

PHYSICAL FITNESS

Comparing the Effects of the Barbell Deadlift and the Plyometric Depth Jump on Vertical Jump Height in Division II Female Collegiate Athletes: A 6-Week Study

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Abstract

Vertical jump performance is vital to many sports and is predictive of power output. Both resistance exercises and plyometric exercises have been shown to increase vertical jump performance. Identifying the type of exercise that increases jump height the most may be useful to coaches and athletes worldwide. The literature has stated that both resistance and plyometric exercises are used in many athletic training programs; however, the plyometric depth jump is often underutilized to increase vertical jump height. This study compares the effects of two types of exercises (plyometric depth jump and traditional deadlift) on vertical leap height in female collegiate athletes. Eleven women's basketball players and 15 women's softball players performed a 6-week training study. The depth jump group ($n = 11$) and the deadlift group ($n = 15$) trained three times per week. Both groups improved in vertical jump height, but the depth jump group had a greater increase, which was nearly significant ($p = .061$). The findings show that the implementation of plyometric exercises, such

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as the depth jump, into training programs could lead to a greater increase in muscular power and vertical jump height than resistance exercises alone.

All physical activities involve the use of muscular force and power. Both traditional resistance training and plyometrics can increase force production and power in an athlete. One measurement of this force production is vertical jump performance (Caruso et al., 2011). Vertical jump can determine an athlete's vertical leap height. Determining which type of exercise increases vertical leap height the most will allow coaches and trainers to build more effective training programs for athletes. These programs can be used in the achievement of the higher level of athletic performance that is so often sought by both athletes and coaches (Stieg et al., 2011). Both strength (or muscular force) and power contribute to maximal human efforts in physical activities. Although similar, the terms differ due to a time component. Muscular strength is simply defined as the amount of muscular force produced at a specific velocity. On the other hand, muscular power is precisely defined as “the time rate of doing work.” While traditional resistance training has been shown to increase muscular strength; plyometric training, or activity that allows a muscle to reach maximal force in the shortest amount of time, has been shown to increase muscular power (Baechle & Earle, 2008).

Muscular power is an essential contributor to athletic performance. Vertical jump height is thought to provide a valuable index of the muscular power of the lower limbs (Buckthorpe et al., 2012). To excel in the vertical jump, athletes must use a high amount of force over a brief period (power) while their feet are in contact with the surface from which they are jumping (Caruso et al., 2011).

Resistance training has become a key component in training to enhance sports performance. It has been used by athletes to increase force production. However, most movements in sports occur too quickly for muscles to produce maximal force. Therefore, a muscle's rate of force production, or power, must be increased (Dalen et al., 2013). For power output to be increased from resistance exercise, the athlete must perform explosive lower body exercises. These may elicit postactivation potentiation, which allows for more fast-twitch motor units to be activated. Power output is related to exercise intensity, so explosive lower-body resistance exercises may increase

power (Chiu & Salem, 2012). Because the deadlift is not an explosive exercise, the lift only increases muscular strength.

Plyometric training gained popularity in the early 1970s and has since been used to improve power output. This type of training involves the stretch-shortening cycle (Mirzaei et al., 2014). Each repetition involves three phases: eccentric, amortization, and concentric. During the eccentric phase, the agonist muscles are stretched, or preloaded, with elastic energy. The amortization phase is the short pause between the eccentric phase and the concentric phase. The concentric phase involves the shortening of agonist muscle fibers and uses the stored elastic energy to increase force production. This force production is increased over a short time, increasing power output (Baechle & Earle, 2008). Because the depth jump is a plyometric exercise, it should increase muscular power, thereby increasing vertical leap height.

The purpose of this study was to determine whether the barbell deadlift or the plyometric depth jump would cause a greater increase in vertical jump height in Division II female collegiate athletes and to propose to coaches and strength coaches the proper implementation of these exercises into strength training programs for female athletes. This work also serves as a foundation for future studies that will explore the differences between and the uses of plyometric and resistance training.

Method

The research on resistance training and plyometric training clearly shows that these methods increase vertical jump height. However, a limited number of studies compare the two forms of exercise and their effects on vertical jump height. The primary focus of this project was to determine which type of exercise (plyometric depth jump or barbell deadlift) would lead to the greater increase in vertical jump height. Next, training on the two exercises and the vertical jump would need to occur. Finally, the time frame would need to be decided and the pre- and posttests scheduled so the study could be worked into the training programs of both groups of athletes.

Research Design

This study used quantitative methodology and quasi-experimental research to compare the vertical jump height of subjects before and

after 6 weeks of training. This research project used a two-group pretest–posttest design, but the subjects were not randomly selected or assigned. This study used only female athletes to ensure that sex was not a confounding factor. This is the same reason that pretesting and posttesting were done on the same day and at the same time of day. For the hypothesis, the independent variables are the deadlift and the depth jump. The dependent variable is vertical jump height.

Experimental Groups

Athletes on the women’s softball and basketball teams who had no preexisting injuries were selected to be a part of the study. The women’s softball team performed the barbell deadlift as a part of their workout routines, and the women’s basketball team performed the plyometric depth jump as a part of their workouts. The workouts for this study began 3 days after pretesting and ended 3 days before posttesting.

Pretest and Posttest

Each group came separately to perform the pretest and posttest vertical jumps. The Vertec was used in the measurement of vertical jump. The procedure was explained to them, and they were allowed two jumps. The average of the two jumps was written down as their jump height. Before the athletes jumped, their standing reach height was taken. The standing reach height and the jump height were used in the calculation of the vertical leap height. Upon completing the 6 weeks of training, all of the athletes returned for the posttest. Three softball players and five basketball players did not perform in the posttest due to ankle injuries. The posttest vertical jump height was measured again for each uninjured athlete. Individual change scores were recorded during the pretest and posttest and used in the calculation of group scores, which were further analyzed (Table 1).

Results

A one-way analysis of covariance (ANCOVA) was conducted. The independent variable (Type of Exercise) involved two levels: deadlift and depth jump. The dependent variable was the vertical jump height in inches measured after the exercise period, and the covariate was the vertical jump height in inches measured before the exercise period. The assumptions for ANCOVA were met. In

Table 1

Analysis of Covariance of Two Levels of Exercise Type Using Pre- and Post-Vertical Leap Heights as Covariant and Dependent Variable, Respectively

Source	Type III SS	df	MS	F	Sig.	Partial η^2
Corrected model	128.566a	2	64.283	39.659	.000	.775
Intercept	2.729	1	2.729	1.684	.207	.068
PREVJH	127.835	1	127.835	78.867	.000	.774
Group	6.278	1	6.278	3.873	.061	.144
Error	37.280	23	1.621			
Total	8662.000	26				
Corrected total	165.846	25				

Note. $R^2 = .775$ (Adjusted $R^2 = .756$). PREVJH = pre-vertical jump height.

particular, the homogeneity of the regression effect was evident for the covariate, and the covariate was linearly related to the dependent measure. This means that the ANCOVA was not biased.

The ANCOVA (Table 1) tested the hypothesis that the post-vertical leap height of the two groups would be the same when adjusted for the pre-vertical jump height. The hypothesis could not be rejected. The ANCOVA was not significant, $F(2, 23) = 3.87$, $p = .061$. However, the p value of .06 is very close to .05, which means that the confidence level is 94%. The lack of statistical significance may have been due to study dropouts. The strength of the relationship between exercise treatment and the dependent variable was strong, as assessed by the partial eta-squared statistics, with the exercise treatment factor accounting for 14.4% of the variance in the dependent measure holding constant the vertical jump height in inches measured before the exercise period.

The R -squared was .756, which means that the model explains 76% of the variance. The post-vertical jump height mean of Group 1 (subjects who performed the depth jump) was 18.27, and the post-vertical jump height mean of Group 2 (subjects who performed the deadlift) was 17.93. Group 1 contained 11 subjects, and Group 2 contained 15 subjects. These descriptive statistics show that the subjects

who performed the depth jump had a higher post-vertical jump height average than the subjects who performed the deadlift. There appears to be a practical benefit to the use of the depth jump for increasing vertical jump height in female collegiate athletes.

Discussion

Although many strength training programs include exercises that strengthen the lower body, plyometric exercises may be underutilized to increase vertical jump height. The eccentric loading that occurs during the depth jump allows agonist muscles to gain force by permitting part of the crossbridges to attach before the concentric phase begins. This produces increased joint movements and force production (Moore & Schilling, 2005). Furthermore, the depth jump pertains to the principle of specificity in which training adaptations are specific to the type of training stress (Baechle et al., 2008). Thus, in theory, the depth jump should have a greater effect on the vertical jump than would the deadlift.

A nearly significant change occurred between the pretest score and the posttest score of the plyometric depth jump group and the barbell deadlift group. Overall, both groups showed an increase in vertical jump height; however, the plyometric depth jump group showed a greater increase. A more significant change may have occurred had there been a larger sample size. For this reason, future studies should aim to have a minimum of 25 participants per group. Also, researchers should apply this study to males to see if the same outcome appears.

Replications of this study should lengthen the time frame to at least 12 weeks. The 6 weeks of training may not have been long enough for the athletes to achieve extremely significant results. Also, this study could be applied to athletes who play different sports or to the general population. Because muscular power can be used to determine the mobility and functional capacity of injured individuals, physical and occupational therapists may be interested in this study (Buckthorpe et al., 2012). Finally, the lack of a control group allows for the possibility that the changes in jump height were due to something other than the exercises. Studies should add a control group to strengthen the internal validity and to eliminate this possibility.

Practical Applications

Athletes and coaches are constantly looking for ways to improve sports performance. Training is no doubt a way to do this, but knowing which exercises to include in the training plan is an obstacle in itself. For most athletes and strength coaches, knowing the type of exercise (traditional resistance or plyometric) that will increase vertical jump height the most can be extremely beneficial. Implementation of the most beneficial exercise into an athlete's training routine can lead to the sought-after increase in athletic performance. Moreover, occupational and physical therapists can apply this information into the rehabilitation routines of their clients. Although the general population may not be able to perform the depth jump, other plyometric exercises may elicit the same increase in muscular power. They could also be used by coaches to assess the functional ability of the athletes before the athletes continue their workout.

This research study was successfully done in a strength room, and future studies may be carried out in comparable settings such as performance centers or other training facilities. The successful replication of this study requires the help of a certified strength and conditioning coach, access to basic resistance and plyometric equipment, and knowledge of and access to proper measurement equipment. Studies done with a larger sample size for a longer period may show the need for a deeper implementation of training techniques that increase muscular power. Evidence for the benefits of both resistance training and plyometric exercises on vertical leap height exists; however, it is up to researchers to improve upon this study and thereby gain further evidence for which type of exercise is the most beneficial in improving athletic performance in athletes.

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