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The Effect of a Combination of Plyometric Hurdle Jump and Jump Box Training on Improving Vertical Jump in Volleyball Athletes

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ABSTRACT

Vertical jump ability is crucial in volleyball as it supports fundamental techniques such as spiking, blocking, and jump serving. It is closely related to the explosive power of the lower limb muscles to generate force in a short period of time. The development of vertical jump requires specific and systematic training, such as plyometric exercises that utilize the stretch–shortening cycle. This study aims to analyze the effect of a combination of plyometric hurdle jump and jump box training on improving the vertical jump of adolescent volleyball athletes. The method used is quantitative with a one-group pretest-posttest pre-experimental design, involving AVONG club athletes aged 13–15 years. The training program was conducted over six weeks, with a total of 18 sessions at a frequency of three times per week. After the intervention, a post-test was administered to measure jump height and determine whether there were changes between the pre-test and post-test results. The findings indicate that plyometric hurdle jump and jump box training have a significant effect on improving the vertical jump ability of volleyball athletes, with a significance value of < 0.001, indicating a difference between pre-test and post-test results. Physiologically, this improvement reflects neuromuscular adaptation, including enhanced muscle coordination and increased recruitment of fast-twitch muscle fibers. These findings provide practical implications by assisting coaches in designing more effective, evidence-based training programs.

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A. Conception and design of the study;
B. Acquisition of data;
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INTRODUCTION

Volleyball is a team sport that requires coordination, speed, teamwork, and optimal physical condition. Vertical jump ability is crucial, as almost all fundamental techniques such as spiking, blocking, and serving depend on jumping performance. The explosive power of the lower limb muscles is a key factor in player success. Training methods such as plyometric training have been shown to improve strength and neuromuscular coordination in athletes (Sylvester et al., 2024). Plyometric exercises include explosive movements such

as hurdle jumps, box jumps, depth jumps, and tuck jumps. Among these, hurdle jumps and box jumps are the most commonly used methods because they effectively activate fast-twitch muscle fibers. Hurdle jumps focus on coordination, speed, and initial take-off power, while box jumps emphasize jump height and landing control to prevent injury. According to Hammami et al. (2022), both exercises can enhance reactive strength and balance, thereby improving vertical jump performance. Plyometric training is most effective when applied during the developmental stage, as it helps establish a long-term strength foundation. However, its implementation in schools and youth volleyball clubs remains limited, indicating the need for further research.

The condition of adolescent volleyball athletes in Indonesia shows that vertical jump ability is still relatively low, mainly due to the lack of specific training methods. Coaches tend to rely on conventional exercises such as squats or skipping, which are less effective in developing explosive power. Therefore, a combination of plyometric training can serve as a potential solution. Several studies have demonstrated the benefits of plyometric exercises. Pratama and Abidin (2024) found that box jump training increased vertical jump performance by 14.2%. Syaddad, Rifki, and Mukhtarsyaf (2025) reported a 17% improvement after six weeks of combined training. Syaleh et al. (2024) showed that barrier hop and box jump training improved jump service skills by up to 19.8% in high school students. In addition, Rahman and Basri (2024) stated that a combination of skipping and barrier hop significantly influenced the vertical jump ability of secondary school players. These findings indicate that plyometric training has a positive impact on jumping performance, although studies examining the synergy between hurdle jumps and box jumps are still limited.

There is a research gap regarding the effectiveness of combining hurdle jump and box jump exercises in adolescent volleyball athletes. Most previous studies have examined only a single type of exercise without evaluating their combined effects, and many were conducted on non-athlete populations, making the findings less relevant for adolescent athletes with established basic volleyball skills. This study aims to address this gap through an applied quantitative experimental approach. The research focuses on male athletes aged 13–15 years who actively train in schools or local clubs. Measurements were conducted using pre-test and post-test vertical jump assessments, with a six-week intervention period to ensure measurable performance changes. Based on this background, this study aims to examine the effect of combining hurdle jump and box jump training on the vertical jump ability of adolescent volleyball athletes. This research is expected to contribute to the literature on innovative plyometric training methods and assist coaches, physical education teachers, and sports development organizations in designing more effective training programs for Indonesian volleyball athletes.

METHODS

This study employed a quantitative approach using a pre-experimental method with a one-group pretest–posttest design. Data analysis was conducted using IBM SPSS Statistics 27 for Windows. A single group of participants underwent a pre-test to

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measure their vertical jump ability, followed by a training program consisting of a combination of plyometric hurdle jump and jump box exercises. After the intervention, a post-test was conducted to assess changes in vertical jump performance. This design was selected to observe the direct effect of the intervention without the inclusion of a control group. According to Sugiyono (2023), this design is appropriate for identifying treatment effects when more complex experimental designs are not feasible.

The study was conducted at the AVONG volleyball field located at Jl. Sukowati No. 20, Ngampel, Kapas District, Bojonegoro Regency, East Java, Indonesia. The population consisted of all AVONG volleyball athletes, totaling 30 individuals. The sample criteria included athletes aged 13–15 years, who had participated in club training for 1–2 years, and were in good physical and mental health.

The research instruments consisted of two main stages: preparation and implementation. The preparation stage included obtaining permission to use facilities and equipment, testing the validity of the measurement instruments, and preparing research assistants. During the implementation stage, the researcher determined the study sample and conducted a pre-test to assess initial vertical jump ability. This was followed by a six-week training program combining plyometric hurdle jump and jump box exercises, with a total of 18 sessions at a frequency of three times per week. After completing the training program, a post-test was administered to measure jump height and determine whether there were significant differences between the pre-test and post-test results.

RESULTS AND DISCUSSION

Result

The data obtained in this study consisted of pre-test and post-test vertical jump measurements of AVONG volleyball athletes. The data were analyzed using descriptive statistics, a normality test, and a hypothesis test using the Wilcoxon Signed Rank Test..

Table 1.
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std.Deviation
Pre-test	25	45	71	55.24	7.014
Post-test	25	53	74	61.00	5.845
Valid N	**25**				

Table 2.
Normality Test

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	.137	25	.200	.944	25	.184
Post-test	.234	25	.001	.884	25	.008

The results of the normality test using the Shapiro-Wilk method showed that the pre-test data had a significance value of 0.184 ($p > 0.05$), indicating a normal distribution.

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In contrast, the post-test data had a significance value of 0.008 ($p < 0.05$), indicating that the data were not normally distributed. Therefore, the assumption of normality was not met.

Table 3.
Hypothesis Test

	Post-test Pre-test
Z	-4.387
Asymp. Sig (2-tailed)	<,001

Based on the results of hypothesis testing using the Wilcoxon Signed Rank Test, a test statistic value of −4.387 was obtained with a significance value of < 0.001. The negative test statistic indicates an increase in scores from pre-test to post-test, where the majority of participants experienced improvement following the intervention. The significance value, which is smaller than $\alpha = 0.05$, indicates that the difference between the two measurements is statistically significant.

These results suggest that the observed changes from pre-test to post-test were not due to chance, but rather a direct effect of the treatment. The training program or method was proven to have a significant effect on improving the measurement outcomes, as indicated by the difference in values before and after the intervention.

Discussion

The results of this study indicate that the combination of plyometric hurdle jump and jump box training has a significant effect on improving the vertical jump ability of volleyball athletes. This is supported by the Wilcoxon Signed Rank Test, which produced a significance value of < 0.001, indicating a statistically significant difference between pre-test and post-test results. In addition, individual data showed that one athlete (FD) experienced an increase in vertical jump from 45 cm to 57 cm after the intervention. This finding confirms that the applied plyometric training method is effective in enhancing lower limb explosive power, which is a key determinant of jump performance (Muchlisin & Pasaribu, 2025). The combination of hurdle jump and jump box training provides a comprehensive stimulus to the neuromuscular system. Hurdle jump training emphasizes rapid transition between landing and take-off phases, while jump box training focuses on vertical force production and landing control. These exercises effectively activate type II muscle fibers, which play a major role in explosive movements (Ramirez-Campillo et al., 2020). From a physiological perspective, structured plyometric training can improve motor unit recruitment, muscle efficiency, and intermuscular coordination, all of which contribute to enhanced jumping performance. Previous studies have also shown that improvements in vertical jump ability following plyometric training are closely associated with neuromuscular adaptations that increase lower limb explosiveness (Qusyaeri et al., 2025). Furthermore, prior research has demonstrated that combined plyometric exercises, such as hurdle hopping and box jump training, significantly improve vertical jump performance compared to pre-training conditions (Imandaqurani & Pratama, 2024). This supports the present findings, indicating that combining different plyometric exercises is more effective than using a single training method. These results are

consistent with existing literature, which shows that plyometric training variations can significantly enhance explosive power and vertical jump performance (Ahmad Syabaruddin & Fery Brian Banjarnahor, 2025). Therefore, the combination of plyometric hurdle jump and jump box training is not only statistically significant but also practically relevant for improving the performance of adolescent volleyball athletes. This training method aligns with the principle of specificity, where exercises that mimic sport-specific movements provide better transfer to actual performance.

CONCLUSION

Based on the results of this study, the combination of plyometric hurdle jump and jump box training has a significant effect on improving the vertical jump ability of volleyball athletes, as indicated by a significance value of < 0.001 ($\alpha < 0.05$). This demonstrates a meaningful difference between pre-test and post-test results. In practical terms, this training method contributes positively to the development of lower limb explosive power, which is essential for executing fundamental volleyball techniques such as spiking, blocking, and jump serving. In conclusion, the combination of plyometric hurdle jump and jump box training can be considered an effective and evidence-based training method to enhance vertical jump performance in volleyball athletes.

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