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INFLUENCE OF EXERCISE SPECIFICITY ON DEPTH JUMP PERFORMANCE

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ABSTRACT
SINGH, D.; SINGH, S. Influence of exercise specificity on depth jump performance. Brazilian Journal of Biomotricity. v. 6, n. 4, p. 261-268, 2012. The present study investigated the influence of exercise specificity on depth Jump Performance of Male Athletes. To achieve the purpose of the study, 80 physical education students with their age ranged between 18-21 years whose mean depth jump performance was 17.44 ± 2.02 inches from 18 inches high box were purposively selected to act as subjects. They were randomly assigned to vertical depth jump training; horizontal depth jump training; combination of both and Control group. Experimental groups performed 6-sets of 10-repetitions of depth jumps per set for twice a week for ten weeks from a height of 20 centimeters progressed to 40 centimeters according to step method. Depth jump was measured before and after 10 weeks. Analysis of Covariance was applied to find out the significant differences among various groups. A pair-wise comparison was done by using the Scheffe’s post-hoc test and the alpha level was set at 0.05. Results showed significant improvement in three experimental groups while comparing with control group. Vertical training group improved significantly as compared to horizontal and combination training groups whereas the comparison of results with regard to horizontal training group and combination training group was found insignificant. The above results revealed that the depth jump performance is influenced by exercise specificity.

Key words: Plyometrics, Vertical depth jump, Horizontal depth jump, Step progression.

INTRODUCTION
Plyometric training is very specific in nature but very broad in applicability. For the lower extremities, it is designed to train the athlete to develop either vertical or horizontal acceleration and all movements in running and jumping are simply the exertion of some vertical or horizontal force against the ground. Specificity is a key concept to keep in mind when planning a plyometric
training program. The sport and the skill to be developed must be analyzed so proper exercises can be emphasized (CHU, 1998). Depth jump training is a common and most searched form of Plyometric drill. Depth jumping requires athletes to drop from a height and upon landing, immediately perform a jumping movement (STEBEN e STEBEN, 1981). Depth jumps use the athlete’s body weight and gravity to exert force against the ground (CHU, 1998). An elevated surface is required for this exercise. The landing surface should be forgiving, yet resilient; grass gymnastic flooring or cushioned turf will work well. The depth jump is a shock-method exercise and comes in the final portion of the training continuum. Therefore, progression into this drill is a must, as well as progression within it. Apply the shock method by using the elevated platform and a drop or fall to the takeoff surface. The key is to initiate a rhythm of landing. The landing is the precise phase we are negotiating, to create as efficient a performance as possible. This requires handling the surprise of landing and subsequent takeoff in as optimal execution as possible. This aspect makes the depth jump elite in its strength, speed and quickness. It also can be a source of problems if you do not progress into it properly (RADCLIFFE e FARENTINOS, 1999).

In practical terms, the task of determining a proper depth jump height centres on the ability to achieve maximal elevation of the body’s centre of gravity after performing a depth jump. If the height is too great for the strength of the legs, then the legs spend too much time absorbing the impact of the landing and cannot reverse the eccentric loading quickly enough to take advantage of the serial elastic component of muscle and the stretch reflex phenomenon. The result is a slow jump dependent on strength and devoid of power. Coach and athlete should work to find the proper height; one that lets the athlete maximize the height jumped plus achieves the shortest Amortization Phase (CHU, 1998). Countermovement vertical jump height has been used as a test protocol to measure successful depth-jump performance.

An athlete is made to carry out a standing high jump after flexing his legs and the maximum height is reached with his hand on a graduated board (Vertical Jump Test). The highest reading of three jumps is registered. The athlete is made to carry out the same operation, landing on the same point from a height which is progressively higher by 20-40-60 centimeters and from each different height of fall; the subsequent jump is read off of the graduated board. The value of the greater height reached in the subsequent jump (after landing) which should be higher than that of the jump from level ‘0’ (standing jump) determines the optimum height of fall for that particular athlete at that moment of training process (ZANON, 1974). By using boxes of different heights or a stair-step apparatus, the athlete drops from levels between 12 and 42 inches onto grass or a firm but resilient mat. Upon landing, the athlete immediately jumps upward or reaches or surpasses the mark placed on the wall during the Vertical Jump Test. The athlete continues to move to a higher drop until he or she can no longer attain the same height as in the vertical jump. Allow one or two minutes of rest between each trial for the muscle systems to recover. The point of the depth or drop height when the athlete attained maximum vertical (rebound) height is the approximate height to train for in this type of Plyometric exercise (RADCLIFFE e FARENTINOS, 1999).

There are two major categories of depth jumping according to the purpose of achieving maximum vertical height or horizontal distance after taking-off. One type of exercise is performed by taking step off from the box and drop to land on both feet. Try to anticipate the landing and spring up as quickly as possible, keep the body from “settling” on the landing and make the ground contact as short as possible. The second category is performed by taking step off from the box and drop to land on both feet. Immediately upon landing, jump as far forward as possible, again landing on both feet (CHU, 1998). We hypothesized that depth jump height would increase with increasing exercise specificity due to greater involvement targeted muscle groups. Therefore, the purpose of this study was to investigate the influence of vertical depth jump training; horizontal depth jump training and combination of both vertical and horizontal depth jump training on Depth Jump performance of college level male athletes by employing depth jumping from optimal dropping height.

**MATERIAL AND METHODS**

**Experimental design**

Eighty subjects were randomly assigned to three experimental groups and one control group. Group-VD (n=20) trained with vertical depth jumping on Monday and Thursday; Group-HD (n=20) trained with horizontal depth jumping on Tuesday and Friday; Group-CD (n=20) trained with
vertical depth jumping on Wednesday and horizontal depth jumping on Saturday throughout 10 weeks of training with identical intensities and volumes. Group-CG (n=20) served as control group. The gymnastic mat was the landing surface to perform depth jumping. All subjects were attending classes according to the college curriculum, except the session for training. Running Long jump performance was measured before and after 10 weeks for subjects of each group. The subjects participated in an instruction session before the pre-test to ensure proper technique and comprehension of the testing process. Test was demonstrated by the trained athlete. To ensure uniformity in the testing conditions, the subjects were tested in the morning sessions by the same testers, under the supervision of the Investigator.

Participants
Purposive sampling technique was used to select eighty (N=80) male Physical Education students of age ranged between 18 to 21 years. They were medically fit to undergo the type of training program and signed an informed consent form prior to participate in the present study. They were tested for proper execution of Depth Jump performance (M=17.44 inches, SD=±2.02) from dropping height of 18 inches. The University’s Joint Research Board approved all procedures for the study.

Procedures
A pilot study was conducted to determine the training intensity and progression of load. The investigator randomly selected 10 subjects from the 80 subjects. They were tested for vertical jump performance and depth jump performance from the 10, 20, 30, 40, 50 and 60 centimeters heights. Investigator found the initial increase in attained height with maximum performance (i.e. 19.15 inches) from 20 centimeters dropping height and depth jump performance was remained greater than vertical jump test performance (i.e. 18.25 inches) up to 40 centimeters dropping height (Figure-1).

![Graphical representation of vertical and depth jump performance.](image)

Dropping height of 20 centimeters from which depth jump performance was maximum and higher than vertical jump performance was the initial training intensity (ZANON 1974, CHU 1998, RADCLIFFE e FARENTINOS, 1999). All subjects were trained twice a week for 10 weeks, performing 6-sets of 10-repetitions per session (DE VILLARREAL et al., 2008). 15-seconds rest-walk was given for recovery between repetitions (READ e CISAR, 2001).1.5-2 minutes slow jogging for 220 meters was given for recovery between sets(VERKHOSHANSKY, 1969). Dropping height was progressed according to the step method from the height with maximum depth jump performance (20 centimeters) up to the height from which performance was remained higher than vertical jump performance (40 centimeters) during the 10 weeks of training (table-1).

<p>| Table 1 - Schedule for 10 weeks training. |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th><strong>Weeks</strong></th>
<th><strong>Dropping Height (in centimeters)</strong></th>
<th><strong>Sessions per week</strong></th>
<th><strong>Number of sets per session</strong></th>
<th><strong>Number of repetitions per set</strong></th>
<th><strong>Total foot contacts in a week</strong></th>
</tr>
</thead>
<tbody>
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</table>
Training was administered by dividing 20 subjects into four groups, 5 subjects in each group. After warm up, they were trained simultaneously at four stations. Rest walk between repetitions was given by placing a cone 11 and 12.1 meters ahead of the dropping height for vertical and horizontal depth jump training, respectively. Slow jog between sets was given by placing another cone at 220 meters from first cone. Subjects participated in cool-down program after training. To measure Depth jump performance, a black-board of 2x4 feet painted with red lines parallel to the ground, one inch apart. The board was fixed firmly to a wall above the ground according to the reach point of the subject with shortest height. The subject was asked to stand with one side toward the wall, heels together and raised the fingertips marked with chalk powder to a maximum height on the black-board without lifting the heels so as to mark his maximum reach point (figure-2A). This reach point was recorded in inches to the nearest half inch. Then, the fingertips were re-chalked. With the chalked hand side toward the wall, the subject was asked to stand on an 18 inches high box toes closer to the front edge of the box. then, the subject took step (figure-2B) from box and drop to the gymnastic mat on both feet (figure- 2C) and immediately upon landing (figure-2D) in the shortest possible time, keep the body from “settling” on the landing and spring up as high as possible by swinging arms as demonstrated by the earlier trained helper to make another mark at the maximal height of the jump (figure- 2E). This jump point marked on the black-board was recorded in inches to the nearest half inch. Three trials were given and the maximum difference between reach point and jump point was considered as the score in inches.
Figure 2 - Illustration of the Depth Jump Test; A-Subject Marking Reach in depth test; B -Subject Marking Reach in depth Jump test; C-Subject dropping from the box test; D-Subject upon landing in depth jump test; E- Subject marking jump height in depth jump test.

Statistical analyses
Analysis of Covariance was applied to find significance of differences among various groups. The pre-test scores were used as the covariate and post-test scores, adjusted for covariance, were the dependent measures. When significant F-value was encountered, a pair-wise comparison was done by using the Scheffe’s post-hoc test to identify significant differences between groups. The alpha level was set at 0.05.

RESULTS
The mean values of Depth jump performance of three experimental groups and control group from Pre-test and post-test are exhibited in Figure-3.

Table 2 - Analysis of Covariance for three experimental groups and the control group with regard depth jump test.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of squares</th>
<th>Degrees of freedom</th>
<th>Mean squares</th>
<th>Sum of squares</th>
<th>F-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>21.57</td>
<td>3</td>
<td>7.1913</td>
<td>26.03*</td>
<td></td>
</tr>
<tr>
<td>Within groups</td>
<td>20.72</td>
<td>75</td>
<td>.2768</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(*) Significant at .05 level; F.05 (3, 75) = 2.73

Analysis of covariance showed significant differences among groups as F-ratio 26.03 was found greater than the tabulated value 2.73 with degree of freedom (3, 75) at 0.05 level of confidence (Table 2). Further, the Scheffe’s post-hoc test was employed to study significance of differences between the paired adjusted final means.

Table 3 - Significance of differences between paired adjusted final means of experimental groups and control group (in inches).
Table 3: Means, difference between means, and Scheffe’s critical difference

<table>
<thead>
<tr>
<th>Group-VD</th>
<th>Group-HD</th>
<th>Group-CD</th>
<th>Group-CG</th>
<th>Difference between means</th>
<th>Scheffe’s critical difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>19.0256</td>
<td>18.2473</td>
<td></td>
<td></td>
<td>0.7783*</td>
<td>0.4758</td>
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<tr>
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<td>18.4734</td>
<td></td>
<td>0.5522*</td>
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<tr>
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<td>17.5538</td>
<td>1.4718*</td>
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<td>18.2473</td>
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<td>0.2261</td>
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<td>0.6935*</td>
<td>0.4758</td>
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<tr>
<td></td>
<td></td>
<td>18.4734</td>
<td>17.5538</td>
<td>0.9196*</td>
<td>0.4758</td>
</tr>
</tbody>
</table>

(*)Significant at .05 level

Post-hoc analysis showed significant improvement in three experimental groups as compared to control group; vertical depth jump training group improved significantly as compared to horizontal depth jump training and combination depth jump training groups. However, the difference between horizontal depth jump training and combination depth jump training was found insignificant (Table 3).

Figure 3 - Pre-test and post-test means of three experimental groups and the control group in Depth jump performance (Inches).

DISCUSSION

Analysis of data reveals that all the three experimental groups were found to be significantly different as compared to the control group. These depth jump performance findings revealed that vertical plyometric training; horizontal plyometric training as well as their combination is effective in bringing about a significant training effect. Similar findings pertaining to depth jump performance have been reported by (GEHRI et al., 1998; THEODOROS et al., 2008; CAMPO et al., 2009).

These findings may be attributed to the fact that the Plyometric training improves neuromuscular adaptations such as increased inhibition of antagonistic muscles as well as activation and contraction of synergistic muscles may account for the improvement in increased vertical jump height (LACHANCE, 1995). STEBEN e STEBEN (1981) stated that the depth jump is thought to enhance vertical jump performance through the quickening of the Amortization Phase which is the electromechanical delay initiation of eccentric to the initiation of concentric muscle actions of the movement. LUNDIN (1985) stated that plyometric training exercises are believed to induce enhanced training responses through the activation of the proprioceptive reflexes and re-use of stored elastic energy. Plyometric training results in an increase in the overall neural stimulation of the muscle and thus improves output; however, qualitative changes are also apparent. In subjects unaccustomed to intense stretch-shorten cycle loads, there is a reduction in electromyographic activity starting 50-100 milliseconds before ground contact and lasting for 100-200 milliseconds (SCHMIDTBLEICHER et al., 1988). GOLLHOFER (1987) has attributed this to a protective
mechanism by the Golgi tendon organ reflex acting during sudden, intense stretch loads to reduce the tension in the tendon muscular unit during the force peak of the stretch-shorten cycle. After a period of plyometric training the inhibitory effects are reduced, termed disinhibition, and increased stretch-shorten cycle performance results (SCHMIDT-BLEICHER et al., 1988). It is further supported by the fact that Plyometric Training stimulates chemical, mechanical and neurological factors that influence the force and stiffness of the contracting muscle (KOMI, 1973). Also, the mean differences between groups VD and HD, VD and CD were greater than Critical difference value of 0.4758 in favour of Group-VD whereas the mean difference between groups HD and CD was found to be insignificant. The percentage of performance increased from pre-tests to the post-tests resulted in 8.22, 4.54 and 5.16 for Groups-VD, HD and CD respectively. These findings may be attributed to the specific effects of Plyometric Training. CHU (1998) suggested that plyometric training should closely resemble the skills necessary for success in the sports; plyometric work should focus on developing vertical component of jumping for vertical lift.

PRACTICAL APPLICATIONS
It is concluded from the above findings that depth jumping progressed according to the step method is effective but induces specific adaptations. Thus, depth jump training should be specific according to the requirement of targeted motor performance.

ACKNOWLEDGEMENTS
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