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SMASH ABILITY IN VOLLEYBALL GAMES SENIOR HIGH SCHOOL: THE PLYOMETRIC TRAINING AND LEG MUSCLE STRENGTH

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ABSTRACT

This research aims to determine the effect of plyometric box jump training on improving smash skills. Plyometric depth jump training enhances smash skills. Differences in the Effect between Box Jump and Depth Jump Training on Improving Smash Skills This type of research is quasi-experimental using two groups, namely the box jump and depth jump groups, each consisting of 10 MAN 1 Bone students. Data collection techniques use observation, tests, and documentation. The results of the T-test show that the significance value for depth jump training is 0.000 and box jump training is 0.001, indicating that each exercise has an influence. For depth jump training, the increase in smash ability was 4.40, while for box jumps, it was 2.60. Conclusion 1: Plyometric box jump training influences the improvement of Smash skills. 2) Plyometric depth jump training affects improving Smash skills. 3) There is a difference in the influence between box jump and depth jump training, which have different influences on improving smash skills.

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1. INTRODUCTION

Volleyball is a popular sport that is in high demand among Indonesians, including students (Jariono et al., 2022). This game is not only a means of recreation but has also developed into a competitive sport that requires technical skills and excellent physical condition. One of the basic techniques that is crucial in volleyball is the smash, which is the main weapon for scoring points (Perikles et al., 2016; Darusman et al., 2021). In volleyball, each individual has different characteristics and levels of technical ability. There are volleyball players with strong skills and those with weak skills. To enhance their volleyball skills and achievements, students require intensive and efficient training (Araújo et al., 2016). Therefore, volleyball abilities must take into account the various components of physical condition.

This research will also explore the potential for skill transfer from plyometric training to other aspects of the game of volleyball. Although the main focus is on improving smashing ability, it is important to understand how plyometric training can impact other skills such as blocking, passing, and movement on the court (Cahyadi et al., 2018).

Physical condition is a unique set of inseparable components, serving as a guide for both improvement and maintenance in training plans. Coordination is the ability to control body movements. If a person can move easily and smoothly in a series of well-controlled movements, they are considered to have excellent coordination. One of the physical components required for a smash is muscular strength, which combines strength and speed (Gabbett et al., 2006; Voelzke et al., 2012).

In volleyball, a smash involves jumping high, hitting the ball sharply downward over the net, and directing it into an area that is challenging for the opponent to reach (Probowo et al., 2022). The success of a smash depends greatly on the player's muscle strength, movement speed, and jumping ability. Therefore, improving smash ability is the main focus in volleyball team training programs, including at the high school level (Wicaksono et al., 2022).

Plyometric training is one training method believed to improve smash ability (Yudi & Anggara, 2021; Shedge et al., 2024). Plyometrics is a training method that combines eccentric and concentric exercises to enhance explosive strength and speed of movement. Various sports, including volleyball, have widely used this method to improve athlete performance (Silva et al., 2019). Plyometric training involves movements that utilize the stretching-shortening cycle of muscles, which can increase muscle production of explosive force (power). In volleyball, this exercise can help increase jump height, arm swing speed, and shot power, all of which are important components in performing an effective smash. In volleyball players perform plyometric depth jump training, a plyometric exercise, by immediately making their maximum jump after descending from a height (Gjinovci et al., 2017). The purpose of plyometric depth jump training is to enhance the muscle's capacity to execute the Stretch Shortening Cycle (SSC) and generate explosive power in the leg muscles (Fitrianto et al., 2021).

Box jumps are a special exercise to increase leg muscle power (Hasanuddin et al., 2023). This exercise is part of deep jump training. Box jumps work muscles like the gluteus medius and minimus, adductor longus, brevis, magnus, minimus, and halucis. They work when the thigh bends, the knee extends, and the body moves forward and backward. Several previous studies have shown that plyometric training is effective in increasing volleyball athletes' vertical jump ability and leg muscle strength. However, there is still a gap in the literature regarding the specific influence of plyometric training on smash ability, especially in the context of high school volleyball teams in Indonesia (Arif & Alexander, 2019; Isabella & Bakti, 2021).

This study aims to fill this gap by investigating the effect of a plyometric training program on volleyball players' smash ability at MAN 1 Bone. Coaches and sports practitioners hope that the results of this research will offer new insights into the effectiveness of plyometric training in enhancing smash performance and serve as a

foundation for the development of more effective training programs (Palar et al., 2015). In the context of MAN 1 Bone, we expect plyometric training to improve the players' smashing ability. This is important considering the time and resource limitations that school sports teams often face. Therefore, effective and efficient training methods such as plyometrics can be a promising alternative (Hidayat et al., 2018).

In addition, this research focuses on enhancing specific aspects of smash ability through plyometric training. This includes jump height, arm swing speed, shot accuracy, and performance consistency. A deeper understanding of these aspects can help in designing more focused and effective exercise programs (Ismoko & Sukoco, 2013). Furthermore, this research will also consider factors such as age, gender, and initial fitness level of the players. Understanding how plyometric training can affect individuals with different characteristics differently is critical for tailoring training programs to maximize the benefits for each player (Singla et al., 2018).

This research will also focus on the safety aspects of implementing plyometric exercises. Given the high intensity of plyometric training, it is crucial to design and implement exercise programs with safety principles in mind to prevent injury and overtraining. This is especially relevant in the context of young athletes at the secondary school level (Sutisyana & Ilahi, 2017; Goodwin & Jeffreys, 2021). In addition, this research will consider the psychological aspects of plyometric training and its influence on players' confidence in smashing. The increase in physical abilities resulting from plyometric training is expected to increase players' confidence in match situations, which in turn can improve the team's overall performance (Sánchez et al., 2020; Kons et al., 2023).

This study will also investigate how plyometric training can be integrated into a broader volleyball training program at MAN 1 Bone. This includes considerations about training periodization, combinations with other training methods, and how to adjust the intensity of plyometric training to the competition schedule and team preparation phase (Soelistyo, 2012). Finally, we hope that this research can significantly contribute to the development of volleyball training methods at the secondary school level in Indonesia. The results of this research, which combine scientific and practical approaches, can serve as a reference for sports coaches and teachers in designing effective training programs to improve the smash ability and overall performance of school volleyball teams.

2. METHOD

This type of research is experimental. Experimental research investigates possible cause-and-effect relationships by subjecting one or more experimental groups to one or more experimental groups (Creswell & Creswell, 2017). We conducted research and tests at MAN 1 Bone, Bone Regency, South Sulawesi Province. This study involved 20 volleyball players from Man 1 Bone. The study involved two groups, Group A and Group B, each comprising 10 individuals. The treatments given to the samples were depth jump training and box jump training. Smash ability is measured by the points the student produces when smashing. This study uses the SPSS 25 program for descriptive

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and inferential data analysis. The following is a Smash Target model presented in Figure 1.

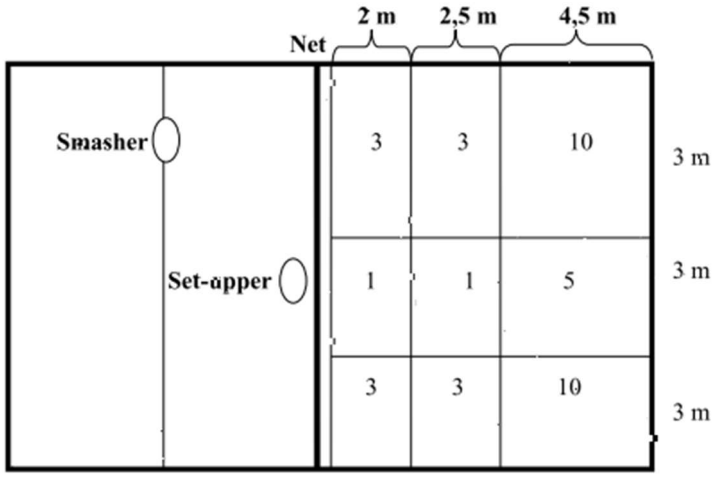

Figure 1. Smash Target

3. RESULTS AND DISCUSSION

Results

Presentation of data analysis results includes descriptive and inferential statistical analysis. The results of the analysis are then discussed, along with their relationship to the theory underlying this research, to provide an interpretation of the data analysis results.

Table 1. Results of Descriptive Analysis of The Initial Test and Final Test for Both Groups

Volleyball Smash Ability	N	Mean	Standard Deviation	Min	Max	Range
Before (A1)	10	7.50	0.850	6	9	3
After (A2)	10	11.90	1.197	10	14	4
Before (B1)	10	7.80	1.229	6	10	4
After (B2)	10	10.40	1.1738	9	12	3

The initial test of the volleyball smash ability of the depth jump training group (A1) obtained an average value of 7.50, standard deviation 0.850, minimum value 6, maximum value 9, and range 3. The depth jump training group (A2) achieved an average score of 11.90, a standard deviation of 1.197, a minimum value of 10, a maximum value of 14, and a range of 4.

The initial test of the volleyball smash ability of the depth jump training group (B1) obtained an average value of 7.80, standard deviation 1.229, minimum value 6, maximum value 10, and range 4. The volleyball smash ability of the depth jump training group (B2) was determined in the final test, with a mean value of 10.40, a standard deviation of 1.1738, a minimum value of 9, a maximum value of 12, and a range of 3.

Table 2. Summary of Normality Test Results for Initial and Final Test Data

Variable	KS-Z	Prob.	α	Ket.
Before (A1)	0.222	0.178	0.05	Normal
After (A2)	0.174	0.200	0,05	Normal
Before (B1)	0.242	0.099	0.05	Normal
After (B2)	0.195	0.200	0,05	Normal

The initial test Table 2 for the volleyball smash ability of the depth jump training group (A1) shows a KS-Z value of 0.222 and a probability value of 0.178. The initial test data follows a normal distribution, as indicated by P > 0.0 and P > 0.05. The volleyball smash ability of the depth jump training group (A2) obtained a KS-Z value of 0.174 and a probability value of 0.200. P>0.05 suggests that the final test data conforms to a normal distribution.

The initial test of the volleyball smash ability of the box jump training group (B1) obtained a KS-Z value of 0.242 and a probability value of 0.099. Because P > 0.05, this indicates that the initial test data follows a normal distribution. The final test determined the volleyball smash ability of the box jump training group (B2) with a KS-Z value of 0.195 and a probability value of 0.200. The final test data displays a normal distribution (P>0.05). The following are the results of the Paired Samples Test in Table 3.

Table 3. Differences in the Effect of Depth Jump Training and Box Jump Training on MAN 1 Bone's Smash Ability

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest Depth Jump - Postest Depth Jump	-4.40	.843	.267	-5.003	-3.797	-16.500	9	.000
Pair 2	Pretest Box Jump - Postest Box Jump	-2.60	1.5776	.4989	-3.7286	-1.4714	-5.212	9	.001

The results of the T-Paired Samples Test in Table 3 indicate that the analysis of the box jump training data yielded a calculated t value (to) = 16,500. (P ≤ 0.05), meaning that there is a significant effect of depth jump training on the volleyball smash ability in the volleyball game of MAN 1 Bone students, while for the results of the depth jump training test based on the table above, it can be seen that the results of data analysis obtained a calculated t value (to) = 5.212. (P ≤ 0.05), meaning that there is a significant effect of depth jump training on the volleyball smash ability in the volleyball game of MAN 1 Bone students.

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The paired sample test results revealed a lower increase in box jump training compared to depth jumps. For depth jump training, the increase is 4,400, whereas for box jumps, it is 2,600. This demonstrates that depth jump training has a greater impact than box jump training when it comes to dominating volleyball matches at MAN 1 Bone, as evidenced by the treatment of up to 10 students per group.

Discussion

The effect of depth jump training on students' volleyball smash ability in volleyball games

Based on the analysis results, it appears that depth jump training has a significant influence on volleyball smash ability in the MAN 1 Bone volleyball game. The depth jump training significantly enhances the volleyball smash ability in the MAN 1 Bone volleyball game. Plyometric depth jump training enhances the explosive power of the leg and hip muscles, specifically the gluteals, hamstrings, quadriceps, and gastrocnemius muscles, allowing them to execute volleyball smashes with high speed and power. This exercise places significant strain on the hips, legs, and lower back muscles while also engaging the muscles responsible for balancing the knees and ankles. This occurs because the exercise solely utilizes one leg to support the weight, necessitating the use of the knee and ankle balancing muscles to maintain balance during the exercise and prevent falls during landings not to fall when landing.

Depth jump training helps optimize movements to achieve maximum height and distance with the appropriate movement rhythm (Ojeda-Aravena et al., 2023). We recommend using either your own body weight or equipment to enhance the stimulation of depth jump exercises. It is believed that depth jump exercises trigger a variety of neuromuscular changes, expanding muscle groups to react more swiftly and forcefully to variations in muscle length and lightness. Neuromuscular conditioning, which enables faster and stronger direction changes, such as up and down movements in jumping and anterior and posterior leg movements during running, appears to be one of the key characteristics of depth jump training. Reducing the time required for this direction change can increase strength and speed (Bakar et al., 2021).

The effect of box jump training on students' volleyball smash ability in volleyball games

The analysis results show that box jump training has a significant influence on volleyball smashing ability in the Man 1 Bone volleyball game. This exercise has a positive influence on leg muscle power in sports. This exercise develops speed and power for the leg and hip muscles, especially the gluteals, hamstrings, quadriceps, and gastrocnemius muscles, at high speed and full of energy. This exercise is useful for developing speed and explosive power. The box jump training involves standing in a half-squatting position with your legs stretched shoulder-width apart, then quickly jumping forward until your feet are under your buttocks and landing on both feet. This box jump training involves the gluteals, hamstrings, quadriceps, and gastrocnemius muscles. This exercise develops the leg and hip muscles, especially the gluteals, hamstrings, quartriceps, and gastrocenemius muscles, at high speed and full of energy.

Box jump training is an exercise that optimizes vertical jumping movements by achieving maximum height and distance (Silva et al., 2019). This exercise aims to increase muscle explosive power by combining isometric and isotonic (eccentric-cocentric) workouts that use dynamic loading. This exercise involves a sudden stretch that occurs before the muscles contract again, or an exercise that allows the muscles to reach maximum strength in the shortest possible time (Wahyuni & Muazarroh, 2021).

The difference between depth jump and box jump training on volleyball smash abilities in students' volleyball games

For volleyball smash ability at MAN 1, depth jump training is superior to box jump training. The deep jump movement puts more stress on the hips, legs, and lower back muscles, as well as the muscles that balance the knees and ankles. This is due to the higher demands on strength and speed during depth jump training, compared to the lower demands during box jump training. The varying demands on strength and speed necessitate different responses from the leg muscles, resulting in a variation in the required leg power. The higher the demand for strength and speed that the muscles receive/endure during contraction, the greater the influence in increasing leg muscle power, which then plays a role in implementing the volleyball smash ability at MAN 1 Bone.

The results of this study indicate that depth jump training is more effective in increasing vertical jump height and reducing ground contact time compared to box jump training. The different neurophysiological mechanisms of the two plyometric exercises explain this. Depth Jump results in more muscle activation, better neuromuscular regulation, and faster structural adaptation in the muscles involved in the vertical jump (Silva et al., 2019; Makaruk et al., 2020). Deep jump training is more effective at improving vertical jump performance and reducing ground contact time than box jump training. The implication of these findings is that coaches and athletes can consider integrating Depth Jump in their plyometric training programs to achieve optimal results in increasing muscle strength and speed (Wahyuni & Muazarroh, 2021). From a neurophysiological perspective, Depth Jump involves more intensive muscle activation and better neuromuscular coordination compared to Box Jump. DJ allows athletes to optimally utilize the effects of the stretch-shortening cycle, in which muscles briefly stretch before contracting strongly for a jump. This process enhances the athlete's vertical jump potential by storing more energy in the muscles and releasing it more efficiently (Fitrianto et al., 2021).

Apart from that, Depth Jump is also known to be able to strengthen the tendon and ligament structures involved in the jumping process, thereby reducing the risk of injury compared to the Box Jump method. These exercises promote better structural adaptations in connective tissue, which is important for maintaining an athlete's performance over the long term. Although depth jump training may necessitate closer supervision and attention to correct execution technique, the long-term performance improvements clearly provide significant added value for the athlete.

4. CONCLUSION

Based on the analysis and discussion results, it appears that depth jump training has a significant impact on students' volleyball smash ability in volleyball games. Aside from that, box jump training has a significant impact on students' volleyball-smashing ability in volleyball games. Additionally, a significant difference exists between the impact of the depth jump training group and the box jump group on the volleyball smash ability of MAN 1 Bone students. The paired sample T-test results demonstrate that each exercise has an impact, with a significance value of 0.000 for depth jump training and 0.001 for box jump training. For depth jump training, the increase in smash ability was 4.40, while for box jumps, it was 2.60.

We hope that the results of this research can significantly contribute to the development of volleyball training methods at the secondary school level in Indonesia. The results of this research can be a reference for sports coaches and teachers in designing effective training programs to improve the smash ability and overall performance of school volleyball teams.

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