether the addition of strength maintenance sessions within this program would have resulted in further increases in PP beyond week 4 for the stronger individuals. PRACTICAL APPLICATIONS: Weaker individuals would benefit from power training more rapidly following an initial increase in strength. For the well trained athlete, power training cycles should last approximately 3-4 weeks in the absence of any strength maintenance sessions.

<table>
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<tr>
<th>Change in PP From Baseline (S/kg)</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 7</th>
<th>Week 8</th>
<th>Week 9</th>
<th>Post-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stronger (SP)</td>
<td>0.26</td>
<td>0.28</td>
<td>0.29</td>
<td>0.30</td>
<td>0.30</td>
<td>0.31</td>
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<tr>
<td>Weaker (WP)</td>
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<td>0.07</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
<td>0.10</td>
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### Acute Effects Of Passive Stretching On The Electromechanical Delay and Evoked Twitch Properties

**Pablo Brando Costa, Katie M. Hoge, Eric D. Ryan, Trent J. Herda, Ashley A. Walter, Travis W. Beck, and Joel T. Cramer**

Studies have shown passive stretching may transiently decrease force and after twitch-related properties. Related, the effects of passive stretching on the electromechanical delay (EMD) are still unknown. PURPOSE: To examine the acute effects of passive stretching on the EMD, peak twitch force (PFT), rate of force development (RFD), and peak-to-peak M-wave (PPM) for the soleus muscle during evoked isometric plantar flexion muscle actions. METHODS: Fourteen men (mean ± SD = 21 ± 2.4 y), body mass = 80.0 ± 14.9 kg; height = 176.9 ± 7.2 cm) volunteered for the study. Five transcutaneous electrical stimuli (each separated by 5 seconds) were delivered to the tibial nerve before and after passive stretching. The stretching protocol consisted of nine repetitions of passive assisted stretching designed to stretch the calf muscles. Each repetition was held for 135 seconds with 5-10 seconds of rest between each passive stretching repetition. An average of three pre- and post-stretching twitches were used to analyze each variable. Dependent-samples t-tests (pre- vs. post-stretching) were used to analyze the EMD, PFT, RFD, and PPM data. RESULTS: There were no significant changes (p > 0.05) from pre- to post-stretching for any of the variables, including EMD (pre- and post-stretching mean ± SE = 29.9 ± 1.1 and 28.8 ± 1.4 ms), PFT (4.5 ± 1.1 and 4.7 ± 1.1), RFD (253.1 ± 157 and 211.6 ± 19), and PPM (3.7 ± 0.5 and 3.4 ± 0.5). CONCLUSIONS: Our findings indicated no significant stretching-related changes in EMD, PFT, RFD, or PPM. These findings suggested that passive stretching of the calf muscles did not affect the mechanical aspects of force production from the onset of the electrically-evoked twitch to the peak twitch force. PRACTICAL APPLICATIONS: These results may help to explain the mechanisms underlying the stretching-induced force deficit that has been reported as either ‘mechanical’ or ‘electrical’ in origin. These findings suggested that if there is a stretching related decrease in muscle force production, it may be more related to decreases in neural drive (i.e., electrical) than alterations in the mechanical components of muscle contraction. These findings may also be useful for strength and conditioning professionals who are concerned with the potential for performance decreases associated with acute passive stretching.
Males who are greater than the mean vs. males who are less than the mean exhibit differences in vertical jump performance in relation to relative force production. Practical Application: Females may benefit from force production while women who are greater than the mean vs. women who are less than the mean appear to exhibit no differences in vertical jump performance than males with less relative GRF. Peak torque levels and ratios of quadriceps to hamstrings were not significantly altered throughout the study for either group. CONCLUSIONS: A relatively short duration eccentric pre-season programme can significantly increase the optimum length of both the knee extensors and flexors, which may have positive benefits in reducing the risk of injury. PRACTICAL APPLICATIONS: Given the strength and conditioning coach’s role in prevention of injury and improvement of performance, it would seem good practice to at the very least include eccentric exercise in the athlete conditioning programme.

Difference in Vertical Jump Performance by Force Production
Nicole Dabbs, Nicole C. Dabbs, Andy V. Khambou, Diamond Nguyen, Brandon P. Uribe, Tai Tran, Edward Jo, Lee E. Brown, Jared W. Coburn, Daniel A. Judelson, Guillermo J. Noffal

Leg Asymmetries During Running In Australian Rules Football Players
With Previous Hamstring Injuries
John Cronin

Asymmetries between lower body limbs during athletic movements are thought to increase the risk of injury and compromise performance. Very little is known about the magnitude of leg asymmetries during human running, especially after an acute hamstring injury. Purpose: The purpose of this study was to quantify the magnitude of leg asymmetries in a number of mechanical variables during running in non-injured and previously injured Australian rules football (ARF) players. METHODS: A group of non-injured ARF players (n = 11) and a group of previously injured ARF players (n = 11) hamstring injuries in previous two years were compared. The legs of the non-injured players were classified as dominant and non-dominant whereas the legs of the injured players were classified as injured or non-injured. The players ran on a non-motorized force treadmill at approximately 80% of their maximum velocity. Kinetic and kinematic data was collected from 12 consecutive steps. RESULTS: For the non-injured players, there were no significant differences between dominant and non-dominant legs for any of the variables - horizontal and vertical force production, vertical stiffness, leg stiffness, contact times, impulse, resonance frequency, peak work and vertical centre of mass displacement. For the injured players, the only variable that was significantly (p<0.001) different between the injured and non-injured leg was horizontal force production (175 ± 30 vs. 326 ± 44 N). Furthermore, the injured leg (injured group) produced significantly less horizontal force than either legs (dominant and non-dominant legs) of the non-injured group (p>0.05), and the non-injured leg produced significantly more horizontal force than either legs of the non-injured group (p>0.05). CONCLUSIONS: In the present study, hamstring injuries have an influence on leg asymmetries in horizontal but not vertical force production during running at sub-maximal velocities. Furthermore, there may be an increase in horizontal force capability in the non-injured leg as a possible compensatory adaptation to the hamstring injury. PRACTICAL APPLICATIONS: Given the high incidence of hamstring injuries and the strength and conditioning coach’s role in rehabilitation of injury and improvement of performance, it would seem good practice to monitor and improve horizontal force capability in the hamstring injured athlete.
Abstracts

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Effect Of Weighted Jump Warm-Up On Vertical Jump In Division II Female Volleyball Players

Nicole Denek, Patricia G. Severe-Jones, Adam M. Berning, M. Curtis, Kent J. Adams

Dynamic warm-up strategies are designed to positively impact performance. Research suggests that warm-ups which elicit a post activation potentiation (PAP) effect via high intensity muscular contractions may increase performance in subsequent activities requiring strength and power.

PURPOSE: The purpose of this investigation was to determine if a functional, dynamic, volleyball specific warm-up that included weighted jumps would elicit a PAP effect and increase subsequent vertical jump height. Ten trained Division II volleyball players (age = 19.8 ± 5.6 yrs; mass = 71.7 ± 9.7 kg; ht = 167.6 ± 23.0 cm). Subjects were at week 6 of their off-season conditioning program. Besides volleyball specific strength and conditioning, the NCAA guidelines, each player accumulates 2 hr/or of individual volleyball practice during this time period. METHODS: Two different warm-up conditions lasting 5-7 minutes were individually employed at two different training sessions within one week. The first warm-up condition consisted of a functional, dynamic warm-up of high jumping, high knees, casual shuffling, while pops (sitting at 3 sets at 20 reps ea), sprints (2 x 15 sec), and tuck jumps (2 x 15 sec). The second warm-up condition was identical to the first, except for the addition of 1 x 10 maximal vertical jumps with countermovement jump performance (jump height) were determined at each load. RESULTS: Squat 1RM strength increased significantly in the T group (103.65±26.94 kg to 115.36±25.43 kg, p<0.001) as compared to no change in the C group (121.43±30.70 kg to 125.71±22.62 kg). No statistically significant changes were observed in power during the CMJ (4736.61±730.70 W to 4562.97±131.94 W) after training. Changes in muscle size and activity were insignificant. CONCLUSIONS: This study is the first study to examine the effectiveness of elastic resistance bands in a microgravity training environment. This model was effective in reducing strength gains. Upping resistance bands may be a variable countermeasure to combat the negative neuromuscular effects experienced from prolonged exposure to microgravity. PRACTICAL APPLICATIONS: With the ineffectiveness of free weights in microgravity, it is necessary to find an alternative means of resistance training. Elastic resistance band training provides a cost-effective and effective means of increasing strength and mass in microgravity. This is the first study to utilize elastic resistance bands in a simulated microgravity environment, more research is warranted to determine the optimal training variables such as sets, reps, and rest periods needed to produce the greatest hypertrophy and strength gains. Additionally, future investigations should include the microgravity-simulated exercise protocol during a concurrent period of bed rest.

Acknowledgement: This investigation was funded by a North Carolina Space Grant - New Investigators Program Grant.

Power Output In The Jump Squat In Adolescent Male Athletes

Andrea Dayne, Andrea M. Dayne, James L. Nuzzo, Jeffrey M. McBride, Alan Bur, N. Travis Triplett

Previous investigators have examined power output in the jump squat in college-age subjects and it has been determined that at which jump squat peak power is maximal in this population is body mass. No data exists in the adolescent population. Additionally, few studies have examined the possible relationship between one repetition maximum (1RM) strength and the load which maximizes peak power.

PURPOSE: To (1) determine the load at which maximal power output is achieved in the jump squat (JS) in adolescent male athletes and (2) to determine if that load is related to strength-to-body mass ratios. METHODS: Eleven high school male athletes (age = 15.6±0.32 years; height = 177.36±4.90 cm; mass = 80.55±16.93 kg; squat 1RM = 141.4±28.06 kg, squat 1RM-to-body mass ratio = 1.76±0.15) were tested. JS testing at loads equal to 0% (body mass), 20%, 40%, 60%, and 80% of individual's squat 1RM. The combination of two linear position transducers and a force platform were utilized to determine peak power (PP), peak force (PF), peak velocity (PV), and peak displacement (PD) at each load. RESULTS: JS at 0% of 1RM produced significantly higher PP (151.6±10.77 W), PV (3.3 ± 0.54 m/s), and PD (0.46 ± 0.15 m) in comparison to the 40%, 60%, and 80% of 1RM loading conditions (p < 0.05). CONCLUSIONS: This is the first study to examine power output in adolescent athletes in the jump squat. As concluded in previous studies, power in the JS is maximal at body mass, including adolescent male subjects. It was observed that peak power was attained at body mass regardless of subject’s baseline strength levels. PRACTICAL APPLICATIONS: It is evident that lower-body power exercises such as the JS can be performed when training adolescent athletes. An adolescent’s baseline strength level does not affect the load at which power output is maximal. While it may be beneficial to train at various loads across the loading spectrum, emphasis may be placed on body mass when training to optimize power.

Effect Of Elastic Band Resistance Training During Simulated Microgravity On Neuromuscular Function

Andrea Dayne, Andrea M. Dayne, Jeffrey M. McBride, Tracie L. Haines, Tony R. Larkin, Tyler J. Kirby, Alan C. Utter, N. Travis Triplett

Prolonged duration in a weightlessness environment results in decreased neuromuscular function. In Earth -1g environment, resistance exercise helps prevent muscle atrophy and its subsequent attenuations in strength and power. Previous studies have attempted to apply findings of gravity-based research to a microgravity environment. Although it has been shown that the decrease in neuromuscular function from a weightless environment can be attenuated through resistance training in -1g, studies have not been completely successful utilizing resistance training in a microgravity environment to completely counter these negative neuromuscular changes.

PURPOSE: To examine the effect of elastic band resistance training in a microgravity simulated environment on muscle size, strength, power, and muscle activity pre- and post-training.

METHODS: Twenty college-age male were randomly assigned to a training (T) group (n=10; age = 20.1±1.34 yrs; height = 178.05±2.83 cm; mass = 77.47±6.63 kg) or a control (C) group (n=10; age = 21.7±1.17 yrs; height = 174.84±5.46 cm; mass = 73.96±8.76 kg) that rehearsed from any training during the nine-week period. Kinetic and kinematic variables, as well as electromyography (EMG) of the vastus lateralis (VL), were collected and analyzed before and after the training period in which the T group completed a progressive resistance protocol consisting of six sets of ten deadlifts utilizing elastic bands while in the custom-made microgravity apparatus. Muscle size was obtained through a DXA scan, strength was measured one repetition maximum (1RM) squat; power was assessed through a countermovement jump (CMJ) at body mass, and muscle activity was determined through EMG of the VL. RESULTS: JS at 1RM strength increased significantly in the T group (150.65±26.94 kg to 115.36±25.43 kg, p<0.001) as compared to no change in the C group (121.43±30.70 kg to 125.71±22.62 kg). No statistically significant changes were observed in power during the CMJ (4736.61±730.70 W to 4562.97±131.94 W) after training. Changes in muscle size and activity were insignificant. CONCLUSIONS: This is the first study to examine the effectiveness of elastic resistance bands in a microgravity training environment. This model was effective in reducing strength gains. Upping resistance bands may be a variable countermeasure to combat the negative neuromuscular effects experienced from prolonged exposure to microgravity. PRACTICAL APPLICATIONS: With the ineffectiveness of free weights in microgravity, it is necessary to find an alternative means of resistance training. Elastic resistance band training provides a cost-effective and effective means of increasing strength in microgravity. Because this is the first study to utilize elastic resistance bands in a simulated microgravity environment, more research is warranted to determine the optimal training variables such as sets, reps, and rest periods needed to produce the greatest hypertrophy and strength gains. Additionally, future investigations should include the microgravity-simulated exercise protocol during a concurrent period of bed rest.

Acknowledgment: This investigation was funded by the North Carolina Space Grant - New Investigators Program Grant.
Effects of Resistance Training on the Hamstring To Quadriceps Strength Ratio in Males and Females  
Sandor Dorgo, Pradeep Edupuganti

The imbalance in the hamstring to quadriceps (H:Q) ratio results in an increased susceptibility to hamstring strains and ACL injuries. Previous studies stipulated that compared to males the lower H:Q ratios may play an important role in the higher likelihood of ACL injuries in females. No known research has investigated the changes in H:Q ratios between males and females after an identical resistance training program. PURPOSE: To compare the changes in hamstring and quadriceps strength and in the H:Q ratio across the different genders. METHODS: Male (n=16) and female (n=17) college-age subjects with no history of lower-body injuries were recruited. All subjects were recreationally active but novice to lower-body resistance training. A 12-week resistance training program was applied consisting two 45-60 minutes sessions per week focusing on hamstring and quadriceps development. Subjects’ hamstring and quadriceps strength for the dominant leg was assessed before and immediately after the intervention using an isometric dynamometer at 30°/60°/90° and 160°/140°/120° angular velocities. Maximal peak torque data were used to calculate quadriceps and hamstring strength relative to body weight, and the conventional and functional H:Q ratios. Pre- and post-test data were analyzed using an ANOVA with repeated measures. RESULTS: Males’ concentric and eccentric hamstring and their concentric quadriceps strength improved significantly from baseline to 12-week at all angular velocities (p<0.002). Females showed significant improvements in the concentric and eccentric hamstring strength of all angular velocities (p<0.002), but only at 60° for the concentric quadriceps strength (p<0.019). Both males and females achieved the recommended Ed hamstrings peak torque-to-body weight ratio of 12-week, but not the recommended 1.0 quadriceps peak torque-to-body weight ratio. Males showed modest and mostly non-significant improvements in conventional H:Q ratios, while females showed significant improvements at all angular velocities (p<0.004). For the functional H:Q ratios, both males and females showed significant improvements from baseline to 12-week (p<0.042), but females showed significantly greater improvements (p<0.002). After the 12-week intervention, males and females reached 0.7-0.8 conventional and 1.1-1.4 functional H:Q ratios. CONCLUSION: While concentric and eccentric hamstring strength improved similarly in males and females, sex differences were observed in the improvement of concentric quadriceps strength as females showed only modest improvements. An important finding of the present study was that both males and females were able to meet and exceed the commonly recommended 0.6 conventional and 1.0 functional H:Q ratios after 12-weeks of resistance training. However, the 12-week intervention was not sufficient to improve subjects’ relative quadriceps strength to that necessary for adequate functional performance. PRACTICAL APPLICATION: A 12-week systematic lower body resistance training program may be effective in increasing the conventional and functional H:Q ratios above the recommended levels both in males and females. However, assessing the H:Q ratios does not fully describe the functional capacity of athletes, therefore the assessment of quadriceps and hamstring relative strength values are recommended in addition to the H:Q ratios.

The Effectiveness of Manual Resistance Versus Weight Training on Fitness Test Achievement Scores in Adolescents  
Sandor Dorgo

Manual Resistance Training (MRT) has recently gained popularity and previous research suggested that MRT may be effective in improving muscular fitness in adults. As resistance training is an effective method to improve the fitness of adolescents, a variety of resistance training modalities have been applied in this population. The advantage of the MRT modality is the low cost due to the minimal equipment and space requirements. PURPOSE: To compare the changes in fitness test scores between adolescents trained by the MRT and by traditional Weight Training (WT). METHODS: One hundred seventy-four adolescents attending school-based physical education classes were pre-tested on their physical attributes by the fitness assessment test kit, including the 1-mile run, curl-up, push-up, trunk lift, flexed arm hang, and modified pull-up tests. Classes of students were then assigned to either the MRT or WT protocol. Resistance training programs were used to complement the physical education classes and were applied for 30-45 minutes three times per week for 18 weeks. Students were tested prior to the intervention, at 9 weeks and at the end of the 18-week period. Data were analyzed using a General Linear Mixed Model Analysis with Tukey’s post-hoc procedure for mean comparisons. RESULTS: At baseline, there were no significant differences between groups for age, height, or weight (p>0.05). However, adolescents in the MRT group scored significantly higher in all measures of the Fitnessgram protocol (p<0.002). By week 9 both the MRT and WT groups showed significant improvements in the curl-up and trunk lift measures (p<0.002) with the MRT group showing greater improvements. For the 1-mile run, push-up, flexed arm hang, and modified pull-up measures only the MRT group showed significant improvements (p<0.002). Fitness scores for the WT group remained significantly higher for the 1-mile run and flexed arm hang tests (p<0.012), but the significant group differences disappeared for the curl-up, trunk lift, push-up, and modified pull-up measures (p>0.05). Neither group showed further significant improvement by 18-weeks for the 1-mile run, curl-up, trunk lift, flexed arm hang, or the modified pull-up measures (p>0.05). In the push-up measure, only the MRT group showed improvement from 9-week to 18-week (p<0.019). At 18-week fitness scores were significantly higher in the MRT group for the 1-mile run, curl-up, push-up, flexed arm hang and modified pull-up tests (p<0.038). From baseline to 18-week both groups showed significant improvements in curl-up, trunk lift and push-up tests (p<0.049), but only the MRT group showed significant improvements for the 1-mile run, flexed arm hang, and modified pull-up tests (p<0.033). CONCLUSION: While the WT program was effective in improving some measures of adolescent’s fitness, the MRT appeared to improve all measures. Adolescents trained by the MRT modality achieved greater improvements in the first half, but only slighter improvements in the second half of the 18-week intervention. Adolescents in the WT group generally made smaller, but more progressive improvements throughout the 18-week intervention. PRACTICAL APPLICATION: Both the MRT and the traditional WT systems are appropriate for improving Fitnessgram scores within school-based physical education programs. The MRT modality appears to be effective in improving adolescents’ fitness scores within 9-weeks of program application.

The Effects of Activity Based Interventions on Selected Health Fitness Parameters of University Students  
John Downing, Gerald L. Masterson, Regin Noroski

PURPOSE: Lack of exercise is related to the development of heart disease, and can also impact other conditions such as obesity, hypertension, hyperlipidemia, atherosclerosis and diabetes. Conversely, understanding the benefits of and engaging in regular physical activity can positively modify these risk factors. PURPOSE: The purpose of this study was to examine the effects of a prescribed exercise program implemented in a required university core fitness course on selected student health fitness parameters. METHODS: One thousand two-hundred and forty-four students originally volunteered to participate in the study. Each student was concurrently enrolled in a content area lecture, and a fitness activity laboratory that convened twice a week. During the first two weeks of the semester and under laboratory instructor supervision, students were required to complete 2 valid health fitness tests, complete the pre-intervention data on standardized forms and submit them to the instructors. The test items included: resting heart rate and blood pressure, one minute bench-press and push-ups, low back and reach flexibility, body composition via skin fold estimation, distance jump test, the modified push-up test, the modified pull-up test, the curl-up, sit-up, push-up, flexed arm hang and modified pull-up tests (p<0.038). From baseline to 18-week both groups showed significant improvements in curl-up, trunk lift and push-up tests (p<0.049), but only the MRT group showed significant improvements for the 1-mile run, flexed arm hang, and modified pull-up tests (p<0.033). CONCLUSION: While the WT program was effective in improving some measures of adolescent’s fitness, the MRT appeared to improve all measures. Adolescents trained by the MRT modality achieved greater improvements in the first half, but only minimal improvements or some decrements in the second half of the 18-week intervention. Adolescents in the WT group generally made smaller, but more progressive improvements throughout the 18-week intervention. PRACTICAL APPLICATION: Both the MRT and the traditional WT systems are appropriate for improving Fitnessgram scores within school-based physical education programs. The MRT modality appears to be effective in improving adolescents’ fitness scores within 9-weeks of program application.
Do High Hamstring To Quadriceps Activation Ratios Impair Jumping Performance?  


Recent reports suggest that training to increase the amount of hamstring activation and hamstring to quadriceps activation ratios (H:Q) may stabilize the knee during jump landings and cutting, and potentially prevent anterior cruciate ligament injuries. However, the potential effect of increased antagonist activation may improve, including the performance of athletes involving knee extension. PURPOSE: This study evaluated the relationship between H:Q and countermovement jump (CMJ) height. METHODS: Subjects included 43 female high school and college students (age 19.14 ± 1.8 years). All subjects provided informed consent, as well as parental consent for those who were less than 18 years old. The study was approved by the university review board. Subjects performed 2 repetitions of maximal voluntary isometric contractions (MVIC) for the quadriceps and hamstring muscles. Subjects also performed 2 repetitions of each of the drop jump from a height equal to their countermovement jump (DJ) and electromyographic (EMG) data were collected for the rectus femoris, vastus lateralis, vastus medialis, biceps hamstrings, and medial hamstrings. Root mean square (RMS) signal processing was used on all EMG data which were analyzed to assess the magnitude and timing of the muscle's bursts pre- and post-landing for the DJ using the average of both trials and normalized to MVIC. The timing of the foot contact was synchronized with the EMG data using a switch mat. The DJ were calculated from the collective average of the hamstring muscles divided by the collective average of the quadriceps muscles. Data were evaluated using a Pearson's correlation coefficient in order to examine the relationship between the subject's H:Q and CMJ height for both the pre and post foot contact phase of the DJ. RESULTS: Results revealed that pre-landing H:Q was positively correlated to CMJ height (r = .35, p < .02). Post-landing H:Q was not correlated to CMJ height (r = .21, p = .16). CONCLUSION: This study demonstrates that high levels of hamstring activation, relative to the quadriceps, do not impair, and may be positively associated with CMJ performance. PRACTICAL APPLICATIONS: The prescription of additional hamstring training for female athletes appears unlikely to impair performance of exercises that involve dynamic knee and hip extension, such as the countermovement jump.

The Effects Of Multiaxial And Uniaxial Unstable Surface Balance Training In College Athletes  

Tracey Eisen, Jerome Danoff, James Leeno, Todd Miller

PURPOSE: The purpose of this study was to compare the effects of two different types of unstable surface balance training (uniaxial on a rocker-board [RB] and multiaxial on a dynamic [DD]) on balance in Division 1 collegiate athletes in sports that are high-risk for ankle sprains. METHODS: Subjects (n=34) consisted of male soccer players, and female volleyball and soccer players, and were equally and randomly assigned to one of three groups (CON, DD, RB). Balance training consisting of balancing on one leg on either the RB or DD, while repeatedly catching a 1kg ball was performed 3 times per week for 4 weeks. Balance was tested at the start and conclusion of the training. RESULTS: A 3-way repeated ANOVA revealed that no group individually changed SEBT scores from pre (CON: 0.96 ± 0.066, DD: 0.96 ± 0.063, RB: 0.97 ± 0.005) to post (CON: 1.00 ± 0.094, DD: 1.01 ± 0.086, RB: 1.02 ± 0.066). Following balance training, the two treatment groups were combined (DD and RB), F = 0.3, p = 0.715. When all groups were combined, there was a significant difference in SEBT scores from pretraining (CON+DD+RB: 0.98 ± 0.005) to posttraining (CON+DD+RB: 1.01 ± 0.062), which likely indicates low statistical power. CONCLUSION: The increase in physical activity the subjects experienced during the return to season activity, may have contributed to the significant differences in SEBT scores over time but not between DD or RB training. PRACTICAL APPLICATIONS: Therefore, a threshold level of training may exist that is necessary to maintain balance during the off season.
**Activation Of Core Musculature During Exercise With Stable And Unstable Loads On Stable And Unstable Surfaces**

**Sean Flanagan, James M. Kohler, William C. Whitney**

Purpose: Training on unstable surfaces is thought to increase the activation of the core (trunk) musculature because of the greater demands for stability. While greater activation of the core has been found with equivalent external resistances, the amount of external force produced by a group of muscles has been found to decrease when the same exercise is performed on an unstable surface. Additionally, while training on unstable surfaces is the most common form of instability training, an individual is more likely to encounter an unstable external resistance rather than an unstable surface, outside of the gym setting. It is unclear how the core musculature activation would compare relative to absolute, rather than absolute, resistances were used, or if unstable load was used rather than an unstable surface. The purpose of this investigation was to determine the effects of both loading mode and surface condition on the amount of weight lifted during a 10 repetition maximum (10-RM) and the corresponding activation of the core musculature, as measured by surface electromyography (sEMG). Methods: Twenty recreationally trained adults performed the overhead press under two loading conditions (barbell/stable load and dumbbell/unstable load) while on two different surfaces (exercise bench/stable surface and Swiss ball/unstable surface). For each condition, subjects performed 3 sets of 3 repetitions with a resistance that was equivalent to a previously determined 10-RM for each condition with sEMG electrodes attached to the following muscles: rectus abdominis (RA), external oblique (EO), upper erector spinae (UES), and lower erector spinae (LES). sEMG signals were collected at 1000 Hz, amplified by 1000 mV, and filtered using a band pass filter between 20-5000 Hz. The root mean square value of each signal during a 25 ms time window was then calculated using a computer algorithm. Peak (pRMS) and integrated (iRMS) RMS root mean square values of each RMS signal were averaged across the three trials for each subject. A 2 x 3 factorial ANOVA with repeated measures was used to compare group mean differences between the 4 conditions (p < 0.05). Results: Stable loads resulted in a 15.7% greater 10-RM, and stable surfaces resulted in an 11.4% greater 10-RM. For the RA, there was no effect for load or surface. For the ED there was a main effect for surface, with 12.5% greater pRMS and 16.8% greater iRMS on the stable surface. For the LES and UES, there was a main effect for load, with the stable load requiring 49.6% and 61.1% greater iRMS, respectively. Additionally, for the UES, the stable load resulted in a 5.6% greater pRMS. There were no significant interactions. Conclusions: The amount of weight lifted declined with increasing instability of either the load or the surface. The RA does not appear to play a significant role in stabilizing the trunk during the overhead press. While the other core musculature responds to changes in surface and loading conditions, increased activation appeared to be a function of the amount of weight lifted on the bench press. The UES did not increase in peak magnitude, suggesting an overall increase in activation rather than a specific point in time. Practical Applications: Greater activation of the core musculature appears to occur by lifting a heavier weight overall than by lifting a lighter weight overhead either with an unstable load or on an unstable surface.
There has been considerable debate about the effectiveness of different rest interval lengths on strength gains. OBJECTIVE: The purpose of the current study was to examine the effects of different rest interval durations on upper- and lower-body strength during and after a 16-week resistance training program. METHODS: Thirty-six recreationally trained men were randomly assigned to one of six groups (NSCA, n = 12; three, TG, n = 12 or five, FG, n = 12) minutes rest interval groups. Each group performed the same program in a non-linear periodized training model. Maximal strength was assessed at baseline, mid-point (eight weeks) and post training (16 weeks) for the bench press and leg press exercises. RESULTS: For the bench press, significant increases were demonstrated within TG and FG at six weeks and 16 weeks versus baseline (p < .05). Additionally, G1 (168 ± 3.7 kg) was significantly stronger than G1 (92.5 ± 3.8 kg) at 16 weeks (p < .05). For the leg press, significant increases were demonstrated within all groups at eight weeks and 16 weeks versus baseline (p < .05). Additionally, there were significant differences between groups at eight weeks (p < .05) and 16 weeks (p < .05) compared to baseline. CONCLUSION: The findings of the current study indicate that longer rest intervals may result in significantly greater increases in upper and lower body strength after the early weeks of training, when compared to shorter rest intervals. PRACTICAL APPLICATIONS: Shorter rest intervals can be effective for strength increases in less trained muscles or exercises; this may apply to advanced athletes following a lift-off novice athletes beginning a resistance training program. Longer rest intervals (up to five minutes) are best applied in highly trained muscles and exercises and the window for adaptation narrows.

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### Upper And Lower Body Strength Increases Consequent To Different Inter-Set Rest Intervals In Trained Men

Belmoro Freitas de Salles, Belmoro Freitas de Salles, Roberto Simão, Humberto Miranda, Martim Bottaro, Erwerton de Souza Bezerra, Fabio Fontana, Jeffrey M. Willardson

Acute Effects Of A Pre-Exercise Supplement On Critical Velocity And Anaerobic Running Capacity In College-Aged Men And Women

David Fukuda, Abbie E. Smith, Kristina L. Kendall, Jennifer L. Graef, Jordan R. Moon, and Jeffrey R. Stout

The critical velocity test provides two measures: critical velocity (CV) and anaerobic running capacity (ARC). In theory, CV represents the maximum running velocity that can be maintained without fatigue, which is regarded as an aerobic measure. The ARC is an estimate of the anaerobic energy reserves in muscle, such as adenosine triphosphate and phosphocreatine. However, previous studies have examined the effects of nutritional supplements on CV and ARC. PURPOSE: To examine the effects of a pre-exercise supplement on CV and ARC in college-aged men and women. METHODS: Ten moderately-trained men and women (mean ± SD; age 25.7 ± 3.4 yrs; height: 172.2 ± 7.5 cm; weight: 70.8 ± 11.7 kg; VO2MAX: 50.6 ± 6.6 ml∙kg-1∙min-1) volunteered to participate in this randomized, double-blinded, placebo-controlled, cross-over study. Thirty minutes prior to testing, participants consumed the active supplement (ACT; 176 g; whey protein, cordyceps sinensis, arginine, creatine, beta-alanin, citruline, green tea, and caffeine or placebo (PLA; 176 g) in 250 mL of water. Thirty minutes prior to testing, participants consumed the active supplement (ACT; 176 g; whey protein, cordyceps sinensis, arginine, creatine, beta-alanin, citruline, green tea, and caffeine) or placebo (PLA; 176 g) in 250 mL of water. Then, participants ran at 10% and 30% of the CV, and then at 70% and 90% of the CV, with a 10-minute rest between each period. After each rest period, participants performed a 30-second sub-maximal test on a treadmill at 70% of the CV. Ten minutes later, participants performed a 30-second sub-maximal test on a treadmill at 70% of the CV. After a 3-minute recovery period, participants performed a 30-second sub-maximal test on a treadmill at 70% of the CV. Ten minutes later, participants performed a 30-second sub-maximal test on a treadmill at 70% of the CV. The 30-second tests were separated by a 2-minute rest period. RESULTS: There were no significant differences between conditions for CV, with the ACT condition being significantly higher than the PLA condition (ACT: 230.0 ± 5.8 m∙s-1; PLA: 223.5 ± 5.2 m∙s-1; p < .01). CONCLUSION: The findings of the current study indicate that longer rest intervals may result in significantly greater increases in upper and lower body strength after the early weeks of training, when compared to shorter rest intervals. PRACTICAL APPLICATIONS: Shorter rest intervals can be effective for strength increases in less trained muscles or exercises; this may apply to advanced athletes following a lift-off novice athletes beginning a resistance training program. Longer rest intervals (up to five minutes) are best applied in highly trained muscles and exercises and the window for adaptation narrows.

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Abstracts

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PURPOSE: Concurrent activation of lower body and force of remote force development, via the combination of muscles remote from the prime mover. PURPOSE: This study assessed the effect of remote voluntary contractions (IVC) on upper body muscle activation and force. METHODS: Twenty-two men (28.7 ± 3.7) and fourteen women (21.1 ± 3.8) performed isometric concentric elbow flexion and extension at 60 degrees/sec. for 3 repetitions in IVC and NO-IVC conditions. The IVC condition included jaw stretching, plantar flexion, and the Valsalva maneuver. Rate of torque development (RTD), peak torque (PT), and average power (P) were assessed using dynamometry (System IV; Biodes Inc., Shirley, NY). Electromyography (Myometer IV, Delsys Inc., Boston, MA) was used to assess activation of muscles potentially involved in the MVC (trapezius, rectus femoris, hamstring belly, rectus abdominis, flexor digitorum superficialis, masseter) and the prime mover and its antagonist (triceps brachii, triceps brachii). A two-way mixed ANOVA with repeated measures for test condition was used to evaluate the interaction between MVC-IVC-IVC conditions and gender, and to assess the main effects. Significant main-effects were further evaluated with a paired samples t-test. RESULTS: Significant main-effects were found for MVC-IVC-IVC condition and p < 0.05) along with significant interaction between test condition and gender (p = 0.05) for tension of peak torque, rate of torque development, and power. Significant main-effects were found for MVC- NO-IVC condition (p < 0.05) without significant interaction between test condition and gender for any test of muscle activation. CONCLUSION: The IVC condition produced 7.8 to 14.1% higher performance for all variables for men, and 5.5 to 12.7% higher values for women for peak torque and rate of torque development. The performance augmentation appears to be the result of 9.7 to 12.0% higher prime mover activation for men and 11.5 to 15.3% higher for women, in the MVC condition. PRACTICAL APPLICATION: Athletes and exercisers should consider using MVCs to augment upper body force and muscle activation during training.

Effect Of Vision Training On Batting Performance And Pitch Recognition Of Division I Baseball Players

Shane T. Gilliam, David J. Szymanski, Michael T. Brawvell, Andrew T. Britt, Charles F. Cicciarella, Amanda L. Herring, Brannon T. Holloway, Hannah E. Lewis, Jeffrey D. Potts, Jessica M. Szymanski, Megan E. TIl, and Frank J. Spaniol

PURPOSE: To investigate the effect of vision training on on bat velocity (BV), batted ball velocity (BBV), and pitch recognition (PR). METHOD: Twenty-one male NCAA Division I baseball players (age = 20.3 ± 3.0 y) were randomly assigned to one of 2 groups of 11 players the season before the season began. Group 1 (n = 11) was the control group and received no vision training. Group 2 (n = 10) completed 18 vision training sessions over 6 weeks (3 sessions/week). Vision consisted of visual flexibility (convergence/divergence), visual recognition (accuracy and response time), and visual tracking (accuracy and response time). Each session was performed with a game pad controller connected to a computer and lasted between 10-20 minutes. Before beginning the 6-week vision training program, all subjects were tested on body composition using a Tanita/TM bioimpedance device; grip strength using a JamarTM hand dynamometer; and vertical jump using a VertecTM vertical jump apparatus to assess lower leg power. Instaneous BV was recorded by a Sistror SPTSTM chronograph. BBV was measured by a Stalker ProTM radar gun set up behind home plate while subjects hit balls, delivered at a mean velocity of 261 m/s (65 mph) from the AtecTM automated pitching machine set up 20.3 m (66 ft) away from home plate and called out “ball” or “strike”. An official NCAA “strike zone”, adjusted for each player, was set up behind home plate for each hitter. The number of correct responses was recorded as the PR score. Both groups were also assessed by a commercial visual training program on their depth perception, visual flexibility, visual recognition, and visual tracking. Once the 6-week training program was completed, all subjects were re-tested on the same parameters previously listed. RESULTS: Univariate ANOVA comparing group 1 and 2 revealed that group 2 significantly (p < 0.05) improved in convergence percentage (p = 0.001), visual recognition response time (p = 0.010), visual recognition accuracy (p = 0.034), visual tracking response time (p = 0.001), and PR (p = 0.012). There were no significant differences in BV, BBV, divergence, or depth perception. CONCLUSIONS: Data suggests that vision training can improve certain aspects of a baseball player’s vision; however, there was no effect on their BBV, divergence, or depth perception during the pressure. PRACTICAL APPLICATIONS: Although no significant improvements in BV occurred for either group, group 2 significantly improved PR compared to group 1. This may allow a hitter to be more selective in the batter’s box, thus increasing the possibility of being more accurate at bat-ball contact. A limitation of this study was that BV was not assessed for each hitter after the target zone were recorded by the Stalker ProTM radar gun. It is suggested that future studies count the total number of swings taken to achieve sample/BVV data to see if there is a significant difference between groups. This may provide data that demonstrates greater skill in hitting the ball “up the middle.” ACKNOWLEDGEMENTS: We would like to thank Visual Edge for partially funding this project.

Resisted Speed Development Methods: The Effect Of Wind Speed


PURPOSE: This study evaluated the effect of wind speed on 10 and 40 yard sprint times and stride frequency. METHODS: Twenty-two men and women (Mean ± SD: age: 22.4 ± 4.1; body mass: 71.0 ± 12.5 kg; 70% ± 4% from invertible speed headwinds) were assessed by wind vane and anemometer. Sprint data from the slowest and fastest wind conditions were kept for analysis. Ten and 40 yard sprint times were assessed using an infrared timing system, and stride frequency was calculated from video analysis. Differences between 10 and 40 yard sprint times and stride frequency in slow and fast wind conditions were assessed using paired sample t-tests. Additionally, differences in scores were calculated for the slow and fast wind conditions for the 10 and 40 yd sprint times, as well as for wind speeds. Regression analysis was used to determine if a change in wind speed was a statistically significant predictor of changes in sprint times. RESULTS: Paired sample t-tests revealed that slow and fast mean wind conditions of 2.36 ± 1.06 and 6.73 ± 2.52 m/s per hour (MPH), respectively, were significantly different (p < 0.001). Mean 10 yard sprint times were 1.97 ± 0.17 seconds and 2.02 ± 0.16 seconds in the slow and fast wind conditions, respectively (p = 0.04). Mean 40 yard sprint times were 5.78 ± 0.52 seconds and 5.84 ± 0.64 seconds in the slow and fast wind conditions, respectively (p = 0.055). There was no significant difference in stride frequency between the slow and fast wind conditions of the 10 (p = 0.55) and 40 (p = 0.11) yard sprint. Results of regression analysis indicated that a change in wind speed was a significant predictor of a change in 40 yard sprint time (R2 = 0.32; p = 0.004) but not for the 10 yard sprint time (R2 = 0.55, p = 0.004). From these results, the following regression equation was created: 4.94 yard sprint time = 0.04 wind speed - 0.055. CONCLUSION: Running into the wind decreases 10 and 40 yard sprint times, without affecting stride frequency. Changes in 40 yard times can be predicted from wind speed. PRACTICAL APPLICATION: Running against the wind is an economical resisted speed development strategy. Coaches can use the regression equation from this study to determine the effect of forecasted or assessed wind speeds on resisted running performance, thus quantifying the nature of this training stimulus. Table 1 provides example data.

Table 1. Example data based on the regression equation.

<table>
<thead>
<tr>
<th>Wind speed (MPH)</th>
<th>2.5</th>
<th>5.0</th>
<th>7.5</th>
<th>10.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 yard sprint time (sec)</td>
<td>0.06</td>
<td>0.23</td>
<td>0.35</td>
<td>0.46</td>
</tr>
</tbody>
</table>
The Effect of Caffeine Supplementation on Strength and Muscular Endurance in Resistance-Trained Women

Erica Goldstein, Patrick Jacobs, Joe Antonia, Michael Whitehurst, Tina Pennolino

The role of caffeine supplementation in strength and power performance is progressively emerging, but with varied results. Moreover, research that has specifically examined the effects of caffeine in strength and women is limited. PURPOSE: To determine the acute effects of caffeine supplementation on strength and muscular endurance in resistance-trained women. METHODS: In a randomized, double-blind crossover design, fifteen women (mean ± SD age: 25 ± 7 years; body mass: 144 ± 8 kg; height: 166 ± 9 cm) consumed caffeine (6 mg·kg⁻¹·plasma) in a randomized order, seven days apart. Sixty min following supplementation, participants performed a one-repetition maximum (1RM) barbell bench press test and repetitions to failure at 60% of 1RM. Heart rate, blood pressure (systolic and diastolic), and rating of perceived exertion were assessed at rest, 60 minutes post-consumption, and immediately following completion of repetitions to failure. A one-way ANOVA for repeated measures was used to analyze potential differences between caffeine and placebo conditions. RESULTS: Analysis indicated a significantly greater bench press maximum with caffeine (p = 0.05) (230 ± 9 kg vs. 211 ± 7 kg) with no significant differences between conditions in 60% 1RM repetitions (p > 0.05). The only statistically significant difference between conditions in physiological measures was a greater systolic blood pressure immediately following exercise, with caffeine (p = 0.05) (116.0 ± 5.3 mmHg vs. 112.9 ± 4.9 mmHg). CONCLUSIONS: Our findings indicate that caffeine appears to be effective for improving upper-extremity strength in resistance-trained women. Practical Applications: A moderate dose of caffeine may be sufficient for enhancing strength performance in resistance-trained women.

The Effects Of Four Weeks Of High-Intensity Interval Training And Creatine Supplementation On Cardiorespiratory Fitness In College-Aged Men

Jennifer Greaf, Kristina L. Kendall, David H. Fukuda, Abbie E. Smith, Jordan R. Davis, Travis W. Beck, Joet L. Camar, and Jeffrey R. Stout

PURPOSE: The purpose of this study was to determine the effects of four weeks of interval training with concurrent creatine supplementation on cardiorespiratory fitness and endurance performance (maximal oxygen consumption (VO2peak), time-to-exhaustion (VO2peakT), ventilatory threshold (VT), and total work done (TWD)) in college-aged men. METHODS: Forty-three recreationally active college-aged men (Age: 21.3 ± 1.7 years; VO2peak: 43.5 ± 9.9 ml·kg·min⁻¹) volunteered to participate in this double-blind, placebo-controlled study. Participants were randomly assigned to one of three groups: creative (5 g·d⁻¹ of 15 g·plasma-supplemented men (age: 25.0 ± 5.0 years, body mass: 116.5 ± 15.2 kg, height: 177 ± 6.0 cm) performed three types of countermovement vertical jumps (CMJ) and static vertical jumps (SVJ) on a force plate. Both CMJ and SVJ were performed in unloaded and loaded (11 kg and 20 kg) conditions. All jumps data were analyzed for power output (watt, W) determined from the maximal oxygen consumption test [TWD (kJ) = (T x W)/1000]. Following initial testing, a two week familiarization period of training and supplementing occurred. Baseline values were then measured and all participants in the Cr and Pl groups engaged in four weeks of high-intensity interval training (HIIT) training on a cycle ergometer. Each training session consisted of 5 bouts of a 3:1 minute cycling work-to-rest ratio, introduced in an undulating progression starting at 80% VO2peak power output and reaching 120%. Separate two-way ANOVAs (group [Cr vs. Pl vs. CN] x time [pre- vs. post-]) were used to identify any group by time interactions. RESULTS: A significant time x treatment interaction occurred for VO2peak (p < 0.001) and VO2peakT (p < 0.001). Post-hoc analyses indicated no significant differences between groups. Both groups increased in VO2peak (Cr: 7.5%; Pl: 9.4%) and VO2peakT (6.2%; Pl: 7.4%) following four weeks of HIIT. A significant time x treatment interaction occurred for VT (p < 0.001). Post hoc analyses indicated improvements in only the Cr (p < 0.05; 16.4%) group over time. No changes were observed in TWD across any group over time. CONCLUSIONS: Both VO2peak and VO2peakT improved following four weeks of HIIT. Creatine supplementation seemed to only have an effect on VT, since improvements were observed in the Cr group while there were no changes in the Pl group. HIIT did change following HIIT or Cr supplementation. Practical Applications: HIIT seems to be an effective and affordable way to improve maximal endurance performance. The addition of Cr seemed to improve VO2peak, but did not increase TWD. Therefore, 10 g of Cr per day for 5 days per week does not seem to further augment maximal oxygen consumption, greater than HIIT alone; however, creativity supplement may improve submaximal endurance performances.

Ingesting Amino Acid-Carbohydrate Prior To And During Consecutive Bouts Of Resistance Training Elevates Energy Expenditure

Kyle Hackney, Andrew R. Kelleher, Lori L. Ploutz-Snyder

Increases in resting energy expenditure (REE) and decreases in the respiratory exchange ratio (RER) have been reported following a single bout of resistance training (RT), indicating enhanced energy utilization and a greater reliance on lipids. It is hypothesized that elevations in RER occur because the synthesis of proteins following muscle damage is energetically expensive, requiring more adenosine triphosphate equivalent molecules for every amino acid added to the peptide chain. During the process, there may be a greater reliance on lipids in order to meet the required energy need. Recently, a wealth of evidence suggests that timing the intake of amino acid-carbohydrate (AACHO) close to the RT session molecules for every amino acid added to the peptide chain. During this process, there may be a greater reliance on lipids in order to meet the required energy need. Recently, a wealth of evidence suggests that timing the intake of amino acid-carbohydrate (AACHO) close to the RT session.

The Relationship Between The Eccentric Utilization Ratio, Reactive Strength, And Pre-Stretch Augmentation And Selected Dynamic And Isometric Muscle Actions.

G. Haff, R. Ruben, M. Molinari, K. Painter, M.W. Ramsey, M.E. Stone, and M.H. Stone

The ability to use the stretch-shortening cycle (SSC) is essential for many sporting activities. There are several approaches by which to assess the SSC. These include the eccentric utilization ratio (EUR), the reactive strength index (RSI), and the percent pre-stretch augmentation (PPA). These measures are typically quantified for vertical jump displacements and power output. The assessment of the SSC activity via jump activities may yield valuable information of the athletes training state and potential training interventions to improve SSC performance.

Purpose: To determine if EUR, RSI, and PPA are related to dynamic and isometric muscle actions. Methods: Twenty seven college track athletes (age: 19±1.6 yrs; body mass: 83.0±2.9 kg; height: 176±8.8 cm) performed three types of countermovement vertical jumps (CMJ) and static vertical jumps (SVJ) on a force plate. Both CMJ and SVJ were performed in unloaded and loaded (11 kg and 20 kg) conditions. All jumps data were analyzed for power output (watt, W) determined from the maximal oxygen consumption test [TWD (kJ) = (T x W)/1000]. Following initial testing, a two week familiarization period of training and supplementing occurred. Baseline values were then measured and all participants in the Cr and Pl groups engaged in four weeks of high-intensity interval training (HIIT) training on a cycle ergometer. Each training session consisted of 5 bouts of a 3:1 minute cycling work-to-rest ratio, introduced in an undulating progression starting at 80% VO2peak power output and reaching 120%. Separate two-way ANOVAs (group [Cr vs. Pl vs. CN] x time [pre- vs. post-]) were used to identify any group by time interactions. Results: A significant time x treatment interaction occurred for VO2peak (p < 0.001) and VO2peakT (p < 0.001). Post-hoc analyses indicated no significant differences between groups. Both groups increased in VO2peak (Cr: 7.5%; Pl: 9.4%) and VO2peakT (6.2%; Pl: 7.4%) following four weeks of HIIT. A significant time x treatment interaction occurred for VT (p < 0.001). Post hoc analyses indicated improvements in only the Cr (p < 0.05; 16.4%) group over time. No changes were observed in TWD across any group over time. Conclusions: Both VO2peak and VO2peakT improved following four weeks of HIIT. Creatine supplementation seemed to only have an effect on VT, since improvements were observed in the Cr group while there were no changes in the Pl group. HIIT did change following HIIT or Cr supplementation. Practical Applications: HIIT seems to be an effective and affordable way to improve maximal endurance performance. The addition of Cr seemed to improve VO2peak, but did not increase TWD. Therefore, 10 g of Cr per day for 5 days per week does not seem to further augment maximal oxygen consumption, greater than HIIT alone; however, creatine supplementation may improve submaximal endurance performances.

Variables

<table>
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<tr>
<th>Variable</th>
<th>Baseline</th>
<th>Day 3</th>
<th>Day 7</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 4</th>
<th>Day 1</th>
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<tbody>
<tr>
<td>RED (kJ·kg⁻¹·day⁻¹)</td>
<td>140.0 ± 36.3</td>
<td>105.0 ± 4.70*</td>
<td>102.0 ± 4.48*</td>
<td>102.0 ± 4.11*</td>
<td>103.0 ± 3.32*</td>
<td>102.0 ± 3.79*</td>
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<tr>
<td>RER (VO2d/VO2i)</td>
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<td>RPPMS (4-s delay)</td>
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<td>0.92 ± 0.16*</td>
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*Statistically greater than baseline, p < 0.05. Standard Error.
Power And Muscular Endurance Repeatability With 48 Hours Rest

Purpose: Athletes often perform intense workouts with short intervals between sessions. The purpose of this investigation was to examine the ability to repeat a high volume chest press workout following a 48-hour rest interval between sessions, as part of a larger intervention. Methods: 15 resistance-trained men (age 26.4 ± 4.9) were recruited from the university population. Subjects performed a one repetition maximum (1RM) on the bench press exercise on a machine device that allowed independent movement of each arm (Hammer Strength™). Two to four minutes of rest was given between attempts. The highest load lifted in good form was recorded as their 1RM. The following week subjects reported to the lab for two testing sessions 48 hours apart. Power testing was measured by performing bench press throws (BPT) using a weight equal to 30% of predetermined maximum 1RM on a ProSport® device. This apparatus utilizes a soft spotting mechanism that contains an electronic sensor, allowing the subject to release the bar at the end range of motion, ensuring a ballistic measurement. The subjects laid on a flat bench placed on a unused force plate (Brogden) and a position transducer was tethered to the center of the ProSport® barbell. The first repetition of position perturb respect to time was taken to calculate velocity of the barbell (Datapak) and multiplied by force to calculate power (Watts). Data was sampled at 1000Hz and low-pass filtered with a cutoff frequency of 30 Hz. Three BPTs were performed with 90 seconds rest between each effort. The best power output of the 3 BPTs was recorded. Subjects were then given 10 minutes of rest before performing 10 sets of the bench press exercise using a load equal to 60% of 1RM. Each set was performed to a point of momentary muscular failure, using a controlled speed. Subjects were given 90 seconds rest between each set. Results: No significant differences were observed in power output, 1st set repetitions, total repetitions, mean reps, or volume load from day 1 to day 2 (low table). Although not statistically significant, bench press power was decreased from day 1 to day 2 of testing (p=0.1), while bench press endurance measures were slightly increased from day 1 to day 2 of testing (3.2% total reps, 3.6% total volume load). Conclusion: A 48 hour rest interval is sufficient for recovery of power and repeatability of muscular endurance workouts in resistance-trained men. Further research is needed to examine the repeatability of shorter or longer rest intervals between workouts. Practical Applications: Coaches can design periodized training programs that allow for high volume muscle group training sessions to be repeated at 48 hours at certain times of the training cycle.

Effects Of Concentric And Eccentric Muscle Contractions On IL-6 Signaling in Human Skeletal Muscle
Travis Harvey, Brian D. Shelmadine, Jennifer J. Moreillon, Jason Liang, Lori Greenwood, Mike Greenwood, Richard Kreider, and Darryn Willoughby

Inflammation response in exercise of healthy humans is significantly different than that which is commonly reported for chronic inflammatory conditions. Regardless of the scenario, cytokines such as Tumor Necrosis Factor (TNF-α) and Interleukin (IL)-1β have demonstrated pro-inflammatory functions, while IL-6 has demonstrated variable pro- and anti-inflammatory roles when exercise is a factor. Prolonged skeletal muscle contractions of sufficient intensity have been shown to induce significant muscle protein damage and a complex inflammatory cascade involving IL-6 and, separately, Heart Shock Proteins (HSP), and components of the Mitogen-Activated Protein Kinase (MAPK) pathway. This cascade not completely understood in any scenario, particularly in humans. Thus the role of inflammation in regards to exercise, particularly resistance training, has not been elucidated. PURPOSE: To determine the effects of concentric (CON) and eccentric (ECC) contractions on cytokine (CK), cytokine, Glycogen Dephosphorylase (GDP), and IL-6 signaling in regards to IL-1β, TNF-α, HSP, NF-κB, Protein Kinase A (PKA), Protein Kinase C (PKC) and Akt (PKB). METHODS: Six active males (19.33 ± 1.03 yrs; 181.94 ± 2.20 cm; 79.32 ± 7.8 kg) participated in a repeated measures design and ingested two booties of 10 ft. 10 inch unilateral knitted extensors at 30% MVC. Each boot consisted of either CON or ECC contractions on either the right or left leg, such contraction type and leg being used once for each subject. Isokinetic strength tests were performed before, immediately post-exercise, and 24 and 48 hours after exercise. Serum IL-6, IL-1β, IL-10, TNF-α, C-reactive protein, and IL-6 mRNA expression of IL-6, HSP-27, and HSP-72 were assessed from vastus lateralis biopsies (Bergstrom ) collected at PRE, PX, and 2 and 6 hr PX. Repeated measures MANOVA and subsequent univariate analyses were performed on all data. RESULTS: Peak torque decreased (p = 0.00) at 1st set repetition, 24 and 48 hr PX. IL-6 but not IL-1β increased (p = 0.06) similarly following CON and ECC. Serum cytokines were different (p = 0.05) between CON and ECC, but did not change over time. In muscle, NF-κB increased (p = 0.01) and STAT-1 decreased (p < 0.05). CON/EC contractions demonstrated significantly greater expression for IL-6, IL-1β, and STAT-1 and STAT-3 than did CON, with a trend (p = 0.051) for STAT-3. There was significant CON/ECC intersection among NF-κB and STAT-1 and a trend (p = 0.074) for HSP-72. Skeletal muscle IL-6 mRNA expression demonstrated no significant results. CONCLUSIONS: Both CON and ECC booties demonstrated muscle damage and fatigue, but were not sufficient to induce a systemic inflammatory response. Intramuscular inflammatory response was most robust to NF-κB and STAT-1. The hypothesis of ECC stimulating the IL-6 pathway more so than CON is supported the relationship in expression of IL-6, IL-1β, and STAT-1 and STAT-3. PRACTICAL APPLICATIONS: This is novel evidence of a relationship among these factors. Boots of resistance exercise that include ECC contractions can favorably affect the exercise inflammation response, perhaps more so than lower intensity CON-only contractions.
The Effects Of External Load On Vertical Jump Peak Power And Eccentric Utilization Ratio

Peter Hellberg, Michael J. Hartman, Jason B. Winchester

The ability to utilize the stretch-shortening cycle (SSC) efficiently is a critical factor for success in many sports that involve sprinting, jumping, and production of maximal muscular power. Given the advances of sports equipment, many athletes are now wearing protective clothing or equipment while participating in competitive or recreational sports. It is not known to what extent the use of protective equipment, or application of the equipment as an external load, may have on the SSC or sports performance. Purpose: The purpose of this research was to examine the influence of external loading on vertical jump and SSC performance in recreationally active college-aged males. Methods: Twenty-four subjects (12 males, 12 females) who routinely participate in recreational sports or exercise volunteered for this study. Vertical jump height was determined using a static jump (SJ), and countermovement jump (CMJ) using a contact mat under normal and loaded conditions. An external load equal to 5% of the subject's body mass was applied via a weighted vest. Following a standardized warm-up, subjects were allowed one practice jump at each condition. Subjects maintained a hands-on-hip position in order to concentrate on hip-leg power and minimize jumping technique differences resulting from arm swing. Three trials were given for each condition, with instruction to obtain maximal height on each jump. Peak power was estimated from vertical jumps using the equation developed by Sayers et al. (1970): h = (v^2) / (2 * g), where h is jump height and v is peak velocity.

Findings: An external load had no significant effect on SRG or CMJ in the male group. When subjects were tested for SSC utilization, the external load had a significant effect on EUR power in only the male group (33.7% ± 9.2%). Conclusions: Data from this investigation suggests that an external load, such as protective athletic equipment, may have an influence on vertical jump and SSC performance in recreational athletes. It is not known to what extent the use of protective equipment, or application of the equipment as an external load while testing to more accurately reflect the conditions in which sport performance will occur for their particular event. Further investigation is needed to determine if the results from this study are consistent among different individuals or in other sports settings.

A Comparison Of Critical Torque And The Electromyographic Mean Power Frequency Threshold During Isometric Leg Extension


Theoretically, the critical torque (CT) and electromyographic mean power frequency fatigue threshold (EMG MPFFT) (fatigue from non-fatiguing isometric torque) are determined by if the EMG signal from the amplitude of the EMG signal was independent of the frequency domain of the EMG signal (AMG). To determine this, the EMG MPFFT (CT) and the CMJ were defined as the CT and EMG MPFFT as defined as the y-intercept of the isometric torque versus slope coefficient (EMG MPFFT). Results: The paired-samples t-tests indicated that there were no significant differences between absolute or %MVIC values for CT (25.3 ± 11.6 Nm and 17.6 ± 5.9 Nm) and EMG MPFFT (29.8 ± 22.3 Nm and 6.4 ± 17.3 Nm). Conclusion: The results of the present study indicate that there were no differences in the isometric torque levels associated with fatigue thresholds estimated from neuromuscular responses (EMG MPFFT) for the VL muscle and the torque versus duration relationship (CT). In addition, the current findings indicated that the mean CT occurred at a torque level (17% ± 5% MVC) that is typically not affected by circulatory occlusion (20% MVC). It is likely, however, that continuous isometric muscle actions at the EMG MPFFT for the VL (24 ± 14% MVC) muscle would be limited, in part, by restricted blood flow to the working muscle. Practical Application: The findings indicate that the mathematical model used to estimate the EMG MPFFT during isometric muscle actions was applicable to the frequency domain of the EMG signal to estimate the EMG MPFFT. The tests (EMG MPFFT) and isokinetic test (peak torque) had a significant correlation, and the internal criterion validity of the EMG MPFFT test was good, with an internal correlation coefficient of 0.73. These findings suggest that the EMG MPFFT test can be used to examine neuromuscular muscle activations associated with a decrease in muscle fiber action potential conduction velocity.

Relationships Among Muscle Fiber Type, Mechanomyographic, And Electromyographic Amplitude

Response Patterns During Ramped Isometric Muscle Actions

Trent Hendra, Terry J. Hough, Andrew C. Fry, Travis W. Beck, Joseph P. Weir, Brian K. Schilling, Eric D. Ryan, Joel T. Cramer

Purpose: The purpose of this study was to examine the mechanomyographic (MMGRMS) and electromyographic (EMGRMS) amplitude vs. force relationships of the vastus lateralis (VL) for sedentary-trained (AT), resistance-trained (RT), and sedentary individuals (SED). Methods: Five AT (mean ± SD age = 21.3 ± 3 yr; body mass = 101.3 ± 37 kg; height = 176.0 ± 0 cm), 4 RT (age = 25 ± 5 y; 4 kg = 4.4  ± 2.6 cm; and 5 SED (25 ± 4 yrs; height = 32 kg; 188 ± 5 cm) men volunteered to perform two normokinetic isometric muscle actions from 5% to 100% of their maximal voluntary contraction (MVC) while MMGRMS and EMGRMS signals were recorded from the VL, muscle thickness, and Bergstrom muscle biopsy data were taken from the VL. The muscle samples were analyzed for myosin heavy chain (MHC) isoform content. Simple linear regression models were fit to the natural log-transformed EMGRMS and MMGRMS vs. force relationships. The slope (b) term for the AT group suggested that the MMG-force relationship may have been sensitive to the earlier achievement of maximal voluntary isometric force. Therefore, the MMG signal may offer an attractive, simple technique for examining isometric muscle actions.

Correlation Between Muscle Fiber Cross-Sectional Area And Strength Gain Using Three Different Resistance-Training Programs In College-Aged Women


Purpose: The purpose of this investigation was to report the formerly unmeasured relationship between previously reported muscle fiber cross-sectional area and muscle performance changes for college-aged women using one of three resistance-training methods. Methods: Thirty-four healthy adult females (21.1 ± 2.7 yr) were randomly divided into four groups: control (C), traditional strength training (TS), traditional endurance training (TE), and low velocity training (LV). Results: Significant gains in muscle fiber CSA and strength were observed in all training groups. The TS group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV). The LV group had the greatest change in muscle fiber CSA (96.8 ± 52.1% versus 60.5 ± 20.6% for ATL vs. LV; and 65.6 ± 20.4% for LV).

The 32nd National Conference & Exhibition

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The Effect Of Different Pedal Types On Maximal Oxygen Consumption And Lactic Acid Accumulation

Jean M Hiebert, Don L. Hoover, Michael A. Best, Ashleigh B. Black, Ryan K. Hruska, Mariah E. Jones

Cycling efficiency is dependent upon many factors such as bike set up, body position, and pedaling cadence. These and other factors often have a large influence on both performance and risk of injury. One parameter not fully understood is the influence of available pedal systems on cycling efficiency, and little scientific literature exists on this topic. PURPOSE: To determine the effect of different pedal systems on maximal oxygen consumption (VO2 max) and lactic acid production during direct testing of maximal aerobic power. METHODS: Nine healthy recreational cyclists (7 males and 2 females, 36.11 ± 7.77 yrs) volunteered to participate in the study. On average, subjects cycled 3-4 times per week for 1-2 hours at a moderate to high intensity. Subjects performed a maximal bicycle graded exercise test on their own bicycle, using one of three pedal systems on different occasions. Pedal systems included: 1) flat pedals, 2) toe-clip pedals, and 3) clipless pedals, and the order of the pedal systems was randomized. Riding resistance was provided by a computer controlled bicycle ergometer and trainer. Initial resistance was based on a 11 power (lbs) to individual body weight (lbs) ratio and increased 2.1, 3, etc., every two minutes until subjects were unable to maintain a pedal cadence of at least 55 revolutions per minute. Gas exchange was analyzed using a portable metabolic system. A portable lactate analyzer was used to measure lactate at each levels prior to the test, upon completion of the test, and at 5 and 7 minutes post-test until values returned to baseline. RESULTS: A one-way ANOVA with repeated measures was conducted to evaluate the relationship between pedal type and the dependent variables, oxygen consumption and lactic acid production. While there were differences in performance under the three pedal conditions, these differences were not statistically significant for either the oxygen consumption or the lactic acid production. Participants produced higher average VO2 values during the clipless condition. Lactic acid accumulation was highest in the flat pedal condition. Lastly, when using the clipless pedals, participants achieved peak lactate levels at relatively higher oxygen consumption measures when compared to the flat pedal or toe-clip pedal conditions. CONCLUSIONS: Pedal condition did not produce statistically significant differences in maximal oxygen consumption or in lactic acid during a graded exercise test. However, these findings may be clinically meaningful, as statistically significant difference often may not exist within a given group of cyclists, whether the group be performing at a local amateur cycling event or an event such as the Tour de France. Participants produced higher average VO2 max values during the clipless condition, suggesting this condition may be more efficient as it is commonly believed. Lactic acid accumulation was highest in the flat condition, suggesting participants may have been less efficient when pedaling in this condition. Likewise, the achievement of peak lactate levels at relatively higher oxygen consumption further suggests the clipless pedals promote higher performance levels when compared to the flat and toe-clip conditions. PRACTICAL APPLICATION: Our findings suggesting clipless pedals allow for greater efficiency and result in higher performance. Further study is necessary to investigate these potentially clinically meaningful findings.

Anthropometric And Performance Comparisons In Professional Baseball Players

Jay Hoffman, Vazquez, J., Richarda N.

PURPOSE: To compare anthropometric and athletic performance variables across the different levels of professional baseball and to examine the relationship that these variables have on baseball specific power performance. METHODS: 343 professional baseball players over a two year period were assessed for height, weight, body composition, grip strength (GRIP), vertical jump peak (VJPP) and mean (VJMP) power, 10 yd sprint, and accelerate (AC). RESULTS: No significant differences were found between the levels of play and correlation analysis was used to examine the relationships between performance variables and body size and composition. Significant correlations were found between lean body mass and VO2 max and between lean body mass and GRIP. Significant correlations were found between VJPP and VJMP and between GRIP and VO2 max. CONCLUSION: Significant correlations were observed between lean body mass and VO2 max, lean body mass and GRIP, VJPP and VJMP, and GRIP and VO2 max. Significant differences were observed between levels of play and performance variables, with professional baseball players having greater VO2 max, lean body mass, GRIP, VJPP, and VJMP values than minor league baseball players. No significant differences were observed between minor league baseball players and college players. No significant differences were observed between professional baseball players and college baseball players. PRACTICAL APPLICATION: Our findings suggest that professional baseball players have greater aerobic capacity and anaerobic capacity than their collegiate counterparts. This is consistent with previous findings in other athletic populations (Witte et al. 2006, J Strength Cond Res, 20:172-177). It is important for coaches and trainers to develop programs that focus on improving VO2 max and anaerobic capacity in collegiate baseball players to improve performance at the professional level.

Gender Differences In Musculotendinous Stiffness And Range Of Motion In College-Aged Men And Women

Katie Hoge, Pablo B. Costa, Eric D. Ryan, Trent J. Herda, Ashley A. Walter, Travis W. Beck, Jeffrey R. Stout, Joel T. Cramer

PURPOSE: To examine musculotendinous stiffness (MTS) and ankle joint range of motion (ROM) in men and women following an acute bout of passive stretching. METHODS: Eight men (mean ± SD age = 25.3 ± 2.0 yrs; body mass = 87.8 ± 12.9 kg; height = 179.6 ± 5.8 cm) and nine women (mean ± SD age = 21.0 ± 2.4 yrs; body mass = 61.7 ± 7.4 kg; height = 166.3 ± 7.5 cm) volunteered for this study. To avoid any menstrual cycle differences, the women were all tested during menses. Each subject’s foot was stabilized in a custom built apparatus designed to measure plantar flexion force with a knee joint angle of 180° and ankle joint angle of 90°. The apparatus was also attached to a sensitive isokinetic dynamometer that stretched the plantar fascia muscles by passively dorsiflexing the foot at a 5°/s until a constant torque threshold was achieved and held at a 5°/s of acceleration as acknowledged by the subject. Nine repetitions of each stretch were held for 30 s with 10 s of rest between repetitions. Before and after the stretching, a maximal, passive flexibility assessment was performed, in which subjects were asked to relax while their foot was maximally dorsiflexed at 5°/s. Passive torque and position were recorded from the isokinetic dynamometer. To calculate MTS, the ankle joint angle (°) and torque (Nm) signals were sampled at 1 kHz during the flexibility assessments and plotted as torque-angle curves (i.e., stress-strain curves). Each subject’s curve was fit with a 4th-order polynomial regression model (Roche et al. 2006, Clin Biomech, 21:705-710), and MTS was calculated as the slope (kN m °1) of the tangent to the curve at a 90° joint angle. RESULTS: MTS decreased by 15.4% (p < .001) in men and 37.4% (p < .001) in women from pre- to post-stretching. Passive range of motion (ROM) increased by 3.1% (p = .016) in men and 7.3% (p = .001) in women from pre- to post-stretching. Differences in MTS were observed between men and women for PROM and MTS prior to and post-stretching. However, the percent change scores from pre- to post-stretching for MTS (P = .021) and PROM (P = .001) were greater for the women than the men. CONCLUSIONS: These findings suggest that 20 min of constant torque passive stretching increased the PROM and decreased the MTS of the plantar fascia in both men and women, although the magnitude of the change was greater for the women. The greater decrease in MTS and increase in PROM for women may have been due to gender-specific differences in viscoelastic creep during the constant torque stretching procedure. PRACTICAL APPLICATIONS: It has been suggested that a decrease in MTS reduces the total amount of strain through a given ROM, which may reduce the risk of strain injuries. Therefore, the findings of this study suggest that men may have to stretch for a longer duration or at a greater intensity to achieve similar increases in ROM and decrease in MTS as women.
The method of timing for short sprints has recently come under closer scrutiny. While most studies show hand-timing to be significantly faster than electronic timing, the degree of the differential between the two methods remains controversial. Purpose of the study was to determine the source of timing differentials between hand-timing and electronic-timing systems in the 40-yd dash. Methods: Twenty-seven male college-aged volunteers (181 ± 6.8 kg) ran two 40-yd dashes on an indoor rubberized floor. A computerized electronic data collection system recorded numerous temporal events; runner’s hand start pad (EHSP), runner’s foot start pad (EFSP) and stop time event from a photocell beam placed at a height of 0.75m for each runner. This same system recorded start and stop events from hand-held stopwatch buttons operated by 6 hand-timers who were instructed to initiate timing on the first visible movement of the runner. The differential times were calculated with EFSP as the zero time results. Electronic start events were not significantly different (p > 0.05) with EFSP being (EHS < 0.01 s) slower than EFSP Hand-timing was initiated significantly slower (0.06 ± 0.01 s, p < 0.001) than EFSP. The average hand-stopping time was significantly faster (0.16 ± 0.04s) than electronic stop time. When the differential for start and finish times were combined, they produce significantly faster 40-yd dash times (0.22 ± 0.024 s, p < 0.001) with hand-timing (5.23 ± 0.035 s) than with electronic timing (5.45 ± 0.051 s). Conclusion: Hand-timed 40-yd dashes will likely be 0.39 ± 0.38% faster than electronic timing. The discrepancy is due to a combination of start and finish differentials in timing. Practical Application: When short-sprint timing is an important element in judging performance or is to be used as a measure of training improvement, electronic timing may provide a more valid and reliable approach.

## Table1. Timed hop test and muscle strains

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<td>Χ² = 5.858, p &lt; 0.05</td>
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Effect Of Glycine Propionyl-L-Carnitine Supplementation On Anaerobic Work Capacity And Lactate Accumulation Are Dosage Dependent

Patrick Jacobs, Erica R. Goldstein, Will Blackburn, Ihsan Orem, John Hughes

Background It has been demonstrated that short term administration of glycine propionyl-L-carnitine (GPLC) produces significantly elevated levels of nitric oxide metabolites at rest and in response to reactive hyperemia. It has been recently shown that acute GPLC supplementation also produces enhanced anaerobic work capacity with reduced lactate production in resistance trained males. However, it is not known what effects chronic GPLC supplementation has on anaerobic performances or on lactate clearance. Purpose The purpose of this study was to examine the effects of varied dosages of chronic GPLC supplementation on the performance of repeated high intensity stationary cycle sprints with limited recovery periods in resistance trained male subjects. Methods Forty-five volunteers (mean age 31.5 ± 1.1 years) volunteered to participate in a double-blind, placebo-controlled, cross-over design study. Subjects had completed two testing sessions, one week between, 90 minutes following oral placebo administration at rest and in response to reactive hyperemia. It has been recently shown that acute GPLC supplementation produces significantly elevated levels of nitric oxide metabolites at rest and in response to reactive hyperemia. It has been recently shown that acute GPLC supplementation also produces enhanced anaerobic work capacity with reduced lactate production in resistance trained males. However, it is not known what effects chronic GPLC supplementation has on anaerobic performances or on lactate clearance. Purpose The purpose of this study was to examine the effects of varied dosages of chronic GPLC supplementation on the performance of repeated high intensity stationary cycle sprints with limited recovery periods in resistance trained male subjects. Methods Forty-five volunteers (mean age 31.5 ± 1.1 years) volunteered to participate in a double-blind, placebo-controlled, cross-over design study. Subjects had completed two testing sessions, one week between, 90 minutes following oral placebo administration at rest and in response to reactive hyperemia. It has been recently shown that acute GPLC supplementation produces significantly elevated levels of nitric oxide metabolites at rest and in response to reactive hyperemia. It has been recently shown that acute GPLC supplementation also produces enhanced anaerobic work capacity with reduced lactate production in resistance trained males. However, it is not known what effects chronic GPLC supplementation has on anaerobic performances or on lactate clearance. Purpose The purpose of this study was to examine the effects of varied dosages of chronic GPLC supplementation on the performance of repeated high intensity stationary cycle sprints with limited recovery periods in resistance trained male subjects. Results Analyses indicated significant time X group interactions for PP and MP, as well as for total lactate accumulation. Secondary analyses showed that sprint bouts three, four, and five produced 1.8% lower values of PP, and 3.9% lower values of MP for GPLC 3.0 and 4.5 g per day than baseline values. Conversely, 1.5 g GPLC produced 3% lower values of PP and 2.5% lower values of MP compared with baseline values. DEC values were 11.1% greater across the five sprint bouts with 4.5 g GPLC, 8.6% higher with 3.0 g GPLC, but the 1.5 g GPLC supplementation produced DEC values -5.5%, 3.6%, 4.5% and -1.8% different from the baseline values. DEC values were significantly different (p < 0.05) only 14min following sprints in the 1.5 g GPLC supplementation group. Conclusion The effects of GPLC supplementation on anaerobic work capacity and lactate accumulation appear to be dosage dependent. Four weeks of GPLC supplementation at 1.5 g and 4.5 g per day resulted in reduced power output and increased time of power decrement compared with values derived from baseline placebo testing. Supplementation of 1.5 g per day of GPLC produced enhanced values of MP and FP with significantly reduced lactate accumulation as previously reported with an initial acute 4.5 g dosage. Practical Applications GPLC appears to be a useful dietary supplement to enhance anaerobic work capacity and presumably sport performance, but the dosage must be specifically applied relative to the work challenges.

## Effect Of Starting Stance On Sprint Time In NAIA Volleyball Players

Trevor Johnson, Brown LE, Coburn JW, Judelson DA, Khamoui AV, Uribe BP, Tran T

Foot position (i.e. starting stance) likely plays an important role in influencing short-distance sprint speed, and therefore, the ability to reach a ball. PURPOSE: The purpose of this study was to evaluate four different starting stances on sprint speed. METHODS: Twenty-six NAIA collegiate volleyball players, (age: men 20.03 ± 2.9 yr; women 19.3 ± 1.25 yr; height: men 193.6 ± 0.5 cm; women 179.6 ± 0.7 cm; mass: men 83.5 ± 11.7 kg; women 69.4 ± 9.7 kg) volunteered to participate in one testing session. Each subject warmed up with a 3 min jog around the volleyball court. Following warm-up, subjects performed twelve 15ft sprints, completing three trials each of four starting stances (parallel [P], staggered [S], false-step [FS], and staggered false-step [SFS]). Investigators randomized stance order; RESULTS: A 2 x 4 x 4 design (stance condition x number of sprints x testing condition [Rest, Post-Static]) repeated measures ANOVA revealed there was no significant interaction of sex and condition; however, there were main effects for sex and condition. The main-effect for sex demonstrated that males were faster than females. The 1.5g stance produced faster speeds than the 2.5g stance.

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## CONCLUSION: This study indicates that starting with a staggered stance (whether employing a false step or not) produces the greatest sprinting velocity over the initial 15ft. Although taking a false-step seems counterproductive, the resultant stretch-shortening cycle likely increases force production of the push-off phase and therefore, sprint speed. The 5 stance might produce greater speeds by reducing movement time in response to a stimulus. PRACTICAL APPLICATIONS: Volleyball players might increase their sprint speed by utilizing either a staggered-false-step or a staggered stance prior to accelerating.
Abstracts

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Four position s: starting stance likely plays an important role in influencing short-distance sprint speed, and therefore, the ability to reach a ball. PURPOSE: The purpose of this study was to evaluate four different starting stances on sprint speed. METHODS: Twenty-six NAIA collegiate volleyball players, aged men 20.80±3.29 ys, women 19.31±1.25 ys, height men 191.28±8.15 cm, women 179.16±7.73 cm, mass men 83.52±11.79 kg, women 69.43±9.74 kg volunteered to participate in one testing session. Each subject warmed up with a 3 to 4 min jog around the volleyball court. Following warm-up, subjects performed twelve 15m sprints, completing three trials each of four starting stances (peaked [P], false-step [FS], staggered [S], and staggered false-step [SFS]). Investigators randomized stance order. RESULTS: A 2 x 4 (sex x condition) mixed-factor repeated measures ANOVA revealed there was no significant interaction of sex and condition; however, there were main effects for sex and condition. The mean effect for sex demonstrated that males were faster than females. Performance scores were significantly slower using the FS stance (2.15±0.09 s) than any other starting stance (SFS = 1.46±0.06, S = 1.66±0.07, FS = 1.88±0.10). The FS stance produced faster speeds than the S stance. CONCLUSION: This study indicates that starting with a staggered stance (whether employing a false step or not) produces the greatest sprinting velocity over the initial 15m. Although taking a false-step seems counterproductive, the resultant slight shortening of cycle likely increases force production of the push off phase and therefore, sprint speed. The 5 stance might produce greater speeds by reducing movement time in response to a stimulus. PRACTICAL APPLICATIONS: Volleyball players might increase their sprint speed by utilizing either a staggered false-step or a staggered stance prior to accelerating.

Efficacy Of Potentiation Of Shot Put Performance Through Pre-Activity Heavy Medicine Ball Throws
Lawrence W. Judge, David Bellar, Ellen I. Gluckman

It has become increasingly prevalent among track and field throwers’ coaches to utilize heavy implements as part of the pre-activity warm-up in an attempt to enhance shot put performance. Though the trend exists among coaches, little research has been done to test the efficacy of the use of heavy implements for enhancement of athletic performance. PURPOSE: To examine the potentiating effect of throwing a heavy medicine ball on subsequent standing shot put performance. METHODS: The participants were five college-aged female shot putters (age 20.5±1.7yrs, ht: 167.2±6.10 in, wt: 86.53±23.6kg, 80% 1RM) who each individually performed a standing shot put performance (11.29±2.2). A within-subjects design was used to compare the possible potentiating effects of throwing a heavy medicine ball prior to a competition shot put. Participants reported to the gymnasium on four separate occasions. On the first visit, participants became familiar with the technique of the standing shot put throw, and a maximal throw for height with a heavy medicine ball beginning from the ground. On the second through forth visits participants warmed up (~15 min of dynamic stretching) and then completed five, maximal effort, standing throws with a competition-industry shot put (4kg). Each attempt was preceded by one of three randomly assigned treatments. The treatments included a maximal effort throw for height with either an 8kg or 12kg medicine ball, or no medicine ball throw (control). The distance for each of the maximal effort shot put attempt was measured. RESULTS: ANDA (treatment x time) revealed no significant main effect for treatment (F(1,11)=7.36, p=0.02), or time (F(1,14)=4.94, p=0.04) as well as no significant interaction effects (F(1,11)=0.49, p=0.49, p=0.70). Compared to the control (8.5±1.5), the 8kg (11.5±1.5) and 12kg (10.5±1.5) treatments produced mean distances that were shorter, though the difference was not significant. CONCLUSION: In moderately trained female athletes the use of heavy medicine balls as part of the pre-activity warm-up does not enhance exercise performance based upon the data from the present investigation. Efficacy Of Potentiation Of Shot Put Performance Through Pre-Activity Heavy Medicine Ball Throws
Lawrence W. Judge, David Bellar, Ellen I. Gluckman

The Impact Of Certification On High School Strength Facilities, Equipment, And Safety/Utilization
Lawrence W. Judge, Jeffrey Petersen, Bruce Craig

Strength and conditioning facilities (SCFs) have become an integral component of high schools for use in physical education, athletics, and community wellness programs. The rapid growth and use of high school SCFs creates a need for research and better understanding of these facilities. PURPOSE: This study was developed to gather descriptive and quantitative data on the secondary school SCFs in a US Midwestern state and to assess the impact of the NSCA certified strength and conditioning specialist (CSCS) on factors such as equipment, facility size, and safety/ utilizaion. METHODS: A total of 396 questionnaires were distributed via email to high school athletic directors in the state. A 70-item survey instrument, developed with expert input from certified strength professionals, was utilized to collect data regarding the SCFs in high schools throughout the state. This survey was formatted for online completion using the InQsit system. All descriptive and one-way ANOVA statistical analyses were conducted on SPSS 19.0 with a p < 0.05 significance level. RESULTS: A total of 164 valid and complete surveys were returned for a response rate of 27.3%. These results were balanced amongst all school enrollment levels (1A to 5A) with 22.8% class 1A, 20.4% class 2A, 11.1% class 3A, 18.5% class 4A, and 27.8% class 5A. There were significant differences in equipment, facility size, and safety factors between school facilities with CSCS leadership and those without CSCS leadership. There were significantly greater numbers of bench press stations in CSCS led facilities (7.3±1.5) compared to non-CSCS led facilities (4.8±1.5; F(1,11)=11.20, p=0.001). The 8.86 mean number of squat stations for CSCS led facilities were significantly greater than the 4.40 mean squat stations for non-CSCS led facilities, F(1,11)=5.50, p=0.03. Additionally the mean number of power clean stations were significantly greater for CSCS led schools at 8.81±1.75 compared to 4.7±0.94 for non-CSCS led schools, F(1,11)=20.26, p<0.001. The average number of Olympic bars were significantly higher in CSCS led schools at 25.00 compared to 12.85 for non-CSCS led schools, F(1,11)=22.84, p<0.001. Mean facility size measured in square footage was significantly greater for CSCS led schools at 4833 square feet compared to 2444 square feet for non-CSCS led schools, F(1,8)=8.92, p=0.03. From a safety/utilization perspective the level of daily facility usage is significantly greater; F(1,10)=15.56, p<0.001, and CSCS led schools with an average of 27.6 users compared to 14.07 daily users for non-CSCS led facilities. Additionally, the maximum safe capacity estimated for each facility was significantly greater; F(1,10)=14.42, p<0.001, for CSCS operated facilities with a maximum capacity of 75.7% than for non-CSCS led facilities with a capacity of 47.7%. CONCLUSION: The leadership of a CSCS in interscholastic programs impacts facility use, the selection of equipment, and safety/ utilization. It appears the CSCS’s application of their scientific knowledge goes beyond training athletes for the goal of improving athletic performance as it actually influences the SCF. PRACTICAL APPLICATIONS: Athletic administrators at the high school level need to recognize the impact CSCS program leadership can have on the overall quality of the strength and conditioning program. Future research should expand this study to regional and national levels.

The Impact Of Certification On High School Strength Facilities, Equipment, And Safety/Utilization
Lawrence W. Judge, Jeffrey Petersen, Bruce Craig
Purpose: Electronic sensor armbands (ESA) appear to be valid and reliable in comparison to indirect calorimetry when measuring resting energy expenditure (EE). However, questions remain in terms of the ESA’s ability to measure EE under exercise conditions. The purpose of this study was to evaluate the validity and reliability of the ESA to estimate EE at rest and during selected activities of daily living.

Methods: Fifteen volunteers, 10 females (29 ± 11 yrs.) and 5 males (40 ± 14 yrs.) were assessed on two occasions. On the initial visit, height and weight were recorded. Following 10 minutes of quiet rest heart rate and blood pressure were recorded. Participants then completed 20 minutes of level walking on a treadmill. The treadmill exercise was divided into two stages of walking: 10 minutes at 1 mph followed by 10 minutes at 4 mph. Following the treadmill exercise, subjects completed a six minute self paced walk test and then 10 minutes of self paced stair walking (walking up and down a 3 storey staircase). Exercise was repeated for 5 minutes of quiet rest.

Throughout the protocol, EE was measured by mobile open circuit indirect calorimetry and the ESA. A mobile metabolic system (MMS) was used as the criterion measurement. Minute by minute oxygen uptake and respiratory exchange ratio (RER) was measured and EE kcal/min-1 was calculated by multiplying the oxygen uptake (L/min) by the caloric equivalent based on the RER. In the second visit, subjects rested for 10 minutes and then completed the treadmill protocol that was used during the initial visit.

Results: At the initial visit the EE estimated from the ESA were significantly higher than that recorded by the MMS at both 3 mph (4.8 ± 1.3 vs. 3.5 ± 1.6 kcal·min-1) and 4 mph (3.6 ± 1.7 vs. 2.7 ± 1.4 kcal·min-1) (p<.000). For the six minute walk test EE, ESA was 4.7 ± 1.8 kcal·min-1 vs. 3.5 ± 1.6 kcal·min-1 for the MMS. For the self paced stair exercise EE, ESA was 5.6 ± 1.6 kcal·min-1 and MMS was 6.6 ± 3.1 kcal·min-1 (p<.000). The second visit ESA EE at 3 mph was significantly higher than that observed on the MMS (4.5 ± 1.6 kcal·min-1 vs. 4.1 ± 1.7 kcal·min-1, p<.000). EE measures between the ESA and MMS demonstrated an intraclass correlation of .84 and Cronbach’s alpha of .90 p<.000 for the first visit and an intraclass correlation of .83 and Cronbach’s alpha of .90 p<.000 for the second visit.

Conclusion: The strong intraclass correlations suggest that the ESA was sensitive to changes in EE during treadmill walking. However, the ESA consistently overestimated EE for both self paced and treadmill walking and underestimated EE during self paced stair climbing.

Practice Application: The use of ESA to estimate EE during exercise is becoming increasingly popular and while these devices appear sensitive to variations in EE they have a tendency to overestimate EE. To improve the accuracy in these devices during activities such as self paced walking or stair climbing, subjects should be encouraged to wear them freely.
Relationship Between Dynamic Kinematics And Isometric Force-Time Characteristics

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Previous research has investigated the force-time curve characteristics of isometric muscle actions, however, few have addressed their relationship to the kinematics of dynamic movements. PURPOSE: The purpose of this study was to investigate relationships between dynamic kinematics (high pull peak velocity, high pull rate of velocity development, vertical jump peak velocity (VJPV), vertical jump rate of velocity development (VJRVD)) and isometric force-time curve characteristics (peak force (IsoPF), peak force relative to body mass (IsoPF/BM), rate of force development at various time frames (RFD50ms, RFD100ms, RFD150ms, RFD200ms, RFDMax)).

METHODS: Forty-eight men and women (age 22.83±1.75 y; height 173.43±9.08 cm; mass 72.24±17.63 kg) completed two testing sessions. The first session began with a five minute warm-up on a cycle ergometer at 50 rpm (25 watts). Following the warm-up, subjects performed three maximum isometric mid-thigh pulls with each repetition held for three seconds. All repetitions of the isometric and dynamic mid-thigh pulls were performed inside a power rack on a force plate that sampled at 1000Hz. On the second testing session, subjects completed the same five minute warm-up followed by three dynamic mid-thigh high pulls with a 30% Isotop load. Two position transducers attached adjacent to the bar collar determined high pull peak velocity and rate of velocity development. Following the dynamic high pulls, subjects performed three countermovement vertical jumps with arm swing on the force plate. Investigators determined VJPV by subtracting body weight from the force-time curve, dividing by body mass, and integrating with respect to time using the trapezoidal rule for numerical integration. VJPV resulted by calculating the slope of the velocity-time record.

RESULTS: VJPV significantly (p<0.05) correlated with IsoPF (r=0.531), IsoPF/BM (r=0.507), IsoPF200 (r=0.487), IsoPF250 (r=0.475), and IsoPF300 (r=0.380). VJRVD significantly (p<0.05) correlated with IsoPF (r=0.454), IsoPF200 (r=0.390), IsoPF250 (r=0.328), RFD50ms (r=0.359) and IsoPF/BM (r=0.394). No other variables significantly correlated.

CONCLUSIONS: These correlations suggest that explosive isometric force production within windows of 150-250ms appear to be associated with the ability to accelerate one's body mass and attain high velocity during dynamic movements. The weak correlations between vertical jump kinematics (VJPV, VJRVD) and IsoPF/IsoPF/BM indicate absolute isometric strength might exhibit greater transfer to dynamic performance than relative isometric strength.

PRACTICAL APPLICATIONS:

Individuals needing to accelerate their own body mass and achieve high velocities (such as in jumping and sprinting) may want to consider training modalities targeting both maximum power output and maximum strength within the context of a comprehensive strength and conditioning program.

The Effects Of Four Weeks Of High-Intensity Interval Training And Creation Supplementation On Critical Power And Anaerobic Working Capacity In College-Aged Men

Kristina L. Kendall, Jennifer L. Graef, Daniel H. Fukuda, Abbie E. Smith, Jordan R. Moon, Travis W. Beck, Joel T. Cramer, and Jeffrey R. Stout

The critical power test provides two measures, critical power (CP) and anaerobic working capacity (AWC). In theory, the CP measurement represents the maximal power output that can be maintained without fatigue, which is regarded as an aerobic measure. AWC is an estimate of work capacity associated with energy muscle reserves adenosine triphosphate (ATP) and phosphocreatine (PCr). High-intensity interval training (HIIT) has been shown to be an effective training method for improving endurance performance, including CP and AWC measures. In addition, creative supplementation has been reported to improve AWC without training; however, it had no effect on CP to date, so one has to examine the effect of CP supplementation during HIIT on CP and AWC.

PURPOSE: The purpose of this study was to examine the effects of four weeks of HIIT in conjunction with CP supplementation on CP and AWC in college-aged men.

METHODS: Forty-two recreationally active men (mean ± SD, age 23.62 ± 4.78 yrs; height: 177.45 ± 7.30 cm; weight: 82.53 ± 12.79kg) volunteered to participate in this study. Participants were assigned to one of three groups: CP (n=16) 10g Cr + 10g dextrose powder blend, placebo (PL, n=16) 20g dextrose powder blend, control (CON, n=10) no treatment.

Prior to and following supplementation, each participant performed a continuous maximal oxygen consumption test (VO2PEAK) on a cycle ergometer to establish peak power output (PPO). Participants then completed a CP test, consisting of three exercise bouts to exhaustion with the workload set as a percentage of their PPO to determine CP and AWC. Following initial testing, a 2-week familiarization period of training and supplementation occurred. Baseline values were then measured and all participants in the CP and PL groups engaged in 4 weeks of HIIT training on a cycle-ergometer. Training consisted of either five or six sets of 2 minutes with 1 minute passive rest, five days per week. Training intensity followed an undulating model starting at 80% PPO and reaching 120%.

RESULTS: Significant two-way interactions (time base- vs. post- x treatment) were observed. Baseline values were then measured and all participants in the CP and PL groups engaged in 4 weeks of HIIT training on a cycle-ergometer. Training consisted of either five or six sets of 2 minutes with 1 minute passive rest, five days per week. Training intensity followed an undulating model starting at 80% PPO and reaching 120%

CONCLUSIONS: Significant improvements were observed in both CP and AWC measures as a result of high-intensity interval training and supplementation with creatine. Further research is necessary to determine the optimal training parameters and supplementation to achieve maximum performance gains in college-aged men.

An Examination Of Biases And Perceptions Of Contemporary Strength And Conditioning Professionals At The University Level

Marcus W. Kijapipat, Jeremy M. Powers, Candis A. Ashley, Bill L. Campbell, & Robert F. Dedrick

The backgrounds of strength and conditioning coaches employed by Division I athletic programs are diverse. The diversity of the backgrounds can be described along a multitude of variables including educational background, professional certifications, physical size and fitness, and competitive playing experiences; to name a few. Though research has not addressed this matter directly, it is possible that the background and characteristics of strength and conditioning coaches may bias professional assessment of prospective hires. PURPOSE: Determine the presence of biases within a large sample of collegiate strength and conditioning coaches with respect to the relative importance of education, certifications, physical attributes, and playing experience. It is predicted that coaches will have biases that favor the qualities found in a coach that most closely resemble their own personal characteristics. METHODS: The design of the study utilized electronic mail recruitment of strength and conditioning coaches at all Division I athletic programs. One hundred fifty-six (34 female, 122 male, mean age = 33 years) full-time strength and conditioning professionals were interviewed. RESULTS: Analyses utilizing ANOVA and t-tests revealed several significant findings in line with the research hypothesis. Specifically, strength and conditioning coaches possessing CSCS certification indicated this characteristic is more essential than those coaches without that certification (P < 0.05; ES = 1.17). Coaches with degrees in the exercise science field indicated this characteristic is more essential than coaches trained in fields outside of exercise science (P < 0.05; ES = 0.86). Coaches with collegiate playing experience indicated that such experience is more essential than coaches without collegiate playing experience (P < 0.05; ES = 0.50). Lastly, coaches describing themselves as highly muscular indicated that being physically larger was more essential for a coach than those describing themselves as less muscular (P < 0.05; ES = 1.00). DISCUSSION: These results generally confirm the hypothesis that strength and conditioning professionals generally perceive their personal background to be more essential for effectiveness as a coach than are background characteristics they do not personally possess. While these findings are not surprising given the reality that our life experiences shape our perceptions, the work does confirm the perspective that many strength and conditioning professionals view their path to professional achievement as the most appropriate. PRACTICAL APPLICATION: This study indicates that aspiring young professionals should be fully aware that the professional opinions provided to them by current strength and conditioning coaches will be diminished over time as the field evolves and moves away from many existing stereotypes. Aspiring strength and conditioning coaches are encouraged to seek out all available means and all available professional counsel to improve their employment profile and enhance their candidacy for positions within the field.

Effects Of Beta-Alanine Supplementation On Performance And Body Composition In Collegiate Wrestlers And Football Players

Ben Kern, Dr. Tracey L. Robinson

Supplementation with β-alanine has been associated with improved strength, anaerobic endurance, body composition, and performance on tests of anaerobic power following training programs, including high-intensity interval training (HIIT) and heavy resistance training. Early studies for college wrestlers included repeated bouts of high-intensity exercise with intermittent rest periods, the type of training paradigms β-alanine has been shown to be an effective training method for improving endurance performance, including CP and AWC measures. In addition, creatine supplementation has been reported to improve AWC without training; however, it had no effect on CP to date, so one has to examine the effect of CP supplementation during HIIT on CP and AWC.

PURPOSE: The purpose of this study was to examine the effects of four weeks of HIIT on CP and AWC in collegiate wrestlers and football players.

METHODS: 22 Division II college wrestlers (n=14; 7 ± 1 y; age 20 ± 10 lbs) and 16 football players (n=16; 7 ± 10 lbs) completed this double-blind, placebo controlled study. Each subject received either 5g β-alanine or placebo in powdered capsule form. Subjects were treated 6 times post treatment on a 3:1:3:1:1:3 protocol. All participants performed a CP test, consisting of three exercise bouts to exhaustion with the workload set as a percentage of their PPO to determine CP and AWC measures. Prior to and following supplementation, each participant performed a continuous maximal oxygen consumption test (VO2PEAK) on a cycle-ergometer to establish peak power output (PPO). Participants then completed a CP test, consisting of three exercise bouts to exhaustion with the workload set as a percentage of their PPO to determine CP and AWC measures. In addition, creative supplementation has been reported to improve AWC without training; however, it had no effect on CP to date, so one has to examine the effect of CP supplementation during HIIT on CP and AWC.

RESULTS: Significant improvements were observed in both CP and AWC measures as a result of high-intensity interval training and supplementation with creatine. Further research is necessary to determine the optimal training parameters and supplementation to achieve maximum performance gains in college-aged men.

CONCLUSIONS: Significant improvements were observed in both CP and AWC measures as a result of high-intensity interval training and supplementation with creatine. Further research is necessary to determine the optimal training parameters and supplementation to achieve maximum performance gains in college-aged men.

PRACTICAL APPLICATIONS: These correlations suggest that explosive isometric force production within windows of 150-250ms appear to be associated with the ability to accelerate one’s body mass and attain high velocity during dynamic movements. The weak correlations between vertical jump kinematics (VJPV, VJRVD) and IsoPF/IsoPF/BM indicate absolute isometric strength might exhibit greater transfer to dynamic performance than relative isometric strength.
Effect Of Squat Depth On Vertical Jump Performance Variables

Tyler Kirby, Jeffrey M. McBride, Tony R. Larkin, Trace L. Hines, Andrea M. Dayne, Amanda R. Roberts

Maximizing vertical jump performance is a critical element to success in many athletic activities. Certain individual kinetic and kinematic variables may have greater contributing roles to vertical jump outcome. Squat depth prior to the initiation of the concentric motion would seem to have an impact on these variables, yet there are limited investigations comparing squat depths and vertical jump performance variables.

PURPOSE: To determine the effect of squat depth on vertical jump performance variables. METHODS: Seven recreationally-trained males (Height = 1.77±0.47 m, Weight = 83.6±0.10 kg) performed static (SJ) and countermovement jumps (CMJ) from six squat depths (0.15 m, 0.30 m, 0.45 m, 0.60 m, 0.75 m) for both the SJ and CMJ. RESULTS: Subjects had a weight bias across their upper body, which was unexpected and showed that the body position transverse to the bar did not move independently of the body while standing on a flat plate. Peak force (PF), impulse (I), and jump height (JH) were measured. RESULTS: Significant differences were found between 0.15 m squat depth and other squat depths (0.30 m, 0.45 m, 0.60 m, and 0.75 m) for both the SJ and CMJ. PF, I, and JH. SJ PF was significantly higher (p<0.05) at 0.15m (2823.9±318.5 N) in comparison to 0.30m (2283.7±230.6 N), 0.45m (1943.5±184.3 N), 0.60m (1791.2±214.2 N), 0.75m (1573.6±274.1 N). I was significantly lower at 0.15 m (2823.9±318.5 N) in comparison to 0.30m (377.8±53.1 N), 0.45m (413.6±41.2 N), 0.60m (526.0±62.5 N), 0.75m (597.3±58.1 N). JH was significantly lower at 0.15 m (0.275±0.046 m) in comparison to 0.30m (0.374±0.074 m), 0.45m (0.447±0.070 m), 0.60m (0.578±0.076 m), 0.75m (0.690±0.072 m). CMJ PF was significantly higher at 0.15m (2082.8±266.1 N) in comparison to 0.30m (1823.5±204.5 N), 0.45m (1434.1±171.7 N), 0.60m (1293.4±208.7 N), 0.75m (1131.4±187.2 N). CMJ I was significantly lower at 0.15 m (2082.8±266.1 N) in comparison to 0.30m (2082.8±266.1 N), 0.45m (1791.2±214.2 N), 0.60m (1573.6±274.1 N). CMJ JH was significantly lower at 0.15 m (0.275±0.046 m) in comparison to 0.30m (0.374±0.074 m), 0.45m (0.447±0.070 m), 0.60m (0.578±0.076 m), 0.75m (0.690±0.072 m). CMJ JH was significantly lower at 0.15 m (0.275±0.046 m) in comparison to 0.30m (0.374±0.074 m), 0.45m (0.447±0.070 m), 0.60m (0.578±0.076 m), 0.75m (0.690±0.072 m). CMJ JH was significantly lower at 0.15 m (0.275±0.046 m) in comparison to 0.30m (0.374±0.074 m), 0.45m (0.447±0.070 m), 0.60m (0.578±0.076 m), 0.75m (0.690±0.072 m). CMJ JH was significantly lower at 0.15 m (0.275±0.046 m) in comparison to 0.30m (0.374±0.074 m), 0.45m (0.447±0.070 m), 0.60m (0.578±0.076 m), 0.75m (0.690±0.072 m). CMJ JH was significantly lower at 0.15 m (0.275±0.046 m) in comparison to 0.30m (0.374±0.074 m), 0.45m (0.447±0.070 m), 0.60m (0.578±0.076 m), 0.75m (0.690±0.072 m). CMJ JH was significantly lower at 0.15 m (0.275±0.046 m) in comparison to 0.30m (0.374±0.074 m), 0.45m (0.447±0.070 m), 0.60m (0.578±0.076 m), 0.75m (0.690±0.072 m). CMJ JH was significantly lower at 0.15 m (0.275±0.046 m) in comparison to 0.30m (0.374±0.074 m), 0.45m (0.447±0.070 m), 0.60m (0.578±0.076 m), 0.75m (0.690±0.072 m). CMJ JH was significantly lower at 0.15 m (0.275±0.046 m) in comparison to 0.30m (0.374±0.074 m), 0.45m (0.447±0.070 m), 0.60m (0.578±0.076 m), 0.75m (0.690±0.072 m). CMJ JH was significantly lower at 0.15 m (0.275±0.046 m) in comparison to 0.30m (0.374±0.074 m), 0.45m (0.447±0.070 m), 0.60m (0.578±0.076 m), 0.75m (0.690±0.072 m).

A major objective in volleyball training is to increase vertical jump height and jump speed. Various training approaches have been attempted to enhance the specificity of training for these elements of the game. Further investigation is needed to determine the degree to which selected jump training techniques might enhance game-specific performance. The purpose of this study was to determine the effect of speed jump training on countermovement vertical jump (CMJ), 3-step approach vertical jump (AVJ), standing blocking transition jump (SBTJ), and approach blocking transition jump (ABTJ). Female volleyball players (n = 21, age 15-21 yrs) served as subjects. Prior to training, each athlete was measured for maximum CMJ and AVJ using a vertical pole with movable veins that measured vertical touch height. The training program consisted of performing 4 sets of reactive jumps and was performed 3 times/week for 4 weeks on an automated jump mat that recorded ground reaction time and the average of the 4 jumps. During training, each athlete attempted to perform her jumps as quickly as possible while maintaining an average jump height of at least 85% of their best CMJ. Following training, players improved significantly in CMJ (20.7±2.2 to 21.0±2.2 ins), AVJ (21.9±3.7 to 22.5±2.8 ins), SBTJ (17.7±2.9 to 20.0±2.4 ins), and ABTJ (20.5±3.1 to 22.4±2.4 ins). The relative increase in SBTJ (4.0±0.9%) was significantly greater than for AVTJ (1.7±0.0%), AVJ (0.9±0.2%), and HJ (4.8±2.4%), with no significant difference noted among the latter. It appears that concentrating on quickness in jump training while attempting to maintain a near-maximal effort can produce improvements in both jumping performance and game-specific quickness.
Effects of Six Weeks Periodized Squat Training With Or Without Whole Body Vibratory Stimulation Upon the Relationship Between Isometric and Dynamic Performance

Hugh Lamont, Joel T. Cromer, Christopher MacDonald, Michael G. Bemben

Research training interventions aimed at increasing lower body power and rates of force development have produced varying results. Potentially, the use of WBV in between sets of resistance training may increase high-threshold motor unit recruitment and synchronization leading to greater adaptations in both isometric and dynamic performance. The relationship between isometric force/time characteristics and dynamic performance and their respective changes in response to resistance training is of practical importance to strength and conditioning practitioners. PURPOSE: To determine the effects of applying whole body vibration prior to and immediately between sets of Smith Machine squat upon induced changes in isometric and dynamic performance and their relationships to one another. METHODS: Twenty-four recreationally resistance trained men were randomly assigned to one of two groups, resistance only (SQI < 11), or resistance plus whole body vibration (SQI > 11). An isometric squat test as well as Squat Jumps (SQJ) and Depth Jumps (DJ) were performed prior to and following a six-week, periodized Smith Machine squat program. WBV was applied 180 s prior to the first work set (S2H: 1-rep max, 20s) and immediately following (S3H: 4-6rm, 30s) for fifteen subjects (S4H: 6-10, 10s) between exercise within a 24s inter-set rest period. Subjects were instructed to assume a quarter squat posture while positioning their feet directly under their center of mass which was modified using a hand-held gimbal to a knee angle of 135° ± 5°. Measures of isometric force (N) and isometric rates of force development (N/s) were recorded from the onset of contraction (F0) to time points corresponding to F30ms, F80ms, F250ms, Force at initial peak (Finitial), Force at 50% of MVC (MVC50) Time Finitial (ms) as well as the Peak Isometric Power (Pav, W) for both jump conditions. RESULTS: Correlation matrices matching isometric force/time variables and dynamic (SQJ, DJ) performance. PURPOSE: The purpose of this investigation was to determine if a cycling warm-up that included a maximal overload would elicit a PAP effect and increase subsequent sprint cycling power output. METHODS: Ten (age: 22 ± 3 yrs, mass: 75% ± 15% to 117 ± 13% [cm]) recreationally trained athletic males (n=10) and females (n=1) participated in a study designed to consist of two randomly ordered sessions of sprint cycling on a bicycle ergometer with computer interface to assess power output. Two warm-up conditions were employed over two days. The standard warm-up condition consisted of a 4-minute stationary cycle ride with little resistance (1 kg) at a self-selected cadence. The overload warm-up condition consisted of the standard warm-up plus an overload condition. That is, after the standard warm-up, the overload condition subjects performed 4 minutes while the weight basket was loaded to full capacity (10 kg). At 4 minutes, subjects pedaled the cycle as fast as possible. At maximal pedaling rpm, the weight basket was dropped manually, loading the cycle and starting a 10-second time. In order to elicit complete fatigue (9 out 10 peak) within 8-10 seconds, the researcher pressed down on the weight basket thereby non-occluding resistance. After completing each individual warm-up condition, subjects then repeated for 4 minutes, while 7.5% of the subject's body weight (kg) was loaded on the weight basket. At the 4-minute mark, subjects then pedaled the cycle as fast as possible. Once the subject reached 150 rpm (near maximal) on the cycle, the weight basket dropped, loading the cycle and starting a 10-second time; the subject continued to pedal as hard as possible throughout the 10 second test. Paired Sample T test was used to determine if there was a significant difference (p < 0.05) in relative power output between the two conditions. RESULTS: The results of this study demonstrated a significant increase in relative power output (13.1 ± 3.0 vs. 13.4 ± 3.0 and 1032 ± 273 vs. 1002 ± 275, respectively) after subjects performed a maximal sprint cycle overload as compared to a standard warm-up. Despite an increase in power in the overload condition, no difference was observed in fatigued percent power drop between the two conditions. CONCLUSIONS: Data from this study suggest that the use of an overload sprint cycle warm-up may enhance activities where peak power output is required and needs to be maintained for short bouts. PRACTICAL APPLICATIONS: The coach may consider using this type of variation in overload during their dynamic, athletic warm-up to optimize performance in sports where peak and short-term power output are key components of competition.
Purpose: The present research sought to develop and validate a novel instrument for the assessment of body image dissatisfaction and negative health behaviors in adolescent males. Additionally, the research was focused on providing a useful tool for the strength and conditioning professional to use when assessing athletic performance for the sport related to their sport performance. Methods: A comprehensive search of relevant medical and socio-behavioral databases was conducted for years 1990-2005 yielding 250 useful studies (244 empirical and 49 theoretical) for inclusion in a content analysis. Search terms included body image, ‘adolescence’, ‘satisfaction’, and ‘negative’. Statistically relevant interpersonal, intrapersonal, and social factors were coded and classified. The most statistically relevant factors were formulated into questions and subscales to form the overall pilot instrument. The instrument was piloted with a sample of 27 adolescent boys and was adjusted and revised based on feedback. Results: The initial instrument was reviewed by a panel of five content area experts. Each of the 28 scale questions were evaluated for relevance and readability. Four out of the five experts (80%) approved the questions to be included in the scale. Content, face, disconfirm, and convergent validity was established using the objective measures evaluated by expert panel. Each of the final 28 questions was determined to be appropriate and valid to be included in the scale. Nine questions were omitted based on the evaluation and inclusion criteria. Initial pilot reliability was judged to be somewhat acceptable for the body image scale with a Cronbach α = 0.66, final reliability of the Adolescent Body Image Satisfaction Scale (ABISS) after the modification of 9 items was judged to be acceptable with a Cronbach α = 0.82. Conclusions: Following the adjustments made to the ABISS during the pilot study, the instrument was used to study 330 adolescent males. Based on subjectives as well as objective feedback, the ABISS appears to be a valid and reliable instrument that can be used to measure the psychosocial attributes of adolescent males pertaining to body image satisfaction. Practical Applications: Strength and conditioning professionals should be aware of the psychological attributes of their athletes and clients as much as their physiologic attributes. Having an understanding of how adolescents view their bodies and the image of ideal professionals in designing appropriate, health-promotive strength programs, while at the same time monitoring for signs of body image dissatisfaction, which can lead to negative health practices (e.g., performance-enhancing drug use, exercise additions, disorders eating). The ABISS appears to be a valid and reliable instrument to assess for the aforementioned features, but should be further validated with other populations.

The Effects Of Growth And Maturation On Leg Stiffness And Reactive Strength Index In Youths Aged 7 – 18 Years
Rhodi Lloyd, Oliver, Jon Hughes, Michael Williams, Craig

Stretch-shortening cycle (SCC) function, recognized as fundamental for effective plyometrics and sprinting, can be estimated from measures of leg stiffness and reactive strength index (RSI). Whilst published data for these measures exist for adult populations, limited data is available within pediatric populations. Given the significance of SCC to explosive ability, it is deemed necessary to identify potential sensitive periods of growth and development which may produce accelerated adaptations. PURPOSE: (i) determine differences in leg stiffness and RSI between chronologically- and maturity-divided groups of school children (2nd-11th Grade); and (ii) investigate whether age- or maturity-related factors were dominant contributions to RSI and leg stiffness performance. METHODS: Two hundred and eighty high school-aged boys performed four maximal hopping trials and a single trial of sub-maximal hopping (2.9 Hz). RSI was calculated from the maximal hopping trial, while leg stiffness was calculated from the sub-maximal trial. Additionally, four trials of both squat (S); and countermovement-jumps (CMJ) were performed, representing concentric strength and slow SSC respectively, with the mean of the best two jump heights being used for analysis. RESULTS: One-way ANOVA revealed significant increases in leg stiffness between grades 3-5 and 11-12, and between grades 4-5 and 7-10 for RSI. When grouped according to estimated maturity, significant differences were found for both leg stiffness and RSI between < 3 yrs pre-PHV (mean = 3.10°) and PHV (mean = 0.65°) yr, and between PHV and > 3 yrs post-PHV (mean = 2.39°) yr. Multiple stepwise regression analysis revealed that body mass (R2 change = 0.62), RSI (R2 change = 0.52) and maturity status (R2 change = 0.52) produced the greatest explained variance for leg stiffness (R2 = 0.66; p < 0.001). When leg stiffness was normalized to body mass, height (R2 change = 0.38), RSI (R2 change = 0.30) and maturity (R2 change = 0.30) produced the greatest explained variance (R2 = 0.40; p < 0.001). For RSI, SICR change = 0.54, stiffness (R2 change = 0.30), body mass (R2 change = 0.29), CMJ (R2 change = 0.21) and age (R2 change = 0.11) produced the largest explained variance (R2 = 0.61; p < 0.02). Statistics for both tolerance (R2 change = 0.21) and VP (R2 change = 0.11) supported minimal risk of multicollinearity for both models. CONCLUSIONS: The greatest variance in leg stiffness and RSI could be explained by maturational factors (Body mass and concentric strength respectively). Therefore the windows of accelerated adaptation should be expressed in relation to the onset of PHV as opposed to chronological age. Three years pre- and post-PHV should be considered as suitable windows in which to maximize SCC adaptation. PRACTICAL APPLICATIONS: Periods of accelerated adaptation have been suggested to reflect a time when a system(s) is most sensitive to manipulation, therefore SCC-type training may be most beneficial during the identified maturity related periods of accelerated adaptation. Within these identified periods training emphasis should be placed on concentric strength expression for RSI development. Whilst body mass was identified as the main contributor to leg stiffness, owing to the limited amount of explained variance for relative leg stiffness alternative biomechanical, neuromuscular or motor control variables should be considered in future research.

The Validity Of The Kansas Squat Test For Track And Field Sprinters And Jumpers
Paul Lubbers, Andrew C. Fry

The ability to generate power is an essential component to achieving optimal performance in several track and field events, particularly the throws, sprints and jumps. The Winging Ankle Test (WAnT) is one of the most established forms of standardized anaerobic power testing. The WAnT is performed utilizing a cycle ergometer and has been shown to be both reliable and valid. Sprinters and jumpers train for power using a combination of running and strength training techniques. The WAnT may be appropriate for testing the running component of training due to its cyclical nature, but it might not be the most fitting test for addressing the more linear weight lifting component. A linear power test could allow for a more comprehensive assessment of the trained status of sprinters and jumpers than a cyclic test alone. The Kansas Squat Test (KST) is a repetitive lifting test that has been designed to measure similar indices of power as the WAnT. PURPOSE: To examine the relationship between the WAnT and KST on measures of Power-Fast (PF), Average Power (AP), Minimum Power (MP), Fatigue (% Power Drop [PTD]), and Post-test Lactic (Lac) for collegiate track and field sprinters and jumpers. METHODS: Seven male (72.91±10.0kg, 180.70±4.0cm) and seven female (64.43±10.05kg, 171.63±5.15cm) members of a collegiate track and field sprinters and jumpers squad participated in this study. Each participant completed separate familiarization sessions with both the WAnT and KST prior to the data collection sessions. One-Arm Squat was determined using a smith machine, also during an individual session. The data collection sessions were conducted at the beginning of track practice, separated by one week. The WAnT 30-second test was performed using a cycle ergometer with resistance set at 0.67 kg/dm. The KST was performed using the smith machine and consisted of 15 repetitions of speed squat at a cadence of 1 RM/sec-1. The external KST load was calculated using the system mass as (BM = RAnk X 754.84). KST power measures were determined using an external dynamometer utilizing system mass (BM = KST Load). Pre- and post-test lactic acid concentrations were also recorded. RESULTS: Pearson correlations between the WAnT and KST are as follows: PF: r = 0.892°, AP: r = 0.875°, MP: r = 0.839°, PCT: r = 0.369°, Lact: r = 0.110°. (p<0.01). CONCLUSION: These data indicate that the KST is a reliable alternative to the WAnT for measuring Peak, Average and Minimum Power for sprinters and jumpers. PRACTICAL APPLICATIONS: Collegiate track and field sprinters and jumpers train for power using both running and weightlifting exercises. The current study demonstrates a potential testing method that is specific to which, when incorporated into a testing battery, may aid in providing a more comprehensive analysis of the athlete’s power status.
Abstracts

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The ability to generate power is an essential component to achieving optimal performance in several track and field events, particularly the throws, sprints and jumps. The Wingate Anaerobic Test (WAnT) is one of the most established forms of standardized anaerobic power testing. The WAnT is performed utilizing a cycle ergometer and has been shown to be both reliable and valid. Sprinters and jumpers train for power using a combination of running and strength training techniques. The WAnT may be appropriate for testing the running component of training due to its cyclical nature, but it might not be the most fitting test for addressing the more linear weight lifting component. A specific power test could allow for a more comprehensive assessment of the trained status of sprinters and jumpers than a cyclic test alone. The Kansas Squat Test (KST) is a repetitive lifting test that has been designed to measure similar indices of power as the WAnT. PURPOSE: To examine the relationship between the WAnT and the KST on measures of Peak Power (PP), Average Power (AP), Minimum Power (MP), Fatigue %, Power Drop (FTP), and Post-test Lactate (La) for collegiate track and field sprinters and jumpers. METHODS: Seven male (72.91±10.0kg, 180.70±4.0cm) and seven female (64.43±10.0kg, 171.63±3.5cm) members of a collegiate track and field sprinters and jumpers squad participated in this study. Each participant completed separate familiarization sessions with both the WAnT and KST prior to the data collection sessions. A 1-RM squat was determined using a smith machine, also during an individual session. The data collection sessions were conducted at the beginning of track practice, separated by one week. The WAnT 3rd second test was performed using a cycle ergometer with resistance set at 0.0 kg/m. The KST was performed using the smith machine and consisted of 10 repetitions of speed squat at a cadence of 1 lift/sec. The external KST load was calculated using the system mass as (BM+1-RM)/70-BM. KST power measures were determined using an external dynamometer utilizing system mass (BM+KST Load). Pre- and post-test lactate concentrations were also recorded. RESULTS: Pearson correlations between the WAnT and KST are as follows: Rr = 0.89*; ARr = 0.87*; MP = 0.89; FTP = -0.30; La = 0.30. *p<0.05. CONCLUSION: These data indicate that the KST is a feasible alternative to the WAnT for measuring Peak, Average and Minimum Power for sprinters and jumpers. PRACTICAL APPLICATIONS: Collegiate track and field sprinters and jumpers train for power using both running and weightlifting exercises. The current study demonstrates a potential testing method that is lift-specific which, when incorporated into a testing battery, may aid in providing a more comprehensive analysis of the athlete's power status.

Upper Body Muscular Endurance Among Active Duty Male And Female Firefighters

Peter Maguary, Tom Fonger, Jessica May

Purpose: This study was conducted to examine the age and sex related differences in upper body muscular endurance among active duty fire- fighters (FF). METHODS: Muscular endurance was assessed using the standard YMCA Bench Press protocol on 533 (302 male and 231 female) active duty FF. Subjects were categorized by sex (M: 35 years of age or ≥35 years of age) and sex (male or female). Male FF lifted a 80 pound bar and female FF a 55 pound bar through full range of motion, at a set cadence, with proper form until subjects reached fatigue. Raw scores as well as age and gender percentile rankings were then analyzed to determine if differences exist. Level of significance was set at p < 0.05. Results: Significant main sex score differences existed between young (17-36 yrs) and old (≥35 yrs) male FF but not between young (17-36 yrs) and old (≥35 yrs) female FF. Significant main sex score differences existed in both age categories. When scores were compared to age and sex stratified normative data, the mean percentile ranking of the old male FF (76%) was significantly greater than the percentile ranking of the young male FF (76%). Again, no differences existed among the percentile rankings of young (86%) and old (86%) female FF. Female FF ranked significantly higher than male FF when compared to normative data in both age categories. Conclusions: Both male and female FF have a high level of upper body muscular endurance. Age has a greater impact on upper body muscular endurance in male FF. Female FF score higher than male FF when the YMCA Bench Press test is used to assess upper body muscular endurance. Practical Applications: Further study in this area is needed to identify whether the age related decrease in muscle endurance observed in male FF is task relevant.

Transference Of Kettlebell Training To Traditional Olympic Weight Lifting And Muscular Endurance

Pat Manocchia, David K. Spierer, Jackie Minichello, Steven Bura, Jessica Castro, Ross Markowitz

PURPOSE: Kettlebells are commonly used across a broad spectrum of strength and conditioning programs, from novice or beginner recreational users to elite level athletes. Many of the movements conducted with kettlebells are of a ballistic nature, similar to that of Olympic Lifts. Since ket- tlebell training and Olympic lifts display some similarities regarding the technique, we hypothesized that training with kettlebells would translate into a resultant improvement in strength and power during Olympic style lifts. This may be of significance when designing proper training regi- mens or seeking an alternative program to traditional lifting. The research data purports the efficacy of adaptations to the training group, who had prior complex training experience. PRACTICAL APPLICATIONS: Results from the current study suggest that complex training mirrors the benefits seen with traditional resistance or plyometric training. Moreover, complex training revealed no decrement in strength and anthropometric values and it appears to be a viable training modality. Further, complex training allows for the incorporation of various modulations into a single-week session, offering variability and time efficient training regimens into a power athlete's periodization. Further research is warranted to determine the optim- al set/repetition/timeing scheme of complex training, in this population, to maximize the benefits of this hybrid training method.
Educational Contents Analysis Of Ncca Accredited Personal Training Certification Programs

Iván Gonzalo Martínez, Pedro J. Benito, Peinado Esther, Moreno Martínez

We are attending a vertiginous growth of the implantation of personal training (PT) services in Spain. However, there’s a great confusion on what type of knowledge, skills and abilities (KSA) should PT have due to its wide and fast implementation, together with the absence of professional regulation.

PURPOSE: The aim of this study is to determine the relative importance that several international certifications, accredited by National Commission For Certifying Agencies (NCCA) as of December 2008, grants to different knowledge fields. METHODS: Contents of 10 PT certifications programs were analyzed: NSCA, ACSM, NASM, AAD, IFPA, NSCA, NETA, NPTP and The Cooper Institute. Distribution of the contents in 8 categories that include all KSA that should have a PT according to these organizations. A international panel of experts validated the selection and definition of the categories, afterwards we distributed the contents of such certification in these categories. When any content didn’t agree exactly with those owned to this study, an interpretation was carried out, assigning the relative importance based on panel of experts criteria. Statistical analysis used measures of central tendency (mean and standard deviation), as well as coefficient of variability (CV), using SPSS software (v.15.0; SPSS, Inc, Chicago, IL). RESULTS: The categories resulted from the analysis are (Table 1): exercise programming and prescription (EP), applied sciences (AS), physical fitness testing and interpretation (FTT), exercise technique (ET), nutrition (N), marketing and business applications (MB), safety and emergency management (SEM), legal issues (LI). The most relevant category is ET, as expected due to the importance of exercises technique (47%); with CV <0.50. The second category is EP, with 39% of the contents, and also with high CV (17%). Both categories have a great relevance. The importance of EP is related to the increasing number of personal training programs in Spain. The AS and FTT categories were very similar (15% each) and have high variability too. The LI and MB categories have similar lower importance like other certification programs, which show that they have a low demand. CONCLUSIONS: PT is a growing sector in Spain with a great relevance of ET and EP. Therefore, personal training programs should distribute their contents and load assigned to them in a similar way to the results obtained in this study.

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Difference In 40-Yd Dash And Pro-Agility Times On Artificial Turf And Natural Grass

Jerry Mayhew, Graydon Gaines, Andrey Swedenhjelm, Jesse Cooper, Michael Bird, and Jeremy Houser

Artificial turf may be the start of the art for the playing surface in football. Anecdotal evidence suggests that artificial turf may enhance sprint speed, but there seems to be little scientific data to support this claim. Purpose: The purpose of this study was to determine the difference in 40-yd dash and pro-agility time on artificial turf (AT) and natural grass (NG). Methods: Red-shirt freshmen Div II college football players (n = 24) performed two trials each of a 40-yd dash and pro-agility run on each surface. The first test series was performed on AT, and the second test series was performed a week later on NG. Players wore shorts, T-shirts, and regulation football cleats. Two sprints were timed by an electronic timing system (ET) and by 2 hand timers (HT). Agility was timed on each surface by 2 hand timers; the average of the two times was used. Results: Intraclass correlation coefficients (ICC) for repeated trials ranged from 0.50 (pro-agility) to 0.89 (40-yd dash). There was no significant difference in 45-yd dash times between ET on turf (3.39 ± 0.31 s) and on NG (3.32 ± 0.31 s). HT 40-yd dashes (AT: 5.12 ± 0.30 s, NG: 5.16 ± 0.30 s) were significantly faster than ET 40-yd dashes (AT: 5.39 ± 0.30 s, NG: 5.38 ± 0.30 s) on both surfaces. The difference between HT and ET on turf (2.38 ± 0.46 s) was significantly greater than the difference on NG (0.23 ± 0.05 s), and the differences were monotonically correlated (SEC = 0.21). The relationship between the difference between HT and ET vs the criterion ET was greater for NG (r = 0.65, p<0.01) than for AT (r = 0.16, p>0.35). Pro-agility times were significantly faster on turf (46.4 ± 0.28 s) than on grass (47.6 ± 0.32 s). Conclusions: Sprint speed is no faster on AT than on NG, but cutting speed may be faster on AT. Based on the difference between HT and ET, hand-timers may disproportionately anticipate players to be faster on AT than on NG. Furthermore, the slower a player is on NG, the faster his time was anticipated to be by HT. Practical Application: Artificial turf may not enhance straight-ahead speed but may add change-of-direction speed in college football players. Anticipation of straight-ahead speed by hand-timers may cause a slightly faster recording of 45-yd dash speed when sprints are performed on AT.

Effect Of Absolute And Relative Loading On Muscle Activity During Stable And Unstable Squatting

Jeffrey McBride, Tony R. Larkin, Andrea M. Dayne, Tracie L. Haines, Tyler J. Kirby

Studies have reported various results with respect to the level of muscle activity present during the performance of exercises in stable and unstable conditions. Some of the contradictions may be due to the use of relative or absolute loading during the comparisons of the two conditions. PURPOSE: The purpose of this investigation was to determine the effect of stable and unstable conditions on one repetition maximum strength and muscle activity during dynamic squatting using both relative and absolute loading. METHODS: Ten recreationally trained male participants completed this study (age = 24 ± 1.6 y, height = 170.0 ± 5.6 cm, body mass = 83.7 ± 14.9 kg, BMI (body mass = 23.0 ± 3.1)), which involved two laboratory sessions separated by one week. Linear position transducers were used to track bar displacement; the subjects stood on force plates for all trials. Vastus lateralis (VL), biceps femoris (BF) and erector spinae (L1) muscle activity (average integrated EMG (IEMG)) was recorded during all sessions. During the first session subjects completed a one repetition maximum test in a stable (SAM) using 1RM (128.0 ± 4.0 kg) and an unstable dynamic squat (USAM) using 0.81 (17.3 kg) in a randomized order with a thirty minute rest period between conditions. The second session consisted of the performance of three trials each for twelve different conditions in a randomized order: 1) unstable squatting using 70% of USAM, 2) unstable squats using 80% of USAM, 3) unstable squats using 80% of USAM, 4) stable squatting using 80% of USAM, 5) stable squat using 80% of USAM, 6) unstable squats using 80% of USAM, 7) unstable squats using 80% of USAM, 8) unstable squats using 80% of USAM, 10) unstable squats using 80% of USAM. RESULTS: Significant differences between conditions were observed for all muscles with the exception of USAM, 80% and 80% squat conditions. The USAM was greater than both conditions (p = 0.01). Interactions between the three conditions (USAM, 80% squat and 80% squat) were also observed for all muscles except for USAM, 80% squat and 80% squat conditions. CONCLUSIONS: It appears that the change in dynamic squatting results in the same or significantly lower values of muscle activity in comparison to stable squatting.
The Relationship Between Unilateral and Bilateral Jump Kinematics and Sprint Performance
Kevin McCurdy, John Walker, Mike Guerrero, Matt Kutz

Purpose: The purpose of this study was to determine the relationship between measures of unilateral and bilateral jumping performance and 10- and 25-meter sprint performance. Methods: Fifteen division I women soccer players (height 165 ± 2.44 cm, mass 61.65 ± 7.7 kg, age 20.19 ± 0.91 yrs) volunteered to participate in this study. After a 10-minute warm-up and dynamic stretching, the subjects completed a 10-meter and 25-meter sprint test. Sprint time was measured with an accelerometer using an electronic timing gate systems (Inform Sport Training Systems, Victoria, BC, Canada). The accelerometer was at the waist, which also measured step length, step frequency and jump kinematics. The following jump kinematic variables were measured: vertical jump height, horizontal jump distance, total contact time (at ground through concentric time), concentric contact time, and flight time. The first trial at each sprint distance was completed with 2 minutes of rest between trials before the best time was recorded for analysis. After a minimum of 40 hours of rest, the subjects completed the jump tests. After a 10-minute warm-up and dynamic stretching, the following jumps were completed in random order with at least a 1-minute rest period between each trial: bilateral countermovement vertical jump (UCV), bilateral countermovement horizontal jump (UHV), bilateral 40 cm drop vertical jump (BDV), bilateral 40 cm drop horizontal jump (BDH), unilateral countermovement vertical jump (UCV), unilateral countermovement horizontal jump (UCH), unilateral 20 cm drop vertical jump (UDV), and unilateral 20 cm drop horizontal jump (UDH). The unilateral jumps were performed on each leg. The trial with the best reactive strength (RS) (jump height or distance/total contact time) was recorded to analyze the relationship between jump kinematics and sprint performance. The relationship between the best flight time to concentric contact time ratio (FT/CCT) and sprint performance was also analyzed. Results: None of the bilateral jump kinematics significantly correlated with 10 m and 25 m sprint times, step length, or step frequency. However, RS significantly correlated with 25 m step length during the left leg UCV (r = 0.6, p ≤ 0.02, SEE = 0.057 m). Right leg jump height (r = 0.71, p ≤ 0.006, SEE = 0.126 m), RS (r = 0.67, p ≤ 0.012, SEE = 0.161 m), and FT/CCT (r = 0.58, p ≤ 0.048, SEE = 0.176 m) were significantly correlated with the 25 m step time during the UCV. Right leg FT/CCT was also significantly related to 25 m step length (r = 0.66, p ≤ 0.013, SEE = 0.06 m) during the UCV. Conclusion: In comparison to bilateral jumps, unilateral vertical jumps produced a stronger relationship with sprint performance. Ankle drop height (STD) was not significantly different across conditions (see Table 1). The average time for the six trials was 13.37 ±0.50 s. The average drop off, the difference between the best and worst time was less in Jan compared to Sep (2.09±0.52 s vs 2.70±1.14 s; p<0.05). The Fatigue Index, defined as the ratio of the best and worst time was less in Jan compared to Sep (0.67±0.14 vs 0.76±0.21; p<0.05). The FT/CCT ratio was significantly higher in Jan compared to Sep (2.17±0.32 vs 2.00±0.29; p<0.05). Significant correlations were found between VO2 max and drop off: r = 0.45 (p = 0.05), drop off percentage: r = 0.45 (p = 0.05) and worst time: r = -0.49 (p = 0.05). Lactate recovery was significantly related to drop off: r1 = 0.49 (p ≤ 0.05) and drop off percentage: r2 = 0.54 (p = 0.05). The peak lactate was 12.56 ± 2.30 mMol/L. Significant correlations were found between VO2 max and peak lactate: r = 0.47 (p ≤ 0.05), VO2 max and drop off: r = 0.47 (p = 0.05), VO2 max and drop off percentage: r = 0.45 (p ≤ 0.05). There were no differences for the time of each repeat between Sep and Jan. There was also no change in fastest time for any of the repeats. The average of the six subjects was significantly lower in Jan compared to Sep (1.87±0.23 vs 1.95±0.30; p<0.05). The average drop off from the first to the sixth repeat was 2.09±1.14 s for Jan and 2.70±1.14 s for Sep (p<0.05). Significant correlations were found between VO2 max and drop off: r = 0.45 (p = 0.05), drop off percentage: r = 0.45 (p = 0.05), VO2 max and drop off: r = 0.47 (p = 0.05). There were no differences for the time of each repeat between Sep and Jan. There was also no change in fastest time for any of the repeats. VO2 max and lactate recovery were related to repeat sprint ability in college hockey players.

Edward McNeely, Stephanie Millette, Ken Brunet and Kevin Wilson

PURPOSE: Hockey is a repeat sprint sport with shifts lasting 30-60 seconds. Hockey players will perform 60-90 sprints per game depending on position and level of play. It has been suggested that aerobic fitness and blood lactate removal ability play a role in recovery between sprints and the ability to maintain speed or power output during repeat sprint activities. The purpose of this study was to determine the relationship between repeat sprint ability and aerobic fitness and lactate removal in elite hockey players. METHODS: Data collected on 21 Division I male hockey players, forwards and defencemen, during fitness testing at pre-season training camp was used in the study. Testing was conducted in two weeks, a week prior to the first session the participants performed the Repeat Sprint Test, an on ice test that involves skating from the goal line to the far goal line and back to the near blue line, covering 300 feet. A repeat is performed every 30 seconds for a total of six repeats. Subjects are electronically timed for each repeat. After the final repeat heart rate recovery is measured every 30s for the first two minutes of the recovery period. Blood lactate samples are taken 60, 180, and 300 seconds after the final repeat. In the second session all subjects completed a multistage ramp test on a Monark bicycle ergometer to determine VO2 max. Expired gases were collected throughout the test and analyzed on a Sensormedics VMax metabolic cart. The test was terminated when the subjects could not maintain the required workload. RESULTS: Mean time for each repeat can be seen in Table 1. There were no differences for the time of each repeat between Sept and Jan. There was also no change in fastest time for any of the repeats. The average time of the six subjects was significantly lower in Jan compared to Sep (13.69±0.58 vs 14.18±0.50; p<0.05). The average drop off from the first to the sixth repeat was 2.09±1.14 s for Jan and 2.70±1.14 s for Sep (p<0.05). Significant correlations were found between VO2 max and drop off: r = 0.47 (p = 0.05), VO2 max and drop off percentage: r = 0.45 (p ≤ 0.05) and VO2 max and worst time: r = -0.49 (p = 0.05). Lactate recovery was significantly related to drop off: r1 = 0.49 (p ≤ 0.05) and drop off percentage: r2 = 0.54 (p = 0.05). VO2 max and lactate recovery were related to repeat sprint ability in college hockey players. PRACTICAL APPLICATION: Even though ice hockey is often considered an anaerobic repeat sprint sport, the development of aerobic fitness should be considered an important part of a hockey players training program.

Edward McNeely

PURPOSE: During the college hockey season players are faced with increased travel, school schedule and NCAA regulations that limit the amount of time that they can dedicate to hockey. In addition a change in focus from conditioning to technical and tactical development can result in less time dedicated to fitness activities compared to the summer months. Recent papers on fitness levels of basketball and football players have suggested that there is a decline in fitness during the competitive season. The purpose of this study was to determine in on-ice fitness changes during a hockey season. METHODS: Data collected on 21 Division I male hockey players, forwards and defencemen, during fitness testing at pre-season training camp (Sept) and follow up testing mid season, five months after the first test (Jan), was used in the study. All athletes had been on ice for at least three weeks prior to the first round of testing. In both sessions the participants performed the Repeat Sprint Test, an on ice test that involves skating from the goal line to the far goal line and back to the near blue line, covering 300 feet. A repeat is performed every 30s seconds for a total of six repeats. Subjects are electronically timed for each repeat. Blood lactate samples are taken 60, 180, and 300 seconds after the final repeat. Data was analyzed by one-way repeated measures ANOVA. When a significant difference (p<0.05) was indicated the Tukey HSD post hoc test was applied. Results are reported below in mean ±SD RESULTS: Mean time for each repeat can be seen in Table 1. There were no differences for the time of each repeat between Sept and Jan. There was also no change in fastest time for any of the repeats. The average of the six subjects was significantly less in Jan compared to Sep (13.69±0.58 vs 14.18±0.50; p<0.05). The average drop off from the first to the sixth repeat was 2.09±1.14 s for Jan and 2.70±1.14 s for Sep (p<0.05). Significant correlations were found between VO2 max and drop off: r = 0.47 (p = 0.05), VO2 max and drop off percentage: r = 0.45 (p ≤ 0.05) and VO2 max and worst time: r = -0.49 (p = 0.05). Lactate recovery was significantly related to drop off: r1 = 0.49 (p ≤ 0.05) and drop off percentage: r2 = 0.54 (p = 0.05). VO2 max and lactate recovery were related to repeat sprint ability in college hockey players. PRACTICAL APPLICATION: Even though ice hockey is often considered an anaerobic repeat sprint sport, the development of aerobic fitness should be considered an important part of a hockey players training program.

Edward McNeely

In Season Changes In On Ice Fitness In Division I Ice Hockey Players

Edward McNeely
Identification Of Position-Specific Combine Test Score Thresholds For Drafted And Non-Drafted Defensive Players

Jason Miller, P.A. Eisenman, M.A. Waller, T.A. Vanhoutte, D.P. Williams

PURPOSE: The National Football League (NFL) Combine (COM) is a test battery designed to identify the collegiate players that could be successfully drafted into the NFL. Although another study has investigated the prediction of draft status from multiple COM test scores, the specific identification of threshold values from each COM test score that distinguishes subgroups of players with a greater or lesser chance of being drafted is unknown. The purpose of this study was to identify, for each defensive position, the specific COM tests and their threshold values that contribute to an increased or decreased likelihood of being drafted. METHODS: The COM data for 758 defensive players (average round drafted 10.3 + 1.3) were included in the study. Signal detection analysis (SDA) (sensitivity & specificity = 50%) identified the significant COM test subgroups and decision rules. RESULTS: Figure 1. DE decision tree, 4 subgroups.

The Effects Of Shoulder Girdle Dynamics, Reach, And Jump Mode On Vertical Jump Performance

Mike Miller, Adam H. Ploeg, Travis J. Dibbet, William R. Holcomb, David C. Berry, Jennifer O'Donoghue

PURPOSE: The purpose of this study was two-fold; 1) to investigate the effects of shoulder girdle dynamics, reach, and scapular elevation on verti- cal jump performance and 2) to investigate why measurements of vertical jump in Kinexology students aspiring for a traditional vertical jumping apparatus (VVJ) are significantly different from those measurements taken from an electronic vertical jump mat (MVJ). A recent class sample of 50 students revealed a significant difference (p<0.05) between vertical jumps performed with a traditional vertical jump apparatus (54.1±12.6 cm) and the electronic jump mat (50.8±11.8 cm). In this sample the MVJ measurement was significantly lower than that of the traditional apparatus. METHODS: Twenty volunteers, 10 women and 10 men, aged 24 ± 1.5 years were tested. All subjects were Kinexology students at Texas A&M University-Commerce. Population demographics for women were as follows: height 165.6±5.3 cm, weight 63.2±5.5 kg, body fat 23.3±5.9% and BMI 24.5±4.2 kg/m². Population demographics for men were as follows: height 175.5±5.3 cm, weight 85.3±11.9 kg, body fat 16.8±3.5% and BMI 27.2±5.5 kg/m². All testing occurred in two sessions, one week apart, in a randomized order. One session consisted of three jump trials utilizing the MVJ only and the second session consisted of three jump trials that utilized the VVJ only. Conclusions: The gravitational measurements were taken during both sessions. These measurements consisted of reach height at shoulder extension (RHSE) (234.1±35.0 cm), reach height at maximal scapular elevation after shoulder extension (MRH) (222.8±34.3 cm), scapular rotation (SR), and shoulder elevation displacement (SSD). Vertical jumps using the traditional vertical jumping apparatus were calculated using both the RHSE (54.7±13.7 cm) and MRH (44.9±15.0 cm). A one-way RM ANOVA with a post-hoc comparison test (Tukey’s), utilizing a Bonferroni adjustment, was used to analyze differences between jump heights. A Pearson’s correlation was utilized to analyze relationships between all data. For significance all statistics were conducted at p<0.05.

The Effects Of High Volume Aquatic Plyometric Training On Vertical Jump, Muscle Power, And Torque

Mike Miller, Adam H. Ploeg, Travis J. Dibbet, William R. Holcomb, David C. Berry, Jennifer O'Donoghue

PURPOSE: Aquatic and aquatic plyometric exercises have been shown to improve athletic performance. One benefit of aquatic plyometric activities is the ability to decrease stresses on the body due to the buoyant properties of water. Bouncing on a surface creates a counterforce to gravity by supporting the body as it moves downward and should allow an athlete to complete higher volumes of aquatic plyometrics with the potential for increased physical outcomes. PURPOSE: The purpose of this study was to examine the effects of high volume aquatic based plyometrics versus traditional on land and/or aquatic plyometric training on vertical jump (VJ), muscle peak power and torque in the dominant knee. METHODS: A random sample of forty-seven healthy subjects started the training, but thirty-nine testing for MVJ and MRH (p<0.05), and VVJ and MRH (p=0.04). There was a significant difference in reach height between RHSE (p<0.016), and VVJ/RHSE and VVJ/MRH (p=0.00). There was a significant difference in reach height between jump heights. A Pearson’s correlation was utilized to analyze relationships between all data. For significance all statistics were conducted at p<0.05. All testing occurred in two sessions, one week apart, in a randomized order. One session consisted of three jump trials utilizing the MVJ only and the second session consisted of three jump trials that utilized the VVJ only. Conclusions: The MVJ measurements were the first to investigate the EE and enjoyment of DRR compared to alternative forms of activity. The findings of this investigation may assist in further understanding how interactive video games such as DRR may be successfully used in interventions to promote physical activity in children. Future research should further investigate the EE and enjoyment of DRR and how the comparison to alternative forms of activity.
Concerns And Limitations Of Dual-Energy X-Ray Absorptiometry (DXA) For The Evaluation Of Fat And Fat-Free Mass In Older Men And Women.


PURPOSE: The purpose of the present study was to evaluate Dual-energy X-ray absorptiometry (DXA) for estimating fat mass (FM), percent fat (%FAT), and fat-free mass (FFM) in older men and women compared to a four-compartment model (4C). METHODS: Forty men and women (65-84y, 20 men and 20 women) participated in the study. Body fat calculations included a criterion 4C model and DXA-derived FFM, %FAT, and FM. The criterion 4C model included body volume from air-displacement plethysmography (ADP), total body water from deuterium dilution, and bone mineral content from DXA. Constant error (CE), standard error of estimate (SEE), total error (TE), and the 95% limits of agreement were used to calculate accuracy of DXA compared to the criterion model.

RESULTS: DXA %FAT had significantly less fat distributed in these areas than did 4C (%: 40.2±11.4% vs. 47.4±6.2%). DISCUSSION: Results from this study support evidence indicating that long-term physical activity has positive effects on bone and body composition in postmenopausal women. However, there did not appear to be any distinct advantage for the women who had been competitive athletes and who generally trained at higher exercise intensities than the recreationally active women.

PRACTICAL APPLICATION: Criterion models of physical activity appear to have the same beneficial effects on bones and body composition as long-term physical activity in postmenopausal women. This has important implications for the prevention and control of chronic diseases such as osteoporosis, obesity, and type 2 diabetes that occur with increasing frequency in older populations.

### Table 1: Bone mineral densities of active, and sedentary group

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>10</td>
<td>0.196 ± 0.094</td>
</tr>
<tr>
<td>Sedentary</td>
<td>10</td>
<td>0.191 ± 0.094</td>
</tr>
</tbody>
</table>

MANCOVA: covariate = body mass, years post-menopause. * = significantly different from Sedentary group (p = 0.05).

Body fat percentage (%FAT) in S (40.8±7.8%) was higher (p = 0.017) compared to either AC (32.1±7.5%) or AT (27.4±8.1%). AT (40.3±4.0 kg) and AC (39.8±3.9 kg) had significantly larger (p = 0.005) values of bone mineral content (BMC) compared to AT and AC were observed for either BF or LB. Androstenol (ADP) and androstenediol (AD) fat distribution patterns showed that AC (43.6±11.2 g): 36.6±11.2%, and AT (35.6±11.5 g): 40.4±6.4% had significantly less fat distributed in these areas than did 4C (%: 40.2±11.4% vs. 47.4±6.2%).

### Table 2: Training Impulse (Trimp) Values During One Week Of Practices And Games

<table>
<thead>
<tr>
<th>Zone (multipliers)</th>
<th>P1 (90 min)</th>
<th>P2 (40 min)</th>
<th>P3 (69 min)</th>
<th>Game 1 (117 min)</th>
<th>Game 2 (112.5 min)</th>
<th>Game 3 (99 min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1 (multipliers)</td>
<td>1.165 5.16 0.148</td>
<td>0.914 0.115</td>
<td>0.911 0.103</td>
<td>1.104 0.084</td>
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</table>

CONCLUSION: DXA appears to be biased in older men and women when comparing mean values of FM, FFM, and %FAT compared to a 4C model. %FAT produced the largest individual errors with limits of agreement ±5.23%FAT. However, DXA produced acceptable TE values and can be considered a valid method for predicting body composition. Nonetheless, regardless of the significant CE values for DXA, using ADP alone in a 2C model produced more accurate, non-biased results compared to the 4C model for all variables, as indicated by a reduced SEE and smaller individual errors. PRACTICAL APPLICATION: FM and FFM DXA values were more accurate than %FAT values compared to a 4C model. However, the 2C model uses more accurate than all DXA-derived values. Additionally, DXA produced significantly different FM, FFM, and %FAT values compared to a 4C model. Therefore, DXA was not suggested for use in older men and women when attempting to predict FM, FFM, or %FAT. Furthermore, choosing ADP for use in the 2C model to predict FM, FFM, and %FAT appears to be more accurate than DXA in this population.
Incidence And Potential Pathomechanics Of Patellofemoral Pain In Female Athletes

Greg Myer, Kevin R. Ford, Kim D. Barber Foss, Arlene George, Adrick Harrison, Mitchell I. Rauh, Jon G. Divine, Timothy E. Hewett

Patellofemoral pain (PFP) is a common disorder in female athletes with an unexplained etiology. PFP symptoms can affect up to 30% of adolescents (13-19 years). Of these, PFP may cause 74% of female athletes to limit or stop their sport participation. Purpose: The purpose of this study was to evaluate measures of lower extremity strength, motion and load prospectively to examine their relationship with PFP development. Our hypothesis was that increased dynamic knee abduction and decreased hip abduction strength would be associated with PFP in female athletes relative to teammates without PFP. Methods: Two hundred forty middle and high school aged female athletes were evaluated by a physician for active PFP (APPF) prior to the start of their basketball season. In addition, laboratory analyses of each athlete’s hip isotonic strength and hip, knee and ankle biomechanics during landing were conducted. The athletes were monitored on a weekly basis for athletic exposures (AE) and the onset of any new PFP (NPFP). The athletes were also subsequently re-evaluated for any new PFP by the same physician at the conclusion of the basketball season. Results: The point prevalence of APPF at the beginning of the season was 14.2 per 100 athletes. The cumulative incidence risk and rate for the development of NPFP during the season was 9.7 per 100 athletes and 1.09 per 1000 AE’s, respectively. All new cases of PFP occurred in the middle school-aged athletes. Biomechanical analyses indicated a significant interaction (p=0.04) of increased knee abduction moment at initial contact in APPF and NPFP involved limbs relative to CTL, and their uninvolved limbs (Figure 1). The post hoc analysis of involved limbs showed that: external knee abduction moment at initial contact was increased (53%) in APFP compared to the APPF relative to CTL. Hip strength or static knee abduction angle did not discriminate between study groups (p=0.53). Conclusions: The current study did not directly support the hypothesis that increased hip abduction strength was related to PFP development. The increased knee abduction in APFP suggests interaction of increased knee abduction in APFP and NPFP involved limbs relative to CTL, and their uninvolved limbs, indicate that increased knee abduction loads at landing may contribute to increased risk of PFP. Future prospective and longitudinal studies design these potential neuromuscular correlates underlying PFP in middle school aged female basketball players are warranted. PRACTICAL APPLICATIONS: Interestingly all new PFP occurred in the middle school aged female basketball players. The data suggest that neuromuscular training focused to reduce initial contact knee abduction implementation at an young age (10-12 year) level should be assessed to determine its effectiveness to minimize lower extremity pathomechanics of PFP and reduce the occurrence of PFP during sports participation in middle school or higher school level.

A Study Of The Resistive Forces Provided By Elastic Supplennial Band During Resistance Exercise: A Case Report

Kurt Neelly, Sean A. Carter, Joe G. Terry

The use of supplemental elastic bands to supplement traditional plate weight resistance to the back squat has become increasingly popular in weight rooms. By using supplemental elastic bands, a variable resistance is produced. The variable resistance will progressively increase the amount of resistance throughout the range of motion of an exercise that possesses an ascending strength curve. The set-up and technique for using elastic bands is currently available regarding the technique and set-up when using SHCR as a form of variable resistance. It has been recommended that sufficient research is not present to endorse current agility training for adolescents. PURPOSE: To investigate two forms of agility training, preplanned and reactive protocols, and determine the effectiveness on 3 agility tests. METHODS: 30 male adolescents (age 16.33 ±1.06; height 69.85 ±2.95 in; weight 154.51±22.23 lbs) participated in 1 of 3 treatment groups: 1) Control Group; 2) Preplanned Protocol; 3) Reactive Protocol. The three agility tests were the T-Test, Illinois Agility Test, and SPND (Speed and Agility OH). Subjects pre-tested on each of the 3 agility tests and then divided into 3 groups based upon performance to equate scores for all 3 groups. Agility protocols were performed on 2 non-consecutive days per week for 6 weeks. Subjects performed a 10-minute warm-up followed by 4 agility drills with 3 repetitions at maximal intensity. Subjects post-tested on the agility tests at the completion of the 6-week protocol. A 2 (time) x 3 (group) repeated measures ANOVA was used to determine if differences existed between the agility tests. RESULTS: This study found that groups significantly improved their scores over time in the T-Test (p<0.001 and SPND (p<0.001) tests respectively. Refer to Table 1 for the mean/standard deviations of the best time trials for each group. CONCLUSIONS: All three groups improved throughout the 6-week study. The limited experience of adolescents may affect cognitive improvements, and biomechanical changes may occur initially as seen in the overall improvement time for the T-Test and SPND. The specific type of agility training measures in this study may have confounded the results. More examination into specific reactive agility testing measures and adolescent training in need. PRACTICAL APPLICATIONS: The utilization of preplanned or reactive agility training has shown improvements for adolescent athletes. Athletes may require longer periods of training for perceptible Central Nervous System adaptations and improvements to occur. Agility training, especially in adolescent athletes can be implemented to prevent injuries and assist in developing correct biomechanics and increase performance.

The Effects Of An 8-Week Supplementation Heavy Chain Resistance Training Program On Lower Extremity Power In An Elite Athlete: A Single-Subject Study

Kurt Neelly, Seth Langevil, Jonathan Hamm, Kory Begy, Joe G. Terry

Traditional free weight training has been the preferred method for athletes to increase strength and power. However, the use of supplemental heavy chain resistance (SHCR) has increased in recent years. The use of SHCR in exercises exhibiting ascending strength curves provides a variable resistance through the range of motion of the lift that maximizes the greatest mechanical advantage. PURPOSE: To assess the change in functional lower extremity power measures in a professional baseball player after completion of an 8-week pitching-specific training program with a periodized SHCR back squat component. METHODS: The subject was a 22-year old professional baseball pitcher (height = 1.90 m, weight = 108 kg) performing an off-season training program. Pre-test (L) power was measured utilizing the following functional tests: countermovement vertical jump measured via a waist belt with tape measure, two-legged standing long jump, and an electronically timed 10-yard dash. The subject then completed an 8-week training program utilizing SHCR in a periodized back squat program (twice per week). Throughout this time, the subject also completed a pitching-specific training program which included general plyometrics, agility, and core stability exercises (twice per week), a shoulder strengthening exercise regimen (three times per week), and an off-season throwing program. Post-test (L) power measures were completed after completion of the 8-week program. RESULTS (Pre-test: Post-test comparisons (Table 1) showed a 8.57% increase in vertical jump height, a 4.41% increase in standing long jump distance, and a 2.93% improvement in 10 yard dash time. CONCLUSION: The results of this study suggest that performing the back squat exercise utilizing SHCR, in conjunction with general plyometrics, agility, and core stability exercises, can increase functional LE power measures in trained athletes. PRACTICAL APPLICATIONS: Limited research is currently available regarding the technique and set-up when using SHCR as a form of variable resistance. It has been recommended that athletes possess adequate strength and experience with static resistance in the desired lift prior to advancing to SHCR. Additionally, athletes must understand the proper set-up technique and use of chains prior to their use. This study suggests that using SHCR in the back squat may be a valuable technique for improving LE power output.

<table>
<thead>
<tr>
<th>Table 1: Pre-test Post-test Power Comparisons</th>
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<tbody>
<tr>
<td><strong>Function</strong></td>
</tr>
<tr>
<td>Vertical Jump</td>
</tr>
<tr>
<td>Standing Long Jump</td>
</tr>
<tr>
<td>10 Yard Dash</td>
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</table>

Aphy is an important skill in athletic performance because it integrates intermittent, dynamic, and skilled movements. Preplanned agility skills are closed skills and have no temporal or spatial uncertainty. Reactive skills, also known as open skills, have temporal and spatial uncertainty and are designed to mimic play in sports. Recognizing the development of adolescent athletes while challenging them in these skills is important. Sufficient research is not present to endorse current agility training for adolescents. PURPOSE: To investigate two forms of agility training, preplanned and reactive protocols, and determine the effectiveness on 3 agility tests. METHODS: 30 male adolescents (age 16.33 ±1.06; height 69.85 ±2.95 in; weight 154.51±22.23 lbs) participated in 1 of 3 treatment groups: 1) Control Group; 2) Preplanned Protocol; 3) Reactive Protocol. The three agility tests were the T-Test, Illinois Agility Test, and SPND (Speed and Agility OH). Subjects pre-tested on each of the 3 agility tests and then divided into 3 groups based upon performance to equate scores for all 3 groups. Agility protocols were performed on 2 non-consecutive days per week for 6 weeks. Subjects performed a 10-minute warm-up followed by 4 agility drills with 3 repetitions at maximal intensity. Subjects post-tested on the agility tests at the completion of the 6-week protocol. A 2 (time) x 3 (group) repeated measures ANOVA was used to determine if differences existed between the agility tests. RESULTS: This study found that groups significantly improved their scores over time in the T-Test (p<0.001 and SPND (p<0.001) tests respectively. Refer to Table 1 for the mean/standard deviations of the best time trials for each group. CONCLUSIONS: All three groups improved throughout the 6-week study. The limited experience of adolescents may affect cognitive improvements, and biomechanical changes may occur initially as seen in the overall improvement time for the T-Test and SPND. The specific type of agility training measures in this study may have confounded the results. More examination into specific reactive agility testing measures and adolescent training in need. PRACTICAL APPLICATIONS: The utilization of preplanned or reactive agility training has shown improvements for adolescent athletes. Athletes may require longer periods of training for perceptible Central Nervous System adaptations and improvements to occur. Agility training, especially in adolescent athletes can be implemented to prevent injuries and assist in developing correct biomechanics and increase performance.

<table>
<thead>
<tr>
<th>Table 1: Mean of Bird Time Test</th>
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<tbody>
<tr>
<td><strong>Agility Test</strong></td>
</tr>
<tr>
<td>T-Test</td>
</tr>
<tr>
<td>Illinois Agility Test</td>
</tr>
<tr>
<td>Pre Illinois Agility Test</td>
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<tr>
<td>Pre SPND</td>
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<tr>
<td>Pre SPND</td>
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</table>
A number of quality tests are available to evaluate the fitness and skill levels of soccer players. Since fitness and skill are essential throughout the duration of a competition, the timing of test administration should be considered. PURPOSE: The purpose of this study was to determine the effect of prior exercise on fitness and skill measurements in female collegiate soccer players. METHODS: Thirteen female collegiate athletes volunteered for the study (age = 19.6 ± 1.3 yrs, height = 1.66 ± 0.07 m, weight = 64.8 ± 7.2 kg). After a familiarization session, participants completed two tests (at least 5 days apart) of a modified Hoff test sequence. Prior to both tests, subjects completed a 5 min to 10 minute cardiovascular warm-up. During one session (W), participants completed an additional ~15 minute workout designed to tax upper and lower body musculature. No additional work was added to the other test session (NW). All subjects were randomly assigned to one of two groups so that the order of the testing (W or NW) was counterbalanced. Upon completion of the Hoffman tests, heart rate (HR) was recorded as well as the total distance (TD) covered during the session. During each lap of the Hoffman test, subjects were required to kick a soccer ball over three consecutive hurdles. Skill (SK) was determined by determining the average number of hurdle attempts per lap completed. Therefore, 3.0 was a perfect score and scores >3.0 were interpreted as lower skill. In addition, we tested for bias in error rate across all conditions (R2 = 0.65) by comparing the total number of errors (TE) to the TD covered in the Hoff test. RESULTS: Average (±SD) TD for W and NW were 996.6 ± 90.3 and 1053 ± 63.3 meters, respectively. SK for the two sessions was W = 3.5 ± 0.39 and NW = 3.2 ± 0.20. In addition, HR (R2 = 0.56) averaged 196.0 ± 7.1 and 186.4 ± 15.5 for W and NW, respectively. Paired t-tests revealed significant differences between W and NW for TD (p = 0.002) and SK (p = 0.031). No significant difference was detected for HR between the two conditions (p > 0.05). There was no relationship between TE and TD (R1 = -0.47, p > 0.25). CONCLUSION: The addition of a brief muscular endurance workout prior to fitness testing significantly decreased SK and TD in these soccer players. TD was unrelated to TE suggesting that the error measure (SK) was not biased against high fitness performers. PRACTICAL APPLICATION: These data reinforce the concept that coaches should standardize conditions for fitness and skill testing. Further, the results of this study indicate that as little as 15 minutes of muscle work may negatively impact skill and performance. However, these results also demonstrate that fatigue athletes prior to assessment could offer insight into how they perform in the latter stages of competition.

**Table 1** Differences in Force, Velocity and Power Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>96 hours</th>
<th>14 days</th>
<th>% Change</th>
<th>p value</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jump height (m)</td>
<td>0.33 ± 0.06</td>
<td>0.33 ± 0.04</td>
<td>-1.29</td>
<td>0.46</td>
<td>0.57</td>
</tr>
<tr>
<td>Peak velocity (m/s)</td>
<td>2.48 ± 0.19</td>
<td>2.57 ± 0.26</td>
<td>3.06</td>
<td>0.87</td>
<td>0.49</td>
</tr>
<tr>
<td>Relative PP (N/kg)</td>
<td>24.4 ± 4.95</td>
<td>22.1 ± 4.20</td>
<td>-10.77</td>
<td>0.24</td>
<td>-0.54</td>
</tr>
<tr>
<td>Relative FF (N/kg)</td>
<td>40.2 ± 5.79</td>
<td>40.8 ± 5.72</td>
<td>1.53</td>
<td>0.07</td>
<td>-0.65</td>
</tr>
<tr>
<td>Velocity at PP (m/s)</td>
<td>2.16 ± 0.15</td>
<td>2.46 ± 0.097</td>
<td>18.15</td>
<td>0.01</td>
<td>2.06</td>
</tr>
<tr>
<td>Relative Force at PP (N/kg)</td>
<td>192.1 ± 3.32</td>
<td>197.7 ± 1.52</td>
<td>3.76</td>
<td>0.63</td>
<td>0.20</td>
</tr>
</tbody>
</table>

**Relationship Of Backward Overhead Medicine Ball Throw With Olympic Weightlifting Performances**

Mathew V. Palozola, Alexander J. Koch, Jerry L. Mayhew

The backward overhead medicine ball (BOMB) throw has gained some attention as a simple measure for estimating total body explosive power. However, previous research indicates varying degrees of relationship with standard power measurement. PURPOSE: To determine the relationship between a BOMB throw and maximal strength (S) and clean and jerk (CJ) performances of collegiate weightlifters. METHODS: 12 collegiate Olympic weightlifters (8 men, 4 women; weight = 73.5 ± 15.4 kg, age = 21 ± 1 y) performed 6 maximal attempts of the BOMB throw with a 3.63 kg medicine ball with 1 min rest between throws. The best throw was recorded for analysis. Three to five days after the throws, the subjects competed in a sanctioned weightlifting meet, and their best lift in the S and CJ were correlated with BOMB throw. RESULTS: Intraclass correlation coefficient across all 3 trials (ICC = 0.89) indicated a high degree of reliability. There was no significant difference across trials, although the average percent improvement between successive throws did not level off until the 3rd throw (1.2 ± 19.6%). Best BOMB throw was significantly correlated (p < 0.05) with S (r = 0.51) and CJ (r = 0.8) to nonsignificance. CONCLUSION: The correlation between BOMB throw and CJ was significant (r = 0.8), indicating that athletes may adopt an improved rate of force development instead of a maximal force approach to attain their 3R. This alteration may be a result of training to utilize their ‘home strength’ in a way which is more beneficial to their sport. The athletes continued to train on the field, possibly allowing them to have a transfer of learning effect which resulted in calisthenics force more efficiently as indicated by the large improvement (18.1%) in velocity at PP. PRACTICAL APPLICATION: Examining changes in magnitudes and timing of the variables associated with maximal force may improve the understanding of how an athlete utilizes their force and velocity capabilities to produce power, especially when investigating transfers of learning.
Abstracts

P – R
Effects Of A 16-Week Employee-Based Walking Program On Selected Physical Fitness Components

Sally Patterson, Russell Robinson, Amanda Wade, Danielle Haas, David Sipes

Workplace health promotion and educational programs have been implemented by employers in hopes to reduce costs by increasing positive lifestyle behavior changes among their employees. Health improvements have been reported when sedentary individuals increase physical activity to reflect more of a moderately active lifestyle. It is imperative to promote physical activity programs as more and more people in the U.S. are becoming more physically inactive. PURPOSE: The purpose of this study was to track and evaluate the effectiveness of a four-month employee-based walking program on selected measures of physical fitness.

METHODS: Twenty-four female (M/F ratio: 47.73±49.45; mass = 73.86±17.00 kg; height = 161.62±71.1 cm; BMI = 26.82±9.93 kg/m²) and 3 male employees (M/F ratio: 44.66±8.70 cm; mass = 72.33±21.81 kg; height = 169.03±31.9 cm; BMI = 27.17±4.31 kg/m²) volunteered for the study. Height and weight, body mass index (BMI), girth measurements, upper body bioelectrical impedance analysis (BIA), Rockport one-mile walking test were assessed initially and every four weeks thereafter. Daily step frequency (SF) was used to determine baseline activity level by averaging seven consecutive days of pedometer data. The subjects then followed a ramping protocol designed to increase SF weekly by 1,000 steps until they reached a goal of a weekly average of 10,000 steps/day. Subjects maintained 10,000 steps/day for four weeks with some self-selecting to ramp to a weekly average of 12,000 steps/day. Over the course of the walking program daily SF was tracked using a pedometer. SF data were reported weekly. RESULTS: Repeated measures ANOVA and descriptive statistics (Table 1) were used to analyze the data. Subjects experienced significant decreases in mass (p = .01), BMI (p = .001), and percent body fat (p = .01). There was also a significant increase in aerobic capacity estimated via the Rockport one-mile walk (p = .01). BMI percent body fat (p = .05) showed a non-significant downward trend. CONCLUSION: The results of this study suggest the use of an employee-based pedometer walking program can positively impact components of physical fitness in employees. The use of a pedometer walking program to increase physical activity was successful in improving aerobic capacity, decreasing body mass, BMI and body fat percentage in participants.

The Effect Of Cryotherapy On Quadriceps Point Tenderness After Intense Eccentric Exercise

Michelle Peluaga, Mack D. Rubby, William H. Holcomb, and Richard D. Tandy

Cryotherapy, a cold modality that results in heat withdrawal when applied to the body, is the most common modality used in the treatment of acute musculoskeletal injury. It has been argued that eccentric exercise-induced muscle damage may lead to ultra-structural changes within skeletal muscle caused by mechanical stress. Thus the excessive eccentric loading during exercise in muscle tissue may cause the development of delayed on-set muscle soreness (DOMS). PURPOSE: The purpose of this study was to investigate the effect of an immediate 45-minute cryotherapy application once daily for 3 days post DOMS-inducing eccentric exercise on the recovery of the quadriceps muscles quantified by mean eccentric peak torque. METHODS: Sixteen healthy subjects (8 male; 8 female; 26.81±1.22 years, height=168.92±22.2 cm; and weight 72.8±3.8 kg with no reported injury in the last 6-months to the knee joint or surrounding musculature, no concurrently lower body weight training and no NSAID or ice volunteered for this study. Day 1 point tenderness was evaluated prior to exercise and after each subject performed 3 maximal eccentric contractions. On day 2 subjects performed 8 sets of 10 maximal eccentric contractions with 60 seconds rest between each set immediately followed by a 45-minute ice bag application directly covering 2/3 of the quadriceps for each subject. On day 2 point tenderness values were assessed immediately prior to following exercise and tenderness values were reassessed at the end of day 2 (45 min) post-exercise. On day 3, point tenderness was assessed immediately prior to exercising and after each subject performed 3 maximal eccentric contractions. On day 3 point tenderness was assessed immediately prior to exercise and after each subject performed 3 eccentric contractions. The mean SF measured for the 7-day period was calculated as the average for the entire study period over all subjects. The mean SF for the first three measurement days was 8166±193 steps/day and the mean SF for the last three measurement days was 8212±205 steps/day. CONCLUSION: Thus a once daily 45-minute ice bag application is not effective in reducing the decreased ability to maintain peak torque following DOMS. PRACTICAL APPLICATIONS: This supports the suggestion that repeated ice bag application throughout the day may be more effective in limiting the formation of edema and decrease secondary injury that may occur with DOMS following eccentric exercise.

The Effect Of Gender And Exercise Type On Relative Hand Grip Strength

Erin Peterson, Will Murray, Jean M. Hiebert

Previous studies indicate hand grip strength in males is greater than females. As these values are typically reported as absolute hand grip strength, they do not take into account the smaller stature of females. Hand strength as reflected relative to anthropometrics such as hand length have not been thoroughly investigated. To investigate this question hand grip strength and body anthropometrics of two groups of physically active females and males was measured. PURPOSE: To assess grip strength of males and females relative to body stature as reflected by hand length, BMI and percent body fat in two different groups (climbers and runners). METHODS: 10 subjects volunteered for this study. Eleven (8 males, 3 females) were recreational rock climbers and nine (4 males, 5 females) were recreational runners. Each subject performed 5 tests over 4 weeks. Each subject had at least one year history of running 20 miles/week at 6-8 minutes/mile; climbers required an ability to climb a minimum of Class 5.1 on the Yosemite Decimal System. Grip strength and sustained grip strength of subject’s dominant hand were measured using a computerized, electronic hand grip dynamometer. Strength in five different grip size settings and sustained grip were assessed per manufacturer’s directions. Height and hand length from the distal palmar crease to tip of middle finger was assessed using a tape measure. The relative hand grip strength was calculated as the relationship between absolute hand grip strength (N) and the subject’s height (H, cm). Hand grip strength, body weight, body composition using sum of skinfolds (SFM), and body mass index (BMI) were also assessed. RESULTS: Data were analyzed using SPSS 11.5. Independent samples T-tests revealed no difference in sustained hand grip strength, BMI, and percent body fat with regards to rock climbers and runners. Gender differences were found in hand length (males > females), and percent body fat (males > females), though no difference was noted in BMI. Analysis of variance tests compared the effect of gender and exercise on relative hand grip strength. Relative hand strength was not different between climbers and runners. However, relative strength was greater in males than females and in agreement with studies assessing absolute hand grip strength. The decreased hand size of females in relation to males may explain the effect of grip position on maximum strength. PRACTICAL APPLICATION: Further studies utilizing subjects of different anthropometric characteristics would provide further insight as to the importance of reporting grip strength as a relative value. Our findings support different grip settings should be used when assessing strength of males and females regardless of typical mode of physical activity.
Hamstring To Quadriceps Timing And Activation Ratios Of High School Athletes During Cutting And Jumping
Erich Petushek, Jason Hilgendorf, McKenzie Fauth, Kelly Petrusauska, Christina R. Feldman, William P. Ebben

PurPOSE: The study assessed hamstring and quadriceps timing and hamstring to quadriceps activation ratios (H:Q), and gender differences therein, during jump landings and cutting maneuvers. METHODS: Subjects included 6 boys (age = 17.1 ± 0.9 years) and 6 girls (age = 15.7 ± 1.2 years). All subjects performed 2 repetitions each of the drop jump from a height equal to their maximum vertical jump (VJ) as well as a sprint and cut at a 45-degree angle (S&C). Electromyographic (EMG) data were collected for the rectus femoris (RF), vastus lateralis (VL), vastus medialis (VM), lateral hamstring (LH), and medial hamstring (MH). Root mean square (RMS) signal processing was used on all EMG data which were analyzed to assess the magnitude and timing of muscle activation. RESULTS: The hamstring to quadriceps timing and activation ratios were calculated from the collective average of the hamstring muscles divided by the collective average of the quadriceps muscles. The ratio was calculated from the force-time records. Data were analyzed using an ANOVA. RESULTS: Compared to the NO-RVC condition, the RVC condition produced 4.0 and 2.9% higher GRF, and 23.1 and 32.2% higher RFD_100, during the squat and jump squat, respectively (p ≤ 0.05). Compared to the HD-RVC condition, the NO-RVC condition produced 6.3% higher RFD_100 (p = 0.05) in the jump squat. DISCUSSION: This is the first study to evaluate the effect of RVC during cutting-based kinetic exercises such as the squat and jump squat. Remote voluntary contractions augmented the variables assessed by 2.9 to 32.2%. PRACTICAL APPLICATION: To enhance strength and power during exercises such as the squat and jump squat, practitioners should encourage athletes to incorporate RVC’s into their training programs.
The influence of the spinal treatment and related conditions on lower extremity function has become more of interest, not only in the treatment of conditions, but also in the influence to athletic performance. PURPOSE: To determine the influence of vertebral axial distraction via a mechanical traction, to the lumbar spine and its influence on lower extremity performance in healthy subjects. METHODS: Seven subjects (male = 3, female = 4) of college age (m=20.86 ± 0.69 yrs) volunteered to participate in the study. All subjects were familiarized with the treatment and testing procedures and flowed of lower extremity and spinal injury or pain for at least one year. Measurements of pre- and post-isometric and isokinetic knee extensions, heart rate, and blood pressure were collected on each subject. Surface EMG was collected on the dominant extensor spinae pre-, mid-, and post-treatment of each subject. Each subject performed a supine position rest period of six minutes for baseline data on measurement, prior to treatment. Subjects were secured to a digitally controlled mechanical traction device to provide the intermittent lumbar traction protocol, following the static pre-tension of 0.9 kg. The intermittent protocol incorporated an upper intensity (UI) of 40% of BW (not to exceed 32 kg) for 60 sec and lower intensity (LI) of 60% (UI) with a minimum of 14 kg, for 20 sec. Total treatment time was six minutes, following pre-tension. RESULTS: There was no significant difference in EMG activity of the erector spinae (p > 0.05) or blood pressure (p > 0.05). Heart rate was decreased significantly (p = 0.01) and isometric and isokinetic knee extension decreased significantly by the 18 and 14 percent, respectively (p < 0.05). CONCLUSION: Static distraction, in the form of supine mechanical traction, causes a decrease in quadriceps performance in lower extremity isometrically and isokinetically. PRACTICAL APPLICATION: Consideration should be taken when prescribing exercises or other treatments that affect the spine due to its potential influence on lower extremity performance.

Low Intensity Vertebral Mechanical Axial Traction Decreases Lower Extremity Performance In Healthy Subjects

Christopher Proulx, Joseph A. Gallo

A Comparison Of Resting Metabolic Rate Assessment Techniques On Collegiate Gymnasts

Thomas Pujol, C.L. Elder, J.T. Barnes, M. Nahlahin-Nelms, M.L. Kearney, J.P. Looenneke, R.D. Williams

Purpose: The purpose of this study was to compare techniques for estimation of resting energy expenditure with a handheld indirect caloricity device in a sample of 16 female Division 1 Collegiate Gymnasts. Methods: Resting metabolic rate (RMR) was measured via a handheld indirect caloricity device, estimated by a commercial biocortic source impedance analyzer (BIA), and estimated using the Harris-Benedict equation. All measurements were taken during the same session and preceded practice sessions. The RMRs attained via indirect caloricity was compared to the estimated RMR for each of the methods by one way ANOVA. Statistical analyses were performed using SPSS with an alpha level of 0.05. Results: The subjects’ (mean age 19 yr; ht 161 cm; wt 53.9 kg) RMR measured via indirect caloricity was 1517.3 kcal/d (99.8), while estimations via BIA and Harris-Benedict were 1334.6 kcal/d (80.13) and 1006.6 kcal/d (55.4), respectively. No significant differences were identified between the measures. Conclusions: While the difference between the RMR attained by the Harris-Benedict and the other measures was quite large, the difference was not significant. As has been seen in other studies the Harris-Benedict equation provided a lower estimate of RMR in a cohort of athletes. Practical Application: Of primary concern are the large differences in estimated kcal across the three methods and the large standard deviation found for the indirect caloricity device. Such discrepancies could potentially leave athletes with a significant caloric deficit. Results suggest a need for continued research to best provide nutrition assessment and guidelines for collegiate gymnasts and perhaps for all collegiate athletes.
Comparison Of Two Base Stealing Techniques in Division I Baseball Players

Jacob Reed, Stephanie Anderson, Bradly Brons, Whitney Schnidler, Robin Lund

PURPOSE: The purpose of this study is to determine the effectiveness of two baseball stealing techniques, cross-over step (CS) and jab step (JS) in Division I baseball players on total distance traveled (meters, m), total time (seconds, s) and velocity (m/s) over the first two sprint strides. METHODS: Eight Division I baseball players from the University of Northern Iowa volunteered for this study. Each subject attended one session and performed six total repetitions of (JS) and (CS), three for each technique. Technique assignment was assigned randomly to eliminate any order effect. RESULTS: The results of the Hotelling's T2 indicate that there was a significant treatment effect (F[1, 7] = 50.935, p < 0.001) on at least one of the measurements. Post hoc analysis concluded that the jab step resulted in significantly greater distance traveled (t(7) = 4.64, p < 0.002) to cover this distance resulting in no difference in overall sprint velocity over the first two strides. CONCLUSIONS: It appears that both techniques will produce similar results in initiating the baseball steal. PRACTICAL APPLICATION: CS or JS are appropriate to teach in baseball drills with neither showing an advantage over the other. Though it required less time to perform the first two strides during CS, the total distance was shorter than JS ending in both techniques resulting in nearly identical velocities.

Comparison Of Two Strategies On Recovery After Exhaustive Exercise

Jacob Reed, Stephanie Anderson, Bradly Brons, Chelsea Drumheller, Jill Kirkenberg.

PURPOSE: The purpose of this study is to examine the effects of two recovery strategies on the ability to lower heart rate (HR) following an exhaustive exercise bout. Additionally, total volume (VT), respiratory rate (RR), and oxygen consumption (VO2) were also collected. METHODS: Nine recreationally active males from the University of Northern Iowa volunteered for the study. Each subject participated in two test sessions with different recovery strategies. Both sessions involved the subjects warming up on a treadmill before being subjected to exhaustive exercise. Once exhaustion was achieved the subjects were instructed to place their hands on their head (HH) or knees (HK). RESULTS: Hotelling's T2 was rejected (F[1, 13] = 13.5, 4, 5, p > 0.007) but no significant effect for VT or RR. Though no significance was recorded, VT was higher and RR lower in HK. CONCLUSIONS: It appears that HK is a potentially superior recovery method, despite the historical usage of the HH method by coaches. PRACTICAL APPLICATION: When in a recovery phase of exhaustive exercise using the HK method maybe preferable if the goal is to lower HR more rapidly however it is unknown if this advantage in HR reduction will actually improve performance.
The Influence Of Flexibility On The Stretching-induced Force Deficit And Maximal Joint Range Of Motion

Eric Ryan, Trent J. Herda, Pablo B. Costa, Ashley A. Walter, Katherine M. Hogs, Jeffrey R. Stout, Travis W. Beek, Joel T. Cramer

Many previous studies have reported a temporary decrease in muscle strength following an acute bout of stretching, which has been termed the "stretching induced force deficit." It has also been suggested that the stretching induced force deficit may be joint angle-specific and influenced by initial level of flexibility. PURPOSE: To examine the effects of initial flexibility on the stretching-induced force deficit in the plantar flexor muscles at multiple joint angles and ankle joint range of motion. METHODS: Fourteen men with limited dorsiflexion ROM (mean age ± SD = 21.2 ± 2.6 yrs; stature = 173 ± 8 cm; mass = 75 ± 12 kg; dorsiflexion ROM = 11 ± 5°) and 14 men with a normal ROM (22 ± 2.5 yrs; 178 ± 8 cm; 75 ± 14 kg; 28 ± 5°) (Roche et al., 1992; Araujo et al., 2002) performed stretching tolerances assessments and isometric maximal voluntary contractions (MVCs) at -9°, -4°, 0°, 4°, and 9° of dorsiflexion (DF) = neutral ankle joint angle designed to examine the ROM and strength, respectively. Testing was performed on a custom-built calf-load cell apparatus attached to a calibrated isokinetic dynamometer before and after a bout of passive stretching. To assess stretch tolerance, the dynamometer lever arm passively dorsiflexed the foot at 5°/s to the maximum tolerable ROM (as acknowledged by the subjects). For the MVC assessments, subjects were instructed to produce maximal force of the plantar flexors for 4 s at each randomly-ordered joint angle. The position signal (°) from the dynamometer and force signal (N) from the load cell were sampled at 1 kHz during the flexibility and stretch assessments, respectively. The passive stretching protocol consisted of nine 15-s constant- torque passive stretches, which was held by the dynamometer at each subject's maximum tolerable passive stretching force (the point of discomfort). Five to 10 s was allowed between each stretching repetition. A three way mixed factorial ANOVA (time × angle × group; 2 × 4 × 2) was used to test the MVC data, while a two way mixed factorial ANOVA (time × group; 2 × 2) was used to analyze the RFD data. RESULTS: There was a 9% decrease in plantar flexor MVC strength from pre- to post-stretching across all joint angles for both groups (P<0.001). Conversely, there was a 4% increase in dorsiflexion RFD from pre- to post-stretching for both groups (P<0.001). However, the normal ROM group had higher dorsiflexion RFD values than the limited ROM group (P<0.001) at all time points. The magnitude of change for MVC strength and dorsiflexion RFD from pre- to post-stretching was not affected (P>0.05) by the joint angle or limitations of ROM. CONCLUSIONS: These findings suggest that the initial level of flexibility did not influence the force deficit observed in dorsiflexion RFD following an acute bout of passive stretching in the plantar flexor muscles. These results also indicate that the stretching-induced force deficit occurs at all the ankle joint angles tested. PRACTICAL APPLICATIONS: These findings may be useful for strength and conditioning professionals or other allied health practitioners who may incorporate stretching prior to testing or performance. Regardless of initial flexibility, 20 min of passive stretching appears to increase dorsiflexion RFD, but decrease the maximal strength capabilities of the plantar flexors at all of the joint angles tested in the present study.

A Comparison Of Muscle Activation Between A Smith Machine And Free Weight Bench Press

Evan E. Schick, Jared W. Coburn, Lee E. Brown, Daniel A. Judelson, Andy V. Khramou, Tai Tran, Brandon P. Uribe, Christian Reyes

PURPOSE: The purpose of this study was to compare muscle activation of the anterior deltoid, medial deltoid, and pectorals major during a Smith machine and free weight bench press across a lower (70% 1RM) and higher (90% 1RM) intensity. METHODS: Fourteen experienced (age, 19.0 ± 2.1 years; height, 178.3 ± 7.5 cm; mass, 88.5 ± 19.4 kg) and twelve inexperienced (age, 20.5 ± 2.1 years; height, 178.4 ± 8.0 cm; mass, 75.5 ± 10.4 kg) men completed two testing sessions. Investigators counterbalanced the order of conditions (free weight, Smith machine) and randomized the order of loads (70% 1RM and 90% 1RM) for control of learning for each participant. The sessions consisted of determining each subject's 1RM on either the Smith Machine or free weight bench press followed by two repetitions at 70% 1RM and two repetitions at 90% 1RM on the tested mode. One week later, subjects completed the same protocol for the other mode. Surface EMG electrodes were placed superficial to the anterior deltoid, medial deltoid and pectorals major muscles prior to data collection. RESULTS: Activation of the medial deltoid was significantly greater on the free weight bench press compared to the Smith machine bench press, regardless of load or experience level. There was no difference in the activation of the anterior deltoid or pectorals major between modes or intensity level. Muscle activation was significantly greater at the 90% 1RM load compared to the 70% 1RM load. Conclusion: The results suggest that the instability caused by the free weight bench press necessitates a greater response by the medial deltoid as a stabilizer of the humeral in the glenohumeral joint. The relative constancy in muscle activation of the anterior deltoid and pectorals major between modes suggests that these two muscles do not play as large a role in stabilizing the shoulder on free weight bench. Alternatively, it may be that the increased stability offered by the Smith machine decreases the need for the anterior deltoid and pectorals major to stabilize, allowing them to produce more force. PRACTICAL APPLICATION: The bench press is a common exercise performed by both athletes and recreational lifters and prescribed by trainers. The results of this study help both the practitioner and trainer in providing more information about the differences in between performing the bench press exercise on a Smith machine and on a free weight bench. Specifically, these results suggest that the free weight bench press may lead to an increased requirement for stabilization from muscles such as the medial deltoid.
Abstracts
S – U
An Analysis Of Playing Positions In Elite International Mens' Volleyball: Considerations For Competition Demands And Physiological Characteristics

Jeremy Sheppard, Tim Gabbett, Luiz Claudio Reesberg Stanganelli, Robert U. Newton

Purpose: The purpose of this study was to investigate the physiological demands, physiological characteristics and jumping ability of different playing positions and in different playing levels of elite male volleyball players. Methods: The first investigation involved an analysis of 16 senior international men’s volleyball matches involving highly ranked national teams. The second investigation involved an analysis of the anthropometric and jump performance characteristics of 162 development national team (DNT) and senior national team (SNT) international volleyball players comprising the positions of middle (n=49), setter (n=22), and outside (n=71). The players were from 4 different countries, with senior men’s national team world rankings of 1, 6, 11, and 16. Results: Mean ± SD frequency of Block Jumps for middles (11.00 ± 3.14) was significantly greater than for setters (6.25 ± 2.87, p < 0.001) and outsides (6.50 ± 3.16, p < 0.001). Attack Jumps were performed more frequently by middles (7.75 ± 1.88) and this was found to be significantly more than setters (0.38 ± 1.06, p < 0.001), and outsides (5.75 ± 3.25, p < 0.01). Middles had a significantly higher reach and greater body mass than setters (6.25 ± 2.87, p < 0.001) and outsides (6.50 ± 3.16, p < 0.001). Attack Jumps were performed more frequently by middles (7.75 ± 1.88) and this was found to be significantly more than setters (0.38 ± 1.06, p < 0.001) and outsides (5.75 ± 3.25, p < 0.01). Middles were taller than outsides and setters (p < 0.001). Consequently, middles had a significantly higher reach and greater body mass than outsides (p < 0.001) and setters (p < 0.001). Both middles and outsides had superior counter movement vertical jump (CMVJ) and spike jump (SJ) scores compared to setters (p < 0.001). Position-specific comparisons between DNT players and SNT players demonstrated that the SNT players were superior in relative CMVJ and SJ scores (p < 0.05) across all positions, with large magnitude of effect (d=0.99). Conclusions: The results of this study highlight the large jumping and landing demands placed on the taller and heavier players in the middle position. The results of this study also establish the large magnitude of difference in jumping ability between junior and senior national team players. Practical Applications: In managing player training loads, strength and conditioning coaches and medical staff must carefully consider the very large additional jumping and landing stress that is placed on taller, heavier middle players, attempting to manage the dose-response relationship to reduce injury potential and increase performance. Talent identification and talent development for aspiring male volleyball players should consider the importance of stature in position selection, and the importance of vertical jump as a discriminator between taller and lower performers across all offensive positions.
Influence Of Exercise Order On Maximum Strength And Muscle Volume In Nonlinear Periodized Resistance Training

Training progresses and sufficient recovery are integral to enhancing exercise performance. Athletes in individual sports (i.e., cycling, running, swimming, triathlon) can use one of numerous techniques such as heart rate, rating of perceived exertion, or lactate threshold velocity to determine exercise intensity. However, in team sport activities the exercise intensity for each athlete is much more difficult to predetermine as members of the team usually perform similar activities which would not necessarily be of the same relative intensity. Likewise, technology has not been as easily utilized in team sports as it has been in individual sports. Recent advances have allowed for heart rate to be collected during team activities through the use of coded heart rate belts which prevent interference between belts worn by teammates. Also, training impulse (TRIMP) equations, where both exercise intensity (from heart rate) and duration of the activity are used to determine exercise load, have been developed and revised. Stagno et al. (2007) recently modified the TRIMP technique for use with team sports. PURPOSE: To determine TRIMP values for elite youth ice hockey players during practice and games within a single week during the middle of their season. METHODS: Seven forwards and five defensemen (mean age 15.8 ± 0.4 years) served as the participants for this study following informed consent. A week of two practices (Tuesday and Thursday) and three games (two on Saturday; one on Sunday) were monitored during the middle of the season (week 15 of 29). In a 29 week season, the team played games 14-24 weekends. Heart rate data was collected using coded heart rate monitors that stored data in the strap. After the practices and games the TRIMP values were determined using the modified equation developed by Stagno et al. (2007) in which heart rates between 65-100% of maximal were divided into 5 zones (1-0.617%, 1.7-2.78%, 3.8-7.95%, 8-16.5%, 17.1-30.6%) and game times were determined using the total TRIMP. Heart rate zones were estimated using the equation developed by Gellish et al. (2007). RESULTS (mean ± SD):

<table>
<thead>
<tr>
<th>Zone (multiplier)</th>
<th>Practice #1</th>
<th>Practice #2</th>
<th>Game #1</th>
<th>Game #2</th>
<th>Game #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.617-1.00</td>
<td>55.4 ± 8.3</td>
<td>71.1 ± 9.1</td>
<td>56.9 ± 33.8</td>
<td>48.5 ± 23.0</td>
<td>38.3 ± 37.6</td>
</tr>
<tr>
<td>1.01-3.00</td>
<td>65.6 ± 53.3</td>
<td>77.1 ± 24.9</td>
<td>44.1 ± 15.1</td>
<td>43.8 ± 14.4</td>
<td>46.5 ± 6.34</td>
</tr>
<tr>
<td>3.01-5.00</td>
<td>59.9 ± 15.9</td>
<td>41.2 ± 13.5</td>
<td>24.8 ± 8.4</td>
<td>22.8 ± 5.7</td>
<td>31.6 ± 7.1</td>
</tr>
<tr>
<td>5.01-7.00</td>
<td>94.9 ± 9.2</td>
<td>86.5 ± 12.7</td>
<td>22.6 ± 9.1</td>
<td>21.8 ± 6.1</td>
<td>28.2 ± 15.2</td>
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<tr>
<td>7.01-9.00</td>
<td>29.0 ± 7.6</td>
<td>28.6 ± 10.3</td>
<td>22.0 ± 7.3</td>
<td>21.1 ± 6.3</td>
<td>22.1 ± 6.1</td>
</tr>
<tr>
<td>Total</td>
<td>190.4 ± 57.8</td>
<td>143.8 ± 41.7</td>
<td>174.5 ± 37.5</td>
<td>177.3 ± 24.6</td>
<td>168.7 ± 49.6</td>
</tr>
</tbody>
</table>

CONCLUSIONS: The games were similar in total TRIMPs to the practices. However, a much greater number of TRIMPs in zone 5 were reported in games than in practice sessions. The TRIMP values for the practices and games were lower than those reported by Stagno et al. (2007) for elite male field hockey players. Whether these differences were due to the level of athlete, the age of the athlete, or the time of season will require further research.  

ACUTE PRE-EXERCISE SUPPLEMENTATION IMPROVES TIMES TO EXHAUSTION DURING HIGH-INTENSITY RUNNING IN MEN AND WOMEN

Abbie Smith, David H. Fukuda, Jennifer L. Graef, Kristina L. Kendall, Jordan R. Moon, Jeffrey R. Stout

Nutrition has become a major focus for athletes and coaches as an effective way to augment training sessions with the ultimate goal being enhanced performance. Specifically, timing of supplementation has developed as the latest area of research. The available body of performance-related nutrition research supports the effectiveness of a few ingredients on anaerobic and aerobic performance. Acute supplementation with unflavored ingredients that are regarded as safe has yet to be thoroughly explored. PURPOSE: To examine the effects of acute pre-exercise supplementation on time to exhaustion (TTE) during high speed running in college-aged men and women. METHODS: Ten moderately trained men and women (mean ± SD; age 26 ± 3 yrs; height 172 ± 8 cm; weight 71 ± 12 kg) volunteered to participate in this randomized, double-blind, placebo-controlled, cross-over study. Thirty minutes prior to testing, participants consumed the active supplement (ACT; 18g whey protein, coconut oil, arginine, creatine, taurine, green tea, and caffeine) or placebo (PLA; 18g maltodextrin, natural and artificial flavors and colors). After a familiarization week, the test was conducted over three non-consecutive days with the randomly ordered ACT and PLA trials (36 total). A maximal oxygen consumption test (VO2MAX) on a treadmill was performed on day one to establish peak velocity output (V̇O2peak). Day two involved treadmill running at 110% and 90% of the V̇O2peak while day three involved running at 105% and 100% of the V̇O2peak. TTE was recorded during each trial, and such trial was separated by 15 min of rest. All testing days were separated by 48 hours. RESULTS: The mean ± SE values for TTE during the ACT trials were 127.5 sec, 156 sec, 185.7 sec, and 303.5 sec at 110, 105, 100, and 90% V̇O2peak respectively. TTE was greater (P < 0.01 - 0.04) for the ACT supplement than the PLA at 110%, 105%, and 100% V̇O2peak but there was no difference (P > 0.58) between ACT and PLA for the V̇O2peak 90% V̇O2peak. CONCLUSIONS: The use of this pre-workout supplement may augment time-to-exhaustion by 10-12% during high intensity running. Although not significant, this supplement may also improve endurance time below V̇O2peak. PRACTICAL APPLICATIONS: Athletes that consume this supplement 30 minutes prior to exercise or competition can prolong their time at high-intensities by up to 12-24 seconds longer than with no supplementation. This may enhance training adaptations and ultimately lead to improvements in both individual and team performance.
The Relationship Between Static Strength, Rotational Strength, Rotational Power, Bat Speed, and Batted-Ball Velocity Of NCAA Division I Baseball Players

Frank Spaniol, Johnny Flores, Randy Bonnette, Don Melrose, Liette Ocker, Daniel A. Judelson

PURPOSE: The purpose of this study was to investigate the relationship between speed and agility of professional arena league football players. Speed was determined by 40 yard dash times and agility by 20 yard shuttle times. METHODS: One hundred and twenty three male subjects, ranging in age from 20 to 31 years, participated in this study. All subjects had a minimum of two years professional football playing experience in a minor professional league or higher level of competition. All subjects were tested for speed by the 40 yard dash and agility by the 20 yard shuttle. Additional data included collected height (HT) and weight (WT). All tests were performed in one testing session in an indoor facility on artificial turf. Each test was administered by two times with hand held stop watches. The best of two tests were recorded for the duration of the nearest hundredth second. Subjects were divided into four groups based on playing position: quarterbacks (n = 8, HT = 73.2 ± 3.1 in., WT = 222.2 ± 12.8 lbs.), fullbacks and linemen (n = 17, HT = 72.7 ± 0.9 in., WT = 252 ± 26.8 lbs.), offensive and defensive linemen (n = 34, HT = 74 ± 1.15 in., WT = 311.6 ± 28.5 lbs.), and wide receivers and defensive backs (n = 64, HT = 71.2 ± 2.2 in., WT = 197.1 ± 15.8 lbs.). Speed times (s) by playing position were as follows: quarterbacks (T = 4.9 ± 0.1 s), fullbacks and linemen (T = 5.5 ± 0.3 s), linemen (T = 5.9 ± 0.2 s), wide receivers and defensive backs (T = 4.7 ± 0.2). Agility times (s) by playing position were as follows: quarterbacks (A = 4.5 ± 0.3 s), fullbacks and linemen (A = 4.6 ± 0.2 s), offensive and defensive linemen (A = 4.9 ± 0.3 s), and wide receivers and defensive backs (A = 4.4 ± 0.2 s). RESULTS: Data analysis was performed on the raw data by using Pearson’s correlation coefficients to determine the relationship between speed and agility among the respective positions. Statistical analysis (p < .05) indicated significant relationships between speed and agility for all positions. Quadrants (r = .49), fullbacks and linemen (r = .46, offensive and defensive linemen (r = .49), and wide receivers and defensive backs (r = .48). CONCLUSIONS: The results of this study indicate a significant relationship between speed and agility of professional arena league football players. PRACTICAL APPLICATION: Since a casual relationship cannot be assumed for speed and agility, it is suggested that coaches, players, and trainers include drills specifically designed to improve speed as well as drills that enhance agility.

The Relationship Between Speed And Agility Of Professional Arena League Football Players

Frank Spaniol, Johnny Flores, Randy Bonnette, Don Melrose, Liette Ocker, David Szymanski

PURPOSE: To investigate the relationship between static strength, rotational strength, rotational power, bat speed and batted-ball velocity of NCAA Division I baseball players. METHODS: Thirty-three NCAA Division I male baseball players (age 20.36 ± 1.41 yrs.) were studied to determine static strength, rotational strength, rotational power, bat speed, and batted-ball velocity. Static strength (S = 6.64 ± 12.83 lbs.) was measured by a cable-tensionometer at the correct point (bat and ball) in a static hitting position. The maximum of three trials was recorded. Rotational strength (R = 194.30 ± 21.46 lbs.) was measured by a Cybex Tensio Rotational Machine. Rotational power (P = 21.09 ± 11.11 mph) was measured by a Stalker Pro digital radar gun during a rotational medicine ball toss using a 3 kg medicine ball. Bat speed (BS = 86.64 ± 5.86 mph) was measured with the ATEC 2000°™ Bat Speed Chronograph by recording the maximum result of five swings on a batting tee. Batted-ball velocity (BBV = 82.02 ± 5.28 mph) was measured with the Stalker Pro digital sports radar gun by recording the maximum velocity of five batted balls from a batting tee. Height (HT = 72.19 ± 2.06 in.) was measured to the nearest half-inch and body weight (BW = 201.86 ± 27.41 lbs.) to the nearest pound. The three-site skin fold test was used to determine percent body fat (BF = 12.99 ± 3.04%) and lean body mass 8.8M ± 173.2 lbs ± 21.1 lbs. RESULTS: Data analysis was performed on the raw data by utilizing a correlation matrix to calculate correlation coefficients for all variables. Statistical analysis (p < .05) indicated moderate to high positive relationships between static strength and bat speed (r = .46) and static strength and batted-ball velocity (r = .62). Additional moderate positive relationships existed for rotational strength and bat speed (r = .45), rotational strength and batted-ball velocity (r = .45), rotational strength and batted-ball velocity (r = .45) and rotational power and bat speed (r = .36), and rotational power and batted-ball velocity (r = .40). CONCLUSIONS: The results of this study indicate a significant relationship among static strength, rotational strength, rotational power, bat speed and batted-ball velocity. PRACTICAL APPLICATIONS: Baseball coaches, players, and trainers should consider the relationship of static strength, rotational strength, and rotational power, when training for bat speed and batted-ball velocity. ACKNOWLEDGMENTS: This study was funded by a grant from the Center for Educational Development, Evaluation, and Research (CEDER) at Texas A&M University-Corpus Christi.

Comparison Of Distances Covered By A Soccer Referee During High School And College Matches

Scott Staiger

Being a soccer referee requires a high level of aerobic fitness depending on the level of the game. It is assumed that referees with higher levels of fitness will cover more distance while keeping up with play, thereby improving their ability to make correct decisions. The actual distance covered depends on several variables including the age and ability of the players, size of the field, and experience of the referee. A global position satellite (GPS) watch is recommended to be used by a referee to measure the distance covered during a match. PURPOSE: To use a GPS watch to analyze and compare distances covered during high school and college soccer matches. METHODS: During this pilot study, one soccer referee volunteered to participate. The referee (age = 37.5 years, height = 1.70 m, weight = 71.8 kg) wore a GPS watch during 8 college (4 men, and 4 women) and 10 high school (5 boys and 5 girls) soccer matches. After the separate seasons, the data from the watch was downloaded to a computer. The data was later categorized and statistically analyzed. RESULTS: The results of the study indicated that the referee covered significantly more distance during a college match (10,822 ± 908.7 m) than during a high school match (8,479 ± 935.01 m) match (p < 0.001). However, the college matches were 10 minutes longer in duration, so the distances were adjusted to reflect a common measure, meters per minute (m/min). After this adjustment, there were no differences in distance covered between college (11.0 ± 10.33 m/min) and high school (11.06 ± 20.29 m/min). CONCLUSIONS: The study supported prior research indicating that soccer referees move a large distance during a match. However, there is no difference in distance covered between high school and college matches when compared by time on the field. PRACTICAL APPLICATIONS: The use of a GPS watch can help soccer officials measure the distance covered during segments of a match or the entire match. This information can be used during the post-game analysis. Another benefit is that the information may help the referees with off-season training, such as designing training programs. The GPS watch could also be worn during off-season training sessions to replicate the demands of a soccer match. More research is needed to validate the use of GPS watches by soccer officials and to further compare the distances covered at different levels of play.

Acute Effects Of Depth Jump Volume On Vertical Jump Performance In Ncaa Di Women’s Soccer Players

Jennie Stepp, Kimberly J. Faulkner, Linda L. Brown, Jared W. Coburn, Daniel A. Judelson

PURPOSE: The purpose of this study was to compare different volumes of depth jumps with rebound in order to find the optimal warm-up for explosive jumping. Methods: New NCAA Div. I women soccer players (age 19.11 ± 2.02 years, height 1.70 ± 0.05 m, mass 64.45 ± 13.7 kg) volunteered to participate in five testing sessions separated by at least 48 hours. Each subject warmed-up on the cycle ergometer for 5 minutes at 25 watts as a comfortable warm-up. Following warm-up, subjects performed three pre-test countermovement jumps followed by 0, 3, 6, 9, or 12 depth jumps. Subjects experienced each condition in a random order on separate days. Subjects then rested for ten minutes followed by three post test countermovement jumps. Dependent variables included vertical jump height as measured by the Vertec and ground reaction force (GRF) measured by a force plate. Investigators individualized box height for each subject at the height of her lateral femoral condyle. Results: ANOVA revealed no significant difference pre to post-test on vertical jump height or GRF for any of the five conditions. Conclusions: These results suggest the volume and or box height used in this study were insufficiently intense to elicit FNP and therefore failed to increase jumping performance. The athletic populations we tested might require a greater volume or higher box height to activate FNP. Also, the next time might have been too long between jump tests for this population, thus missing optimal FNP activations. PRACTICAL APPLICATIONS: This study suggests that NCAA Div. I women soccer players do not use depth jumps at knee height with these volumes as a warm-up in an effort to increase vertical jump performance.
Effect Of Medicine Ball Training On Bat Swing And Batted-Ball Velocities Of Novice Participants

David Szynaski, Sean P. McIntyre, Todd M. Blankenship, Hannah E. Lowe, Kent R. Mire, Josh G. Reed, Bryne E. Stanley, Hung-Sheng Hsu, and Jason R. Beam

In baseball and softball it is important to increase sport-specific power. This may allow a hitter to swing the bat and hit a ball with greater velocity. PURPOSE: To examine the effects of 8 weeks of medicine ball (MB) training on bat swing velocity (BV) and batted ball velocity (BBV) of novice, college-aged students. METHODS: Sixty male and female students were randomly assigned to 1 of 3 training groups. Group 1 (n = 20) men = 18; women = 12) was the control. Group 2 (n = 20; men = 10; women = 10) performed 5 rotational MB exercises for 1 set of 10 repetitions each (50 total MB throws per day) 3x/wk for 8 weeks (1200 total MB throws). Group 3 (n = 20; men = 9; women = 11) performed 5 rotational MB exercises for 2 sets of 10 repetitions each (100 total MB throws per day) 3x/wk for 8 weeks (2400 total MB throws). Instantaneous BV and BBV were recorded using a SETPRO SPARTAN chronograph and SpeedTracTM radar gun while hitting a ball off a batting tee. Dominant and non-dominant grip strength was measured using a JamarTM hand dynamometer. RESULTS: Vertical jump, strength (1RM parallel squat, 1-arm dumbbell row, and bench press), and grip strength significantly improved from pre-training to post-training. All other variables were maintained. At mid-season a significant decrease was observed in batted-ball velocity, while significant improvements were observed in 60 yd sprint and agility times compared to preseason values. All other variables values were maintained. Post-season revealed that batted-ball velocity and speed significantly decreased, while percent body fat, lean body mass, and standing long jump significantly improved from preseason values. All other variable values were maintained. CONCLUSION: These data suggest that a preseason periodized CBT program can improve performance values for college baseball players. Additionally, a 2- day per week in-season CBT program can maintain most pre-season performance and baseball-specific skill values over a collegiate baseball season.

Physiological And Anthropometric Characteristics Of College Baseball Players Over An Entire Year

David Szynaski, Jessica M. Szynaski, Jeff M. Albert, Jason R. Beam, Hung-Sheng Hsu, Shane T. Gilliam, and Jeff O. Potts

The ability to maintain strength, power, speed, agility, and baseball-specific skills throughout a season is vital to the success of a baseball team. PURPOSE: To investigate the physiological and anthropometric characteristics of collegiate baseball players over an entire year and determine when and if changes occurred. METHODS: Twenty-three members of an NCAA Division I baseball team (age = 20.0 ± 1.2 yr, height = 185.4 ± 7.3 cm, body mass = 87.1 ± 11.2 kg) volunteered to be evaluated. Subjects were evaluated for measurements of standard anthropometry (percent body fat and lean body mass) using a TanitaTM bioelectrical impedance device, strength (1RM parallel squat, 1-arm dumbbell row, bench press, and grip strength) using standard Olympic plates and a Jamaski hand dynamometer, power (vertical jump and standing long jump) using a VertecTM and measuring taps, speed (10, 30, 60 yd sprint) using hand-held stop watches, agility (5-10-5 pro agility) using a hand-held stop watch, and baseball-specific skills (bat swing, batted-ball, and throwing velocities) using a SETPRO SPARTAN chronograph, SpeedTracTM radar gun, and JugsTM radar gun in September before team practice began (pre-training), in December after off-season training ended (preseason), in March (mid-season), and in May (post-season). A 2-day per week periodized CBT program was performed during the off-season to preseason (September to December). Training loads and volume progressively increased during this stage of the training year. Volume declined during the in-season (February to May) when the team attempted to train twice per week. Repetition mass (NMHDs) were run on all dependent variables. Significant main effects from the MANOVAs were followed up with repeated measures ANOVAs across seasons and pairwise comparisons were then computed on any significant main effects. Alpha level was adjusted to p < 0.017 to control for Type I error. RESULTS: Vertical jump, strength (1RM parallel squat, 1-arm dumbbell row, and bench press), speed, and batted-ball velocity significantly improved from pre-training to post-training. All other variables were maintained. At mid-season a significant decrease was observed in batted-ball velocity, while significant improvements were observed in 60 yd sprint and agility times compared to preseason values. All other variables values were maintained. Post-season revealed that batted-ball velocity and speed significantly decreased, while percent body fat, lean body mass, and standing long jump significantly improved from preseason values. All other variable values were maintained. CONCLUSION: These data suggest that a preseason periodized CBT program can improve performance values for collegiate baseball players. Additionally, a 2- day per week in-season CBT program can maintain most pre-season performance and baseball-specific skill values over a collegiate baseball season.

Practical Application: It is recommended to keep highly skilled baseball players strong, powerful, and healthy. This will help them on the field, and allow them an opportunity to perform baseball-specific skills optimally throughout the entire playing season.
Effect Of Bosu Balance Trainer® Vs Original Step® On Health- And Skill-Related Components Of Physical Fitness

Erica Taylor, Jason R. Beam, Shane T. Gilliam

INTRODUCTION: Unstable surface training, such as the Bosu Balance Trainer, has grown in popularity in many rehabilitation and general exercise settings as a way to improve gross movement and athletic performance through balance training. However, most studies that have examined these claims have come back with insignificant results. PURPOSE: To determine if the Bosu Balance Trainer provided additional benefits for the health-related and skill-related components of physical fitness compared to performing the same exercise program on the Original Step for healthy, active individuals. METHODS: Fifteen subjects (age 19.24 yrs) were randomly assigned to 1 of 3 groups. The two treatment groups (Bosu® and Step®) followed the 30-minute Bosu® Total Body Workout DVD 3 days/week for 6 weeks. The control group (n = 5) was not allowed to participate in any resistance training program for the 6 weeks. Body composition (biostincluding impedance device), flexibility (sit-and-reach), muscular endurance (1 minute sit-up and pull-up), muscular strength (3 repetition maximum parallel squat), cardiovascular endurance (Treadmill 5 minute step test), and balance (Stack test) were assessed before and after the 6 weeks of training. RESULTS: There were no significant differences between groups for any of the health-related and skill-related components tested. CONCLUSION: The Bosu® Balance Trainer did not provide any additional benefits or increases in general fitness compared to the Original Step or control group. PRACTICAL APPLICATIONS: Based on responses to a questionnaire, subjects in group 3 did not like performing the Bosu® Balance Trainer exercise program on the Original Step. Group 2 liked training conditions and noted no significant differences in improvements compared to the control group. Group 1 noted improved flexibility and coordination during the Bosu® training. However, both groups indicated that the intensity of the training DVD did not progress. Because of this, the subjects were unimpressed with the Bosu® and extended normal training. Future research should take into account the duration, intensity, and progression of the DVD training program.

The Effect of an Extended Warm-Up on Diurnal Performance Differences in Loaded Counter-Movement Jumps

Kristie Lee Taylor, Michael Barker, John Cronin, Nicholas Gill, Dale Chapman, Jeremy Sheppard

PURPOSE: We have previously shown that the performance of a loaded counter-movement jump, which is frequently used in the assessment of an athlete's neuromuscular capabilities, is affected by the time of day that the assessment is conducted. This study aimed to extend those findings by examining whether such variations in performance can be accounted for by the diurnal fluctuations known to exist in body temperature and the ratio between testosterone (T) and cortisol (C) as athletes prepared for a competition. METHODS: Eight recreationally trained males (29.8 ± 5.2 yrs; 178.3 ± 5.2 cm; 80.3 ± 6.5 kg) with a minimum of 6 months resistance training history completed four separate sessions ( differing in time of day and type of warm-up completed). A randomised order, jumps performance was assessed following (a) control warm-up at 8am (b) control warm-up at 4pm (c) extended warm-up at 8am and (d) extended warm-up at 4pm. The control warm-up consisted of dynamic exercises and practice jumps equivalent to the standard warm-up for strength and power assessment used in our laboratory. The extended warm-up incorporated a 20min general warm-up period on a stationary bike (150 – 200 W) prior to completion of the control warm-up. Body temperature was measured using a combination of skin and core temperature to estimate overall body temperature. Peak power, mean power, peak velocity, peak force and jump height were measured using a linear position transducer attached to an Olympic lifting bar with an external load of 20kg (i.e. total load of 40kg). Subjects performed 2 sets of 3 repetitions on maximal effort counter-movement jumps with the bar across their shoulders. RESULTS: Prior to jumping the AM and PM control conditions, whole body temperature was 36.5 ± 36°C, which increased to 36.8 ± 36°C during AM and PM extended warm-up conditions. All kinetic and kinematic variables were higher (ES range = 0.2 – 0.3) during the PM condition compared to the AM control condition. Table 1: Following the extended AM warm-up, when body temperature was = equivalent to the PM control condition, performance was comparable (ES <0.1), except for peak power where the AM extended condition produced greater results (ES = 0.3).

Table 1: Mean (SD) results for kinetic and kinematic variables (mean of 6 trials) during 40kg counter-movement jumps

<table>
<thead>
<tr>
<th>Condition</th>
<th>PK Power (W)</th>
<th>Mean Power (W)</th>
<th>PK (in sec-1)</th>
<th>Peak Force (N)</th>
<th>Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM CONTROL</td>
<td>3747 (636)</td>
<td>2054 (309)</td>
<td>2.15 (0.21)</td>
<td>1697 (152)</td>
<td>26.3 (4.5)</td>
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<td>AM EXTENDED</td>
<td>4060 (768)</td>
<td>2159 (371)</td>
<td>2.24 (0.21)</td>
<td>1738 (167)</td>
<td>27.9 (4.5)</td>
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<tr>
<td>PM CONTROL</td>
<td>3899 (543)</td>
<td>2152 (312)</td>
<td>2.22 (0.16)</td>
<td>1733 (148)</td>
<td>28.0 (3.7)</td>
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<tr>
<td>PM EXTENDED</td>
<td>4047 (705)</td>
<td>2222 (361)</td>
<td>2.25 (0.20)</td>
<td>1761 (157)</td>
<td>26.5 (4.5)</td>
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</tbody>
</table>

CONCLUSIONS: The results of this study indicate that the diurnal variation in whole body temperature, which peaks in the early evening, may explain the diurnal performance differences evident in explosive power output and associated variables. The performance of an extended warm-up, designed to increase the whole body temperature, resulted in improvement in the kinetic and kinematic variables commonly reported from jump performance in the AM condition. PRACTICAL APPLICATIONS: It is suggested that warm-up protocols designed to increase body temperature may be beneficial for reducing diurnal differences in jump performance. This is important for ensuring maximal performance results, and for monitoring performance changes over time, when it may be impractical to standardise the time of day that testing takes place.
Relationships Between Body Composition And Performance Measures In Division III Football Players
Brian Thompson, Glenn J. Cain, Margaret T. Jones

PURPOSE: 1.) To examine mean percent body fat (%BF) and Body Mass Index (BMI) values across three American football position groupings, skill (SK), big skill (BSK) and down linemen (DL). 2.) To examine the relationship between BF and BMI and the following performance measures: vertical jump (VJ), 1-REP max power clean (PC), BS, 1-REP bench press (BR), 1-REP squat (SQ), 1-REP deadlift (DL), 50 yard sprint (50S), and pro-agility (PRD, sec.). METHODS: Body composition data (%BF and BMI) were measured on 54 Division III varsity football players with a minimum of one year of participation in a collegiate strength and conditioning program. Performance measures (VJ, PC, BS, BR, DP, PRD) were collected on 38 of the 54 athletes over three separate testing sessions within a one week period. RESULTS: The following mean values were found for each body composition variable overall and within each group (%BF: VJ (17.0±5.6), SK (14.1±3.0), BSK (17.0±3.8), SQ (12.2±5.7); BMI: VJ (28.8±3.9), SK (25.9±1.8), BSK (29.4±2.2), SQ (26.2±3.0)). There was a significant interaction (p<0.01) across the groups for both body composition data (n=54). A Tukey post-hoc analysis revealed the following results for BF and BMI, respectively: The LN group was significantly higher than the SK (p<.01), SQ (p<.001), and SK (p<.01) groups. The LN group was significantly higher than the SK (p<.01). CONCLUSIONS: The current study found that fat mass and fat-free mass standardized by height, (kg·m−2), a widely used metric and fat-free mass standardized by body height, (kg·m−2) were highly correlated in both the group A (R=0.80, p<0.01) and group B (R=0.78, p<0.01) suggesting that these measures are interchangeable and may provide the athlete with a more complete assessment of body composition. TABLE 1. Correlation coefficient between somatotype components and body composition indices.

|             | BMI       | FMI-SF    | FFMI-SF   | FMI-BI    | FFMI-BI
|-------------|-----------|-----------|-----------|-----------|-----------
| Endomorphy  | -0.21     | -0.42**   | -0.42***  | 0.30***   | 0.02
| Mesomorphy  | 0.77***   | 0.12      | 0.73**    | 0.28      | 0.61***   |
| Ectomorphy  | -0.86***  | -0.31*    | -0.70**   | -0.24     | -0.72***  |

*p<0.05, **p<0.01, ***p<0.001

The Motion Analysis Of Side-Step Cutting In Football Players
Ryo Tominaga, Yoshimasa Ishii, Toru Tanaka, Zhoury Chen, Yong Wang, and Kazuhiko Watanabe

High agility performance is important for football players and the acquisition of this skill has been discussed recently. PURPOSE: The purpose of this study was to analyze the agility test and the motion of side-step cutting by biomechanical method. METHODS: Twenty college football players (mean ± SD: age: 20.3±1.4 yrs, height:174±4.0 cm, weight:78±4.1±kg) participated in this study. Subjects performed 40 yard straight dash and pro-agility test and assigned to three groups: group A: QB, WR, DB; group B: LB, RB, group C: OL, DL. For the biomechanical analysis of side-step cutting, three subjects with different levels of agility performed 5 dash and 5 dash in a straight line and change of direction. The angle of change of direction was 90° and 135° in degree to the right. The motion of side-step cutting was monitored by high speed digital video camera and analyzed by a 3-D analysis system (Vicon system, Japan). The total time, the contact time of left sole and the angle of left lower leg to the ground during the change of direction were analyzed. RESULTS: Correlation analysis showed relatively high validity between 40 yard straight dash and pro-agility test (r=0.71). The values of 40 yard straight dash and pro-agility test in group A and B were significantly higher than in group C (p<0.05). From the biomechanical analysis, the players with high scored pro-agility test showed the contact time was short and the angle of lower leg was small in both 90° and 135°. CONCLUSIONS: The above is valuable information for coaches and athletes involved in improving the skill of agility.

Effect Of 10 Repetitions Of Box Jumps And Depth Jumps On Peak Ground Reaction Force
Tai Tran, Kim Faulkner, Jennie Steng, Andy V. Khamou, Brandon P. Uribe, Nicole C. Dabbs, Edward Jo, Lee E. Brown FNSCA, Jared W. Coburn FNSCA, and Daniel A. Judelson

Volleyball requires explosive strength to achieve high levels of performance. Strength coaches commonly use plyometric exercises such as box jumps and depth jumps to enhance vertical jump performance; however, fatigue may impair training performance. PURPOSE: The purpose of this study was to assess fatigue, via force production, during ten box jumps and ten depth jumps. Methods: Ten Division I female collegiate volleyball players participated in this study (age: 19.1±2.8 yrs, height:177.3±6.1 cm, body mass:73.9±5.9 kg). Participants attended two test sessions separated by a 72 hour rest period. Subjects started visit one by completing a five minute warm-up at a self-selected cadence on a level floor. Subjects started visit two with the other condition. Peak ground reaction force (GRF) was collected using a 4 force plate mat (AMTI, USA). Subjects started visit one by completing a five minute warm-up at a self-selected cadence on a level floor. Subjects started visit two with the other condition. Peak ground reaction force (GRF) was collected using a 4 force plate mat (AMTI, USA). Practical Application: These findings in the present study suggest that anthropometric somatotype rating would be useful for estimating body composition in athletes training.

The relationship between somatotype and body composition was analyzed for all two measurements. RESULTS: The relationships of somatotype component and body composition indices are listed in Table. Mesomorphy and ectomorphy were significantly related to BMI, FWR and BMI by SF were more accurate than SF in relation to body composition. PRACTICAL APPLICATION: These findings in the present study support that anthropometric somatotype rating would be useful for estimating body composition in athletes training.

<table>
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<tr>
<th></th>
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</table>

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Relationship Between Somatotype And Body Composition In Japanese College Athletes
Masato Tokui, Ko Noda, Kyoataro Funatsu, Shuichi Komiya

Estimating body composition is important in assessing the progress of physical performance or physical condition in athletes in training. However, convenient and accurate methods for athletes with highly trained physical characteristics have not yet been established. Meanwhile, somatotyping has been used for the assessment of athletes’ physique. PURPOSE: To investigate the utility of somatotyping for estimating body composition by clarifying relations of somatotype components and body composition indexes in Japanese college athletes. METHODS: Measurements were made on thirty-one male college track and field athletes (19-22 yr) twice each year, at 3-month intervals. We measured weight, height, breadth and girth measurements, skinfold thicknesses (SF), and bioelectrical impedance (BF). Three somatotype components (i.e. endomorphy, mesomorphy and ectomorphy) were determined depending on the Heath-Carter anthropometric method. Body mass index (BMI: kg·m−2), arm fat mass index (AFMI: kg·m−2), fat free mass index (FFMI: kg·m−2) were analyzed as body composition indexes. The relation between somatotype and body composition was analyzed for all two measurements. RESULTS: The relationships of somatotype component and body composition indexes are listed in Table. Mesomorphy and ectomorphy were significantly related to BMI, FWR and BMI by SF were more accurate than SF in relation to body composition. PRACTICAL APPLICATION: These findings in the present study suggest that anthropometric somatotype rating would be useful for estimating body composition in athletes training.

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Tai Tran, Kim Faulkner, Jennie Steng, Andy V. Khamou, Brandon P. Uribe, Nicole C. Dabbs, Edward Jo, Lee E. Brown FNSCA, Jared W. Coburn FNSCA, and Daniel A. Judelson

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Abstracts

V – Z
Rate Of Velocity Development Positively Correlates With Quadriceps Cross Sectional Area

Brandon Uribe, Andy V. Khamsi, Tai Tran, Diamond Nguyen, Nicole D. Capps, Lee E. Brown, Jared W. Coburn, Daniel A. Judelson

PURPOSE: Although isokinetic dynamometers purport to move a limb at a constant speed, the tested limb achieves a variety of velocities through the range of motion. To perform an isometric movement, the tested limb must overcome its inertia through increased torque until the limb angular velocity equals the velocity prescribed by the isokinetic device. The rate of change of velocity over time necessary to achieve the pre-scribed angular velocity is known as RVD. The purpose of this study was to determine the relationship between muscle cross-sectional area (CSA) and RVD of the quadriceps in recreationally trained males during isokinetic concentric knee extension. METHODS: On two separate visits, 57 male (age 23.7 ± 2.2 years; height 178.3 ± 7.0 cm; mass 80.4 ± 13.3 kg) subjects performed three maximal concentric knee extension repetitions of their dominant leg on an isokinetic dynamometer at 15 randomized angular velocities (10-300°·s⁻¹). Investigators calculated muscle cross-sectional area (CSA) via the Housh equation using skinfold and circumference of the anterior thigh. A Pearson correlation calculated the relationship between muscle CSA and RVD. RESULTS: Muscle CSA of the quadriceps significantly (∆p<0.05) correlated with RVD measures from 30°·s⁻¹ to 150°·s⁻¹ through 500°·s⁻¹. RVD measures with r values increasing from 0.33 to 0.56, respectively. However, no significant correlation existed between muscle CSA and RVD at speeds of 30°·s⁻¹ to 15°·s⁻¹ and 60°·s⁻¹ to 15°·s⁻¹. CONCLUSION: Muscle CSA significantly correlated with RVD at the tested angular velocities between 30°·s⁻¹ to 150°·s⁻¹ through 500°·s⁻¹ with an increasing trend. Consequently, increased muscle CSA may lead to increased RVD during isokinetic low-extreme exercise. Therefore, training at high velocities and with sufficient loads to induce muscle hypertrophy might improve performance during high-velocity dynamic movements. PRACTICAL APPLICATIONS: Training designed to increase muscle CSA might increase RVD during isokinetic low-extreme extension movements. Increasing RVD provides therefore reducing time to achieve a desired velocity might represent a desirable adaptation for any dynamic movement.

The Effect Of A Competitive Collegiate Basketball Season On Recovery Cue Seven Questionnaire Scores And Drop Jump Height & Pilot Study

Michelle Van Dyke, J. McMillan, T. Buckley, R. Newcomer, B. Petty, J. Metzler, S. Rossi

Overtraining often comes about when athletes are unable to fully recover from their training demands. Overtraining affects various aspects of an athlete’s physical and mental ability to perform at an optimal level. Practical and effective monitoring for overtraining needs to incorporate both physiological and psychological measures that allow for immediate feedback for either the athlete, strength and conditioning specialist, or coach in order to keep athletes from suffering from the possible downfall of overtraining symptoms. PURPOSE: This study examined the effect of a competitive collegiate season on drop jump heights and recovery cue seven questionnaire scores in division I women’s basketball players. METHODS: Brief female division one collegiate basketball players (mean ± SD, age: 19.0 ± 1.5; height: 174.9 ± 5.6 cm, weight: 80.1 ± 18.9 kg; BMI: 25.2 ± 3.5 kg/m²) volunteered to participate in the study. Prior to data collection, subjects signed an approved informed consent, were instructed how to complete the recovery cue seven and practiced the drop jump technique. During conference play, players reported to the Biomechanics lab each Wednesday following their day off from mandatory basketball workouts for the week. The players completed a recovery cue seven questionnaire. Following a 5-minute warm-up on a cycle ergometer, players performed a self-selected dynamic warm up. Following the warm up, the investigator visually reviewed the drop jump procedure with the subjects. The subjects then performed two-drop jump trials from a box 60 cm onto a force plate (ARMT, Watertown, MA). Jump height was calculated by multiplying 6.1 by flight Time²/2. RESULTS: An ANOVA with repeated measures was used to analyze each of the seven current scales of the recovery cue seven questionnaire along with jump height. No significant differences (∆p>0.05) were found between time points on the recovery cue seven questionnaire or jump height. CONCLUSION: Although no significant differences were found with this study, future research in this area may need to consider analyzing individual player’s results as opposed to analyzing data from the team as a whole. PRACTICAL APPLICATION: The use of a simple supplementation, such as a drop jump and the use of a short psychological assessment, such as the recovery cue seven are very practical tools that can be done on a weekly basis to monitor athlete’s levels of fatigue and possible signs of overtraining. Coaches, athletic trainers and strength and conditioning specialists may benefit by implementing weekly measurements of fatigue into training as a way of monitoring for possible signs of overtraining or underrecovery.

Surveying The Nutritional Habits And Behaviors Of NCAA-Division III Athletes

Courtney C. Wall, Mary Ann Coughlin, Margaret T. Jones

PURPOSE: The purpose of the current study was to assess nutritional habits and behaviors of NCAA-Division III athletes. METHODS: Varsity athletes (N=241), Males: n=119, Females: n=122, age: M: 19.5 ± 1.2, F: 19.6 ± 1.2; completed a questionnaire designed to gather information about nutritional habits and behaviors. Subjects ranged from the 2nd to 10th semester of their undergraduate education. Team sport vs. individual athlete representation was: Male – 73% team sport athletes, 27% individual sport athletes. Female – 66% team sport athletes, 34% individual sport athletes. Team sport athletes represented: basketball, field hockey, tennis, football (male), lacrosse, soccer, softball (female), and volleyball. Individual sport athletes came from tennis and track and field. Questionnaires were administered to athletes before or after a team lift or practice session. Differences were assessed between: 1.) males and females; 2.) freshmen and seniors; and 3.) team and individual sport athletes. Independent sample Mann-Whitney U and Chi-Squared tests were run. RESULTS: On average, athletes reported eating between 3-6 times per day. Approximately 49% drank 7-8 daily servings of water. Less than one daily servings of water would be an accurate estimate for the average person to stay hydrated, with training athletes requiring more. Water loss presented the need for carbohydrate consumption, with only 3-4 servings being taken in throughout the day. Mullin (4) suggested eight 8-ounce servings of carbohydrates per day. The present study also compared dietary habits to the USDA Food Guide Pyramid, it was found that collegiate football players need to consume more servings of fruits and vegetables compared to the current study. CONCLUSION: Proper diet has been found to help athletes improve physical activity and aid in recovery from exercise (1). When comparing results to the USDA Food Guide Pyramid, it was found that collegiate football players need to consume more servings of fruits and vegetables (2), which is similar to the present study where, on average, insufficient servings of fruits and vegetables were consumed. The present study also presented the need for carbohydrate consumption, with only 3-4 servings being taken in throughout the day. Mullin (4) suggested 8-ounce servings of water would be an accurate estimate for the average person to stay hydrated, with training athletes requiring more. Water loss and dehydration during exercise was a problem for collegiate football players (3) and for Division III Athletics, as an average of 5-8 ounce servings of water were consumed daily. In the current study, 17% of athletes reported consuming a dietary supplement. Similarly, Swartz et al. (2) found 31% of football players were consuming supplements. Limited knowledge about supplements and lack of education is a problem for collegiate athletes. PRACTICAL APPLICATION: Nutritional education is recommended for 1) daily food choices; 2) weekend calorie intake; 3) hydration techniques; and 4) supplement usage. Improved knowledge of coaches and availability of certified nutritionists would benefit the nutritional habits of athletes.

Effects Of Resistance Training Volume And Whey Protein Supplementation On Lower-Body Strength And Muscle Cross-Sectional Area

Ashley Walter, Katherine M. Hoge, Trent J. Herda, Pablo B. Costa, Eric R. Ryan, Jeffrey R. Stout FNSCA, Joel T. Cramer FNSCA

Based on recent studies, it may be possible to use a reduced-volume resistance training program in conjunction with whey protein supplementation to achieve similar increases in strength and hypertrophy compared to traditional-volume resistance training without supplementation. PURPOSE: To examine the effects of eight weeks of reduced-volume resistance training with whey protein supplementation versus traditional-volume resistance training without supplementation on leg press strength (LPMAX) and thigh muscle cross-sectional area (mCSA) in collegiate men. METHODS: Twenty men healthy, recreationally active men (mean ± SD age: 21.5 ± 3.5 years; height: 180 ± 7.1 cm weight: 83.8 ± 11.8 kg) volunteered for LPMAX and mCSA testing before and after an 8-week resistance training intervention. LPMAX was determined using a standard one-repetition-maximum (1-RM) protocol on a 45° hip sled, and mCSA at mid-thigh was assessed using a peripheral quantitative computed tomography scanner. Participants were randomly assigned to either the whey protein (WP) or control (CON) group. The WP group (n=10) performed workouts with no supplementation 3 times per week versus 3 times per week of their LPMAX for 8 weeks, where week 1 consisted of 5 sets of 6 repetitions, week 2 4 sets of 6 reps, and weeks 3–8 were 5 sets of 6 repetitions. The WP group (n=12) consumed a whey protein drink (25g polyethylene glycolated whey protein concentrate, 7g leucine, and 200mg creatine) 30 minutes before and immediately after each training session and completed 1 set of 6 repetitions during week 1, 2 sets of 6 repetitions during week 2, and 3 sets of 6 repetitions during weeks 3–8. Resistance training volume was calculated as sets × repetitions × load (kg). RESULTS: An independent samples t-test indicated that the volume of the CON group (mean ± SD age: 144.2 ± 31.3, 313.2) was 1.9 times greater than (p<0.01) the volume of the WP group (74.5, ± 37.2). The two-way ANOVAs indicated 28% (WP) and 22% (CON) increases (p<0.001) from pre- to post-training for LPMAX, while mCSA increased (p<0.001) by 3.4% (WP) and 4.4% (CON). However, there were no interactions (p>0.05) and no differences (∆p>0.05) between the WP and CON groups at either pre- or post-training. CONCLUSIONS: These findings suggest that resistance training with 46% less volume plus whey protein supplementation for 8 weeks resulted in similar increases in leg press strength and thigh mCSA as a higher-volume resistance training program with no supplementation. PRACTICAL APPLICATIONS: These results demonstrated the general importance of nutritional strategies (i.e., protein timing) in conjunction with resistance training for increasing muscle strength and size. These findings may be particularly useful when resistance training volume must remain low, such as during injury rehabilitation and in resistance muscle training phases.

### Table 1. mCSA and LPMAX Values for the whey protein (WP) and control (CON) groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-training</th>
<th>Post-training</th>
<th>Pre-training</th>
<th>Post-training</th>
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<tbody>
<tr>
<td>LPMAX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat Protein</td>
<td>151.3</td>
<td>156.4 *</td>
<td>249.1</td>
<td>314.0 *</td>
</tr>
<tr>
<td>Control</td>
<td>155.9</td>
<td>162.5 *</td>
<td>269.4</td>
<td>327.0 *</td>
</tr>
</tbody>
</table>

Data are means (SE). * indicates a significant (p<0.05) increase from pre- to post-training.
The Ergonomic Effects Of Carbohydrate Supplementation On Force Output And Slope Of Fatigue During A Selected Resistance Protocol

Ben Wax, Steve Kinzey, Brian Lyons and Stan Brown

The ergonomic effects of carbohydrate ingestion prior to and during resistance training has yielded mixed results over the years. A number of investigations have attempted to determine the ergogenic effects of carbohydrate supplements utilizing squat bars or some type of circuit style of resistance training. Past these investigations measured performance in terms of a specific number of repetitions successfully performed, which failed to account for central fatigue factors related to the specific exercise chosen. Few investigations have measured the relationship between central fatigue factors and force generation output during periods of voluntary and stimulated contractions. PURPOSE: To determine the ergogenic effects of carbohydrate ingestion on force output following a selected resistance protocol. METHODS: A male subject with a minimum of 0.5 years of bodybuilding and/or power lifting experience trained following a monitored and random assigned exercise trials one week apart, in which the experimental treatment, glucose polymer (GP) and placebo (P), were randomly assigned and administered in a double blind fashion. The subjects were seated with the knee at an angle slightly less than 90° by a horizontal step secara anchoring just above the malleolus and attached to the other end by a strain gauge. Subjects were seated at the atest to maintain muscle length and prevent substantial use of hip extensors. The subjects ingested either a 10% GP solution (0.1gkg−1 body mass) or P 5 minutes before performing a maximal voluntary contraction with three perceived dominant legs to determine force output. Following another 5-minute rest and thereafter at 6 minute intervals a GP (0.17g/kg body mass) or P solution was ingested during the protocol. The protocol consisted of one leg isometric contractions at 50% of their previously determined one repetition maximum for 20 seconds, followed by 40 seconds of rest between contractions, until failure occurred. Failure was defined as the inability to sustain target force for 1 consecutive seconds. The decrease in force generating capacity was tested from brief maximal voluntary contractions (MVC’s) and short bursts of 60 Hz stimulation applied at 5 Hz. RESULTS: A paired sample T-test revealed performance measured in time to exhaustion (29 ± 13.08 minutes for GP and 16 ± 8.12 for P), total force output (1,970 ± 152.1 N for GP and 1,923 ± 118.6 N for P), peak force (1,970 ± 152.1 N for GP and 1,923 ± 118.6 N for P), and time to peak force (60.0 ± 15.2 seconds for GP and 59.1 ± 15.2 seconds for P) were significantly different between the GP and P conditions (p < 0.05). CONCLUSIONS: The ingestion of a monohydrate carbohydrate supplement prior to and intermittently during selected-resistance protocols appears to provide an ergogenic effect that is reflected by increased force production and delayed time to fatigue.

Comparison Of Body Composition Assessment Techniques In A Non-Athletic, Non-Obese Young Adult Population

Ronald D. Williams, Jr., Jeremy T. Barnes, Thomas J. Pujol

The direct acquisition of ground reaction force data during isoinertial resistance tasks typically requires a force platform. As this is not always practical, alternative devices have been used to estimate dynamic force by directly measuring other variables and using inverse dynamic calculations. For example, linear position and linear velocity transducers have been interfaced with a barbell and used to measure force. However, since barbell stiffness differs between laboratories, the use of published calibration data is often problematic if training-induced changes are to be monitored. PURPOSE: To determine if peak force differed during barbell jump squats using non-centered accelerometer placements. METHODS: A factorial design (12 men & 12 women) with jump squat testing was recruited from a university population. Subjects performed duplicate barbell jump squat trials in which the barbell within the squat position was centered on the pelvis (CMJ) and static jump squats (SJ) at 20%, 30%, 40% and 50% of their body mass index (BMI) for two test days in a counterbalanced sequence. An inertial dynamic accelerometer was directly affixed to each end of the barbell midway between the lateral-most aspect of the shoulder and the thumb side of each hand. Acceleration data were downloaded from 1.15 kHz to 50Hz by averaging every 4 data points. These data were then low-pass filtered (7th order Butterworth) with a cutoff frequency of 1000 Hz to create an ergodynamic signal. Force was determined via inverse dynamics with respect to dynamic accelerometer data. RESULTS: Mean ± SD peak force for the CMJ and SJ were 20% ± 4.1N and 15.4N ± 5.9N (Table 1). CONCLUSIONS: Inertial dynamic accelerometer and static jump squats, dynamic peak force on both the CMJ and SJ were measured in a different peak force output. PRACTICAL APPLICATIONS: It appears that accelerometer placement during squat jumps should either be clear as far as possible to the center of the bar or a squat machine with a horizontally free bar should be used. Although not tested herein, it is likely that linear position and linear velocity transducers would have the identical inconsistencies. As continuous accelerometar placement was not practical, it is unclear what, if any, contribution the dependences made to measurement error.

Table 1. Peak force values (newtons) for load-spectrum jump squats.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean N</th>
<th>SD</th>
<th>2-tailed Sig.</th>
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<tr>
<td>A1 PkF CMJ 20%</td>
<td>1,970.9</td>
<td>96</td>
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<td>A2 PkF CMJ 20%</td>
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<tr>
<td>A2 PkF SJ 40%</td>
<td>1,994.1</td>
<td>98</td>
<td>4.27</td>
</tr>
</tbody>
</table>

A1 & A2 = accelerometers 1 & 2, respectively

Mean N SD t-ratio 2-tailed Sig.
The Relationship Between Isometric and Dynamic Strength in College Aged Males
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The purpose of this investigation was to examine the relationships between measures of maximal isometric force (PF), rate of force development (RFD), vertical jump performance (VJ) and one repetition maximum (1RM) strength in recreationally trained men. The subjects in this study were 26 men (mean ± SD: age 22 ± 1 years, height 175 ± 7 cm, mass 86 ± 10 kg). They were tested for PF using the isometric mid-thigh pull exercise. The 1RM for the squat and bench press exercise were determined as a measure of dynamic strength. Explosive strength was measured as RFD between VJ and 1RM squat (r = 0.69, p<0.05). There were no significant correlations with RFD. The results showed that isometric maximum strength and RFD strongly correlate with each other (r = 0.75, p<0.05). Among the subjects who were over their regulated Army weight (n=11), no significant correlations (p>0.05) were found between any of the tests. Conclusion: For the general population, the U.S. Army correlates moderately well to other estimations of percent body fat. However, among the subjects who were over their regulated Army weight (n=8), no significant correlations (p>0.05) were found between any of the tests. However, after the test was administered to subjects who were above their training weight, the test was seen as a valid tool for assessing strength. Practical Applications: The test is a valid tool for assessing strength in college aged males. However, further research is needed to determine if the test is valid in other populations.
PURPOSE: Physical and anthropometric characteristics have been associated with differences between levels of swimming performance, swimming events, training status, gender, and age. It has been suggested that the greater body fatness observed in girl swimmers than boy swimmers could explain the gender differences in performance. Few studies, however, have examined gender differences in the physical and anthropometric characteristics of young swimmers. PURPOSE: The purpose of this study was to compare the body composition, body build, and anthropometric characteristics of boy and girl sprint swimmers.

METHODS: Two groups (boys, n = 38 and girls, n = 31) of sprint swimmers (mean age ± SD = 11.03 ± 2.29 and 10.45 ± 2.29 years, respectively) volunteered for this study. The subjects were members of local swimming clubs who competed in sprint swimming events (≤ 200 m). Gender comparisons were made for age, body weight (BW), height (HT), fat-free weight (FFW), percent body fat (%fat), endomorphic rating, ectomorphic rating, sum of 12 diameters, sum of 11 circumferences, biacromial diameter, and biiliac diameter, and FFW/HT. The results of the independent t-tests indicated that the only mean differences between the boy and girl sprint swimmers were for %fat (boys = 9.40 ± 5.35 %fat; girls = 12.73 ± 6.19 %fat) and endomorphic rating (boys = 2.87 ± 0.96; girls = 4.29 ± 1.22).

CONCLUSIONS: For the current age group of sprint swimmers, the only gender differences were for measures associated with body fatness and there were no differences for body build measures associated with musculoskeletal size, muscularity, skeletal size, total body mass, or body breadth dimensions. Further studies are needed to examine gender differences in the body composition and body build of distance swimmers, older sprint and distance swimmers, and athletes in sports other than swimming.

PRACTICAL APPLICATIONS: These findings suggest that gender differences in sprint swimming performance may be reduced through training programs for girls designed to reduce body fatness.