THE INFLUENCE OF LEG MUSCLE EXPLOSIVE POWER ON SMASH SKILL IN UNP VOLLEYBALL ATHLETES

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Abstract
Explosive power is an important component in determining volleyball smash skills. However, it is often the case that not all volleyball athletes have optimal lower body muscle explosive power. Additionally, a lack of attention to basic physical condition often leads to the lower body muscle explosive power not developing to its maximum potential. This impacts the athletes' jumping ability, which in turn affects the team's overall performance. This study aims to analyze the extent to which leg muscle explosive power influences volleyball athletes' smash skills. This research method uses a quantitative approach with a quasi-experimental design involving 30 UNP volleyball athletes. Explosive power training was administered over 16 sessions, with a frequency of 4 sessions per week, and training intensity levels were adjusted over 4 weeks. Data on lower limb explosive power were obtained using the vertical jump test for both pre-test and post-test data. This sampling uses a purposive sampling technique. Then it was statistically analyzed using a *paired samples test (t-test)* with the assistance of the SPSS program. The analysis results of this study indicate leg muscle explosive power in volleyball athletes with significance ($p < 0.05$), meaning there is a significant influence of leg muscle explosive power on volleyball athletes' smash skills. Based on the calculation of the coefficient of determination, it was found to be 27.4%, which indicates it falls into the sufficient category. This research is expected to help sports instructors, coaches, and volleyball athletes more easily evaluate and identify athletes' skills.
Keywords: Leg muscle, explosive power, skill, smash, volleyball

INTRODUCTION

The development of volleyball is currently very rapid, keeping pace with the growth of the sport. As a result, volleyball is no longer just for recreation and leisure but has evolved into a profession that demands high performance (Umar et al., 2023). In volleyball, individual skills, such as the smash, are a small part of the technical aspects of training analysis, but they are fundamental volleyball skills, especially for beginners (Castro et al., 2021). Volleyball is one of the sports that demands high physical abilities, particularly in terms of strength, speed, and endurance (Razak et al., 2023). In this game, an athlete is required to be able to perform various skills efficiently, such

as serving, passing, smashing, and blocking. Among all these skills, the ability to jump high for smashes and blocks is one of the determining factors for success in matches (Nunes et al., 2021; Razak et al., 2023). Therefore, leg muscle explosiveness is a very important physical component for a volleyball player.

Lower limb muscle explosive power can be defined as the ability of lower limb muscles to exert force quickly in a single explosive movement, for example, when performing a vertical jump (Kusnanik et al., 2023). In volleyball players, this explosive power is crucial in determining how high a player can jump to hit the ball over the net or block an opponent's attack. Athletes with good leg muscle explosive power will have an advantage in the game because they can reach the ball at heights that are difficult for opponents to reach (Aksović et al., 2020; Rifki, Hanifah, et al., 2022).

A common problem is that not all volleyball athletes have optimal leg muscle explosive power. Factors such as a lack of targeted physical training, monotonous training methods, and insufficient attention to basic physical condition often lead to the explosive power of limb muscles not developing optimally (Sepdanius et al., 2023). This impacts the athletes' jumping ability, which in turn affects the team's overall performance. Beside training factors, the explosive power of leg muscles can also be influenced by other elements such as nutritional intake, fitness level, and the techniques used in the game. If an athlete relies solely on technique without good physical condition, the results achieved will not be optimal (Papadopoulou et al., 2013; Westerbeek & Eime, 2021). Therefore, physical conditioning, especially in terms of leg muscle explosiveness, must be a primary focus in a volleyball training program.

Efforts to increase lower limb muscle explosive power can be done thru various forms of exercise, such as plyometric training, squat jumps, and well-programmed weight training (Aksović et al., 2020). These exercises have been proven to increase the strength and speed of lower limb muscle contractions, resulting in higher and more explosive jumping movements (Aksović et al., 2020; S. Nugroho et al., 2021). Thus, selecting and implementing the appropriate training methods is crucial for supporting the development of volleyball players' abilities.

Deeper still, in volleyball, the ability to execute a powerful and accurate smash is one of the main factors determining a team's success in scoring points. The smash movement not only demands good technical mastery but also requires optimal physical condition, particularly in terms of lower limb muscle explosive power. Lower limb muscle explosive power plays a crucial role in generating high vertical jumps, enabling athletes to hit from the highest position with maximum force. Therefore, research on the influence of lower limb muscle explosive power on smash ability is extremely important for understanding the extent to which this physical factor affects volleyball athletes' performance.

The urgency of this research becomes increasingly apparent considering the importance of a scientific basis in developing effective and targeted training programs. Coaches and athletes often focus on improving hitting technique without deeply considering the underlying biomotor aspects. Thru this research, it is hoped that empirical data can be obtained to explain the relationship between leg muscle explosive power and smash ability, which can then serve as a reference for designing more targeted training programs. In this way, an increase in leg muscle explosive power can directly contribute to an improvement in the strength, speed, and effectiveness of the athletes' smashes.

Beside providing practical benefits for improving athlete performance, this research also makes a significant contribution to the development of sports science, particularly in the field of volleyball training. The results of this study are expected to serve as a reference for future researchers in examining the relationship between physical abilities and technical skills in various sports. With a measurable scientific approach, this research is expected to help coaches, athletes, and academics gain a deeper understanding of the factors that influence smash performance, and contribute to sustainable improvement in sports achievements.

Based on the above explanation, it is clear that leg muscle explosive power is one of the fundamental factors that needs attention in the training of volleyball athletes. Limitations in leg muscle explosive ability can be a hindrance to achieving maximum performance, especially in the smash and blocking skills, which are highly dependent on jump height. Therefore, research and training programs focused on improving lower limb muscle explosive power are relevant and urgent to implement for volleyball athletes.

METHODOLOGY

The research method is a scientific way to obtain specific data with certain goals and objectives. This research falls under quantitative research. The purpose of this study is to examine the influence of lower limb explosive power on the smash skill of UNP volleyball athletes. In the social sciences, the quantitative research method refers to systematic empirical research on quantitative properties and phenomena and their relationships, with the general aim of quantitative research being to develop and utilize mathematical models, theories, and hypotheses regarding a specific phenomenon. Additionally, quantitative research heavily utilizes statistics for various measurements, ranging from data collection to validity and so on.

The participants in this study were volleyball athletes from Padang State University. In this study, the population used is a finite population whose number can be known with certainty. The population is the entire group of research subjects. The objects in the population are studied, the

results are analyzed, and conclusions are drawn for the entire population. Populations can be categorized into two types: 1) Finite populations are those consisting of a specific number of elements. 2) Infinite populations are those consisting of elements whose boundaries are difficult to determine. The sampling technique is purposive sampling, which is a sampling technique with specific criteria. So, the sample in this study consists of 30 athletes. The research was conducted at the UNP Air Tawar Barat Sports Hall.

This study aims to analyze the extent to which leg muscle explosive power influences volleyball athletes' smash skills. This research method uses a quantitative approach with a quasi-experimental design involving 30 UNP volleyball athletes. Explosive power training was administered over 16 sessions, with a frequency of 4 sessions per week, and training intensity levels were adjusted over 4 weeks. Data on lower limb explosive power were obtained using the vertical jump test for both pre-test and post-test data. This sampling uses a purposive sampling technique. Then it was statistically analyzed using a *paired samples test (t-test)* with the assistance of the SPSS program. Data analysis technique using a t-test with analysis steps using IBM SPSS version 24.

RESULTS

Table 1 presents the results of the paired sample *t*-test analysis examining differences in leg muscle explosive power of volleyball athletes before and after the treatment. The table displays the descriptive statistics, including mean and standard deviation values, as well as the results of the paired *t*-test used to determine the significance of the observed differences between the pre-test and post-test measurements.

Table 1. T-test of explosive power of leg muscles in volleyball athletes

Test	n	Descriptive Statistics		Paired T-Test	
		M (Std.D)	t	df	Sig. (2-tailed)
Pre-Test	30	114.092 (20.74)	6.522	29	0.000**
Post-Test	30	126.898 (18.43)			

From the table above, it can be concluded that the calculation results of the influence of leg muscle explosive power on volleyball athletes' smash skills using SPSS yielded a calculated t-value of 6.522 > the table t-value of 1.697. Additionally, the significance value results in $p < 0.05$. Thus, it can be concluded that leg muscle power has an influence on volleyball smash skills. Based on the calculation of the coefficient of determination, which was found to be 27.4%, it can be concluded that the percentage of the influence of leg muscle power on volleyball athletes' smash skills is 27.4%, while the remaining 72.6% is influenced by other factors not mentioned in this study. Therefore,

the influence of leg muscle power on volleyball athletes' smash skills falls into the moderate category.

DISCUSSION

The overall goal of this research is to accurately identify potential athletes, evaluate their talent, and determine its relevance to real-world on-field situations, as well as gain a deep understanding of the dynamics and context of athlete development. This allows athletes to develop their skills to the maximum during training and use them in competition. The increasing popularity of sports worldwide today is proof that accurate evaluation is crucial for any effort to improve athlete quality (Umar et al., 2023b). Furthermore, this study indicates that skills—including volleyball skills—have a significant impact on athlete performance. This implies that talent analysis can help athletes become more proficient in one of the components, namely leg muscle explosive power.

Leg muscle explosive power is one of the most important biomotor components in volleyball, particularly in the skill of performing a smash (Razak et al., 2023; Sakurai & Ohtsuki, 2000). The smash is the primary attacking technique aimed at scoring points by hitting the ball hard, fast, and directed toward the opponent's area (Barajas-Pineda et al., 2023; Rifki & Ariston, 2021). An athlete's success in performing a smash is influenced by a combination of muscle strength, speed of movement, and overall body coordination.

The research results indicate that the higher the explosive power of an athlete's leg muscles, the greater the jumping ability they will exhibit. A good jump height allows athletes to hit the ball from a higher point, making the angle of attack sharper and more difficult for opponents to anticipate (Alishah et al., 2017; Nunes et al., 2021). This aligns with the principles of biomechanics, where the energy generated by limb muscle contractions will be converted into vertical force to support optimal jumping. In addition, a smash in volleyball not only requires strength, but also coordination between arm swing, body position in the air, and the timing of the hit against the ball (Papadopoulou et al., 2013). However, the role of lower limb explosive power remains a dominant factor because without a good jump, the effectiveness of the smash will decrease. Athletes with low leg explosive power tend to have limited jump height, making smash shots easy for opponents to read and anticipate (Imai et al., 2023; Umar et al., 2023b).

Thus, it can be concluded that the explosive power of the leg muscles significantly contributes to the smash skill of volleyball athletes. Efforts to increase leg explosive power thru plyometric exercises, squat jumps, bounding, and variations of strength and speed training will have a direct impact on improving smash performance (Moh. H. D. Nugroho et al., 2023).

Therefore, volleyball coaches need to provide a special training regimen to develop athletes' leg explosive power so that attacking skills can be more optimal. Beside the explosive power of the leg muscles, smash skills are also influenced by several other aspects such as motor coordination, basic techniques, arm muscle strength, body flexibility, and concentration in making decisions during attacks (Tohidin et al., 2021). However, when viewed from a physical aspect, leg muscle explosive power remains one of the main determinants that differentiates the effectiveness of smashes between athletes (Rifki, Farma, et al., 2022).

The smash will be more effective if the athlete can jump high and quickly. This jump is generated by the explosive power of the leg muscles, particularly the quadriceps, hamstrings, glutes, and calves (Razak et al., 2023; Rifki, Farma, et al., 2022). Research in the field of sports science shows a positive correlation between vertical jump and smash ability. The higher an athlete's vertical jump score, the better the quality of their smash (Lola & Tzetzis, 2020; Tohidin et al., 2021). The results of this study confirm that it serves as a valuable reference for sports teachers and volleyball coaches, making a positive contribution to analyzing and evaluating every skill possessed by volleyball athletes.

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CONCLUSION

Based on the analysis results, leg muscle explosive power was proven to play a significant role in improving the smash skills of volleyball athletes. The better an athlete's leg explosive power, the greater their chances of executing a powerful, sharp, and difficult-to-anticipate smash. Therefore, coaches and athletes need to emphasize explosive leg training as an important part of the volleyball training program. Additionally, it also contributes positively to understanding the link between sports, holistic well-being, and the implementation of sports policies.

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