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The Effect of Depth Jump and Box Jump Training on Improving the Leg Muscle Power of Long Jump Athletes

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Abstract

This study aims to determine the effect of depth jump and box jump exercises on improving the leg muscle power of long jump athletes. The research method used is a true experimental design with a two-group pretest-posttest design. The research subjects consisted of ten athletes from the Indonesian University of Education Athletics Club, who were selected using purposive sampling. The instrument used was a Force Platform, which had a validity of 0.70773 and reliability of 0.9186. The training program was conducted over 12 sessions with a frequency of three times per week, covering the pretest, treatment, and posttest stages. Data analysis was performed using normality, homogeneity, and t-tests with a significance level of 0.05 to see the effect of each type of exercise and the differences between them. The results showed that both depth jump and box jump exercises had a significant effect on increasing the leg muscle power of long jump athletes. However, the increase produced by depth jump exercises tended to be greater than that produced by box jump exercises. In conclusion, depth jump training is more effective in increasing leg muscle power than box jump training, so it can be recommended as an optimal plyometric training method for long jump athletes to improve their jumping performance.

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INTRODUCTION

Athletics, as the parent of various sports, plays an important role in developing basic human physical abilities, such as strength, speed, and coordination (Joyner-Kersee & Siepioe, 2025; Safari Jafarloo, 2025; Womsiwor et al., 2025). Since Ancient Greece around the 6th century BC, athletics has been an important part of sports history, with running being the first discipline introduced by Iccus and Herodicus (Martin & Sauerborn, 2013; Wei & Liu, 2019). One of the events included in athletics is the long jump, which is performed by running, pushing off with one foot, then jumping as far as possible and landing in balance (Abd Rahim et al., 2020; McCosker et al., 2020). This movement consists of three main phases, namely the approach, takeoff, and landing, in which leg muscle power plays a dominant role in determining the jump distance. Therefore, increasing leg muscle power through appropriate exercises, such as depth jumps and box jumps, is key to supporting the performance of long jump athletes to achieve maximum jump results.

Leg muscle power is one of the most important components of physical condition in competitive sports, especially in sports that require explosive abilities such as long jump (Gutiérrez-Hellín et al., 2025; Teglas & Radak, 2025). Power is a combination of strength and speed, which is the ability of muscles to generate maximum force in a short period of time (García-Ramos & Thompson, 2025; Rios, 2025). Athletes with optimal leg muscle power will be able to produce longer and more efficient jumps, thereby influencing their performance and achievements (Maestroni et al., 2020; Marshall et al., 2021; Suchomel et al., 2018). However, based on observations and literature reviews, many athletes still do not have maximum leg muscle power due to the lack of specific and targeted training methods to develop leg muscle power. This is the basis for the urgency of this study, namely the need to identify and apply effective training methods to increase leg muscle power, especially for long jump athletes.

Various literature studies have examined the effectiveness of plyometric training in improving athletes› physical abilities. (Moran et al., 2023) explained that Plyometric Jump Training (PJT) can increase leg muscle power, although the effect produced is relatively small (effect size = 0.33). Another study conducted by (Sammoud et al., 2021) shows that an 8-week PJT program can increase muscle power as measured by the countermovement jump and standing long jump, and has an effect on freestyle swimming performance. Additionally,(Çankaya et al., 2018) also demonstrated that plyometric training contributes to improved vertical jump ability, which is crucial in volleyball for executing smashes and blocks. Resistance training (Shen et al., 2025) and contrast training (Liu et al., 2025; Zabaloy et al., 2023) methods have also been proven effective in developing muscle strength and explosive power. However, most of these studies still focus on general strength and speed improvement, rather than specifically on long jump athletes with specific types of training.

The novelty of this study lies in the direct comparison between two forms of plyometric training, namely depth jumps and box jumps, on the improvement of leg muscle power in long jump athletes. Both types of exercises share similar characteristics in terms of the explosive use of leg muscles, but differences in direction and movement patterns are thought to produce different effects on muscle power development (Keller et al., 2020; Moran et al., 2023). Depth jumps emphasize the reactive ability of muscles to support body weight and generate a quick upward jump after landing, while box jumps focus more on upward and forward thrusts that involve coordination and stability (Lopes dos Santos, 2023). Thus, this study aims to determine which exercise is more effective in increasing the muscle power of long jump athletes, which has not been specifically researched until now.

METHOD

This study used a true experimental method with a two-group pretest-posttest design (Sugiyono, 2020). It was divided into three stages, namely pretest, treatment, and posttest. The main objective of this study was to determine the effect of box jump and depth jump exercises on increasing the leg muscle power of long jump athletes. This design was chosen because it allows researchers to compare changes in leg muscle power before and after treatment and to objectively measure the difference in effectiveness between the two types of exercises.

Force Platform was used as a research instrument. This tool was chosen because it is valid and reliable in increasing leg muscle power. The validity value obtained was 0.70773, while the reliability value reached 0.9186 (Haryono & Pribadi, 2012). This test will be conducted at the Sports Science Laboratory, FPOK UPI Campus, 3rd floor. Seven athletes from the Indonesian

University of Education Student activity units Athletics Club were involved as research subjects using a non-probability sampling approach, namely purposive sampling (Asrulla et al., 2023). Sample selection was based on specific criteria deemed relevant to the research objectives ((Ahmed, 2024; Nyimbili & Nyimbili, 2024). This study used a treatment consisting of depth jump and box jump exercises conducted three times a week (Wahyuni et al., 2021; Warthadi et al., 2024). The research procedure included: (1) a preparation stage to prepare the test requirements in the laboratory, (2) initial data collection through warm-up and force platform tests, (3) implementation of the training program for 12 sessions in accordance with training principles (Kryeziu et al., 2019), (4) final data collection with force platform tests after treatment, and (5) processing of initial and final data using SPSS 25 for statistical analysis.

Data analysis was conducted to determine the effect of depth jump and box jump training on the increase in leg muscle power of long jump athletes at the Athletic Club of the Indonesia University of Education using pretest and posttest scores. The stages included a normality test using Shapiro Wilk to examine data distribution (Hali et al., 2024), a homogeneity test using Levene to examine variance uniformity, and a t-test. A one-sample t-test was used to determine the effect of training on leg muscle power, while an independent t-test was used to compare the differences in results between the depth jump and box jump groups. Decisions were based on a significance value of 0.05; if $p < 0.05$, it meant that there was a significant effect or difference, while if $p > 0.05$, it meant that there was no significant effect or difference (Faradiba, 2020).

Table 1. Research Design

Group	Pre-Test	Treatment	Post-Test
Depth Jump	O1	X	O2
Box Jump	O3	X	O4

Description:
O1: Pre-test in the form of test scores, namely the initial Force Platform test.
O2: Post-test in the form of Force Platform test scores after treatment.
O3: Pre-test in the form of test scores, namely the initial Force Platform test.
O4: Post-test in the form of Force Platform test scores after treatment.
X: Treatment (Depth Jump and Box Jump exercises.

RESULTS AND DISCUSSION

The results of the study indicate that depth jump and box jump exercises have an effect on increasing the leg muscle power of long jump athletes. This reinforces the concept that leg muscle power is the main physical component that determines the success of long jump performance, especially in the take-off phase, which requires the ability to generate maximum force in a short time (Suchomel et al., 2018). Pre-test and post-test results using a Force Platform showed an increase in leg muscle power after 12 treatment sessions. The increase in the average leg muscle power value in the depth jump group from 61.34 to 66.88 and in the box jump group from 49.64 to 52.10 shows that depth jump and box jump plyometric exercises are effective in increasing leg muscle explosive ability. These results are in line with research (Moran et al., 2023) which states that plyometric jump training can increase leg muscle power through stretch-shortening cycle (SSC) stimulation, which is a neuromuscular mechanism that allows muscles to produce greater force after rapid eccentric contraction.The results of the study indicate that the use of the Depth Jump and Box Jump training methods has a significant effect on increasing the leg muscle power of long jump athletes. The pre-test and post-test results using the Force Platform show an increase in leg muscle power after 12 treatment sessions. In the depth jump group, the average leg muscle power increased from 61.34 in the pre-test to 66.88 in the post-test. Meanwhile, in the box jump group, the average value increased from 49.64 in the pre-test to 52.10 in the post-test. This increase shows that both training methods contribute positively to the development of leg muscle power in long jump athletes.

Table 2. Normality Test Results

Group	Statistic	df	Sig.
Pretest Depth Jump	.930	5	.593
Postest Depth Jump	.903	5	.428
Pretest Box Jump	.993	5	.989
Postest Box Jump	.996	5	.996

Table 2 shows that the Shapiro–Wilk normality test results indicate that all pre-test and post-test data in both groups are normally distributed ($p > 0.05$). It can be seen that in the initial test, the Depth Jump group obtained a statistical value of 0.930, df 5, and Sig. of 0.593, while in the final data, it obtained a statistical value of

0.903, df 5, Sig. of 0.428. In the Box Jump group, the initial test obtained a statistical value of 0.993, df 5, and Sig. of 0.989, while the final result obtained a statistical value of 0.996, df 5, and a Sig. value of 0.996. In addition, the homogeneity of variance test using the Levene Test showed that the data between groups was homogeneous ($p = 0.614$).

The paired sample t-test showed that both training methods had a significant effect ($p < 0.05$), indicating that both depth jumps and box jumps can be used as training stimuli for power development. These findings are consistent with the results of studies by (Çankaya et al., 2018; Sammoud et al., 2021), which explain that plyometric training significantly improves vertical jump ability and leg explosiveness in athletes from various sports.

However, the results of the independent sample t-test showed a significant difference between the two training groups ($p = 0.023$), where the increase in leg muscle power in the depth jump group was greater than that in the box jump group. Physiologically, depth jumps provide higher eccentric loads due to the landing phase from a certain height, thereby stimulating greater neuromuscular adaptation through optimal utilization of the SSC (Keller et al., 2020; Moran et al., 2023). This condition allows for an increase in muscle ability to generate high reactive forces in a short time.

Conversely, box jump training emphasizes movement coordination, stability, and vertical thrust without the reactive demands of depth jumps. Lopes dos Santos (2023) explains that box height and movement patterns in box jumps play a greater role in improving movement control and jump efficiency, resulting in lower power adaptations compared to high-reactive exercises like depth jumps.

In the context of long jump, increased leg muscle power has direct implications for athlete performance. Abd Rahim et al. (2020) and McCosker et al. (2020) emphasize that the ability to generate explosive force during the takeoff phase is crucial for determining speed and takeoff angle, which ultimately affect jump distance. Therefore, the results of this study support the use of depth jumps as a more effective plyometric training method for increasing the leg muscle power of long jump athletes.

However, this study has limitations, particularly in the relatively small sample size and limited intervention duration. Shen et al. (2025) suggest that combining plyometric training with other methods such as resistance training or complex training, as well as using a larger sample size, could provide a more comprehensive picture of muscle power adaptation. Therefore, further research with a broader design is highly recommended.

The results of the paired sample t-test show that depth jump training has a significant effect on increasing leg muscle power, as indicated by the difference between the pre-test and post-test values. Similarly, box jump training also shows a significant effect on increasing the leg muscle power of long jump athletes ($p = 0.009$). These findings indicate that both box jump and depth jump exercises are effective in improving lower limb muscle explosive power. Based on the results of the independent sample t-test, there was a significant difference in the increase in lower limb muscle power between the depth jump and box jump groups ($p = 0.023$). The mean difference value shows that the improvement produced by depth jump training is greater than that of box jump training. This indicates that depth jump training is more effective in increasing the leg muscle power of long jump athletes.

Physiologically, these results can be explained because depth jump training emphasizes the optimal utilization of the stretch-shortening cycle (SSC), thereby increasing the ability of muscles to generate maximum force in a short time. Meanwhile, box jump training emphasizes coordination and vertical thrust, resulting in a relatively smaller increase in power. Thus, depth jump training can be recommended as a more effective plyometric training method for increasing the leg muscle power of long jump athletes. However, this study has limitations in terms of the relatively small sample size, so further research with a larger number of subjects and a variety of measurement instruments is needed to strengthen the generalization of the findings.

CONCLUSION

This study concludes that depth jump and box jump exercises have an effect on increasing the leg muscle power of long jump athletes. However, depth jump exercises show greater improvement compared to box jump exercises. Thus, depth jump exercises are more effective as a plyometric training method to increase leg muscle power and support improved long jump performance. Further research is recommended to involve a larger sample size and use a variety of measurement instruments to strengthen the generalization of the findings.

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