

# Analysis of the Role of Arm Power in Improving Volleyball Smash Accuracy: Literature Review

Muhammad Wahyu Triatmaja<sup>1</sup>, Nur Luthfiatus Solikah<sup>2</sup>, Yudi Dwi Saputra<sup>1</sup>

<sup>1</sup> Department of Sport Science, Faculty of Sport Science and Health, Universitas Negeri Surabaya, Indonesia.

<sup>2</sup> Department of Physiotherapy, Faculty of Medicine, Universitas Negeri Surabaya, Indonesia.

\*Email Corresponding author: [muhammadwahyu.22146@mhs.unesa.ac.id](mailto:muhammadwahyu.22146@mhs.unesa.ac.id)

**Abstract.** Smash is the primary offensive technique in volleyball that requires speed, power, and accuracy. The success of this technique is highly influenced by the athlete's physical condition, particularly the explosive power of the arm muscles. This article aims to analyze the contribution of arm explosive power to the improvement of smash accuracy through a literature review. Data were collected from various relevant national and international studies. The review findings indicate that arm muscle explosive power has a significant correlation with smash accuracy, with contributions ranging from 25% to 41%. Athletes with higher explosive power tend to have better motor control, allowing for more accurate and powerful smash execution. Additionally, plyometric training has been proven effective in increasing arm muscle explosive power, which indirectly enhances smash performance. The studies also highlight the importance of overall body movement coordination, including the involvement of core and lower body muscles in generating maximum striking force. These findings confirm that the development of arm muscle explosive power is a crucial aspect of training programs aimed at improving volleyball smash accuracy.

**Keywords:** accuracy, explosive, smash, volleyball

Academic Editor: Firdaus  
Published: 08 August 2025

**Citation:** Triatmaja, M. W., Solikah, N. L., & Saputra, Y. D. (2025). Analysis of the Role of Arm Power in Improving Volleyball Smash Accuracy. *International Conference on Biomedical and Sports Medicine*, 1(01), 17–22. Retrieved from <https://ejournal.unesa.ac.id/index.php/ibismed/article/view/72203>

Copyright: © 2025 by the authors

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## Introduction

An effective game is one that can turn opportunities into points, as each collected point contributes to a team's victory. In volleyball, one way to earn points is by sending the ball into the opponent's defensive area through offensive actions such as a smash. In volleyball, a smash is one of the striking techniques used for attacking (Putri et al., 2021). Executing a smash requires hitting the ball quickly and accurately, making it difficult for the opponent to defend against the attack.

The main objective in volleyball is to hit the ball as hard as possible to generate maximum speed (Miura et al., 2020). The smash technique in volleyball plays a crucial role in achieving success, in addition to various physical factors that influence it (Razak et al., 2023). Syafruddin (1999, as cited in Arista & Hermanzoni, 2019) stated that there are two factors that can influence performance: internal factors such as physical condition, technique, tactics, and mental state, and external factors such as coaches, facilities, family, nutrition, and

others. The success of a smash in volleyball depends on physical components, particularly arm explosive power, which plays an essential role in producing fast, powerful, and accurate strikes.

Arm explosive power is a combination of speed and strength components (Febby, 2020). According to Irodat (2008, as cited in Sin et al., 2020), arm muscles refer to a person's ability to exert maximum force from the upper arm down to the forearm. Arm muscle explosive power contributes significantly to smash accuracy, with a contribution rate of 41.22%. Therefore, greater arm muscle strength and more proportional body composition are associated with higher smash accuracy (Asnaldi, 2020). To achieve a fast and powerful smash, strong arm explosive power is required (Schleichardt as cited in (Sin et al., 2020).

Based on the discussion above, this article aims to determine the extent to which arm muscle explosive power contributes to improving smash accuracy in volleyball. Smash accuracy is one of the most crucial techniques when performing attacks to score points and win matches. The ability to deliver a powerful and targeted smash is highly influenced by the athlete's physical condition, particularly the explosive power of the arm muscles, which enables players to produce fast, strong, and accurate strikes.

## Methods

This study adopts a literature review method, which involves the systematic analysis and synthesis of relevant scholarly sources related to the research topic (S. R. Solikah & Shofiani, 2023). A literature review presents the author's critical reflection on the findings of previous studies, including journal articles and theses that align with the research focus. Cahyono et al (2019) emphasize that a literature review constitutes a scientific inquiry centered on a specific topic and must be supported by relevant, current, and comprehensive sources. The process typically includes establishing a theoretical foundation, conducting a theoretical analysis, and reviewing pertinent literature.

## Result and Discussion

Title	Author	Methods	Results
Explosive Power Of The Arms And Its Relationship With Speed Of The Arm Angle, The Angle Of Ball's Flight And The Accuracy Of Spiking Skill Of Volleyball Players.	Shahad kadhun hameed, Entser Kadhim Abdalkarem	This study used a descriptive approach with a survey method.	A significant correlation was found between explosive power and the accuracy of smash skills. Greater explosive power contributes to improved spiking precision in volleyball.
The Correlation Between Flexibility and Arm Explosive Power with Smash Accuracy in Volleyball.	Arie Asnaldi	This study used a correlational research design.	The explosive power of the arm muscles contributes 41.22% to the accuracy of volleyball smashes.
Contribution of Explosive Power Muscle Arms and Concentration of Floating Service in Volleyball.	Erianti, Yuni astuti, Zulbahri	This study used a correlational research design.	The explosive power of the arm muscles was found to have a significant correlation with serving performance, contributing 18.06%. Enhanced arm explosive strength is associated with improved serving ability.
Power And Velocity Performance Of Swing Movement In The Adolescent Male Volleyball Players - Age And Positional Difference.	Junsheng Wang, Zhikai Qin, Zhifeng Wei	This study used a quantitative experimental design.	The involvement of the trunk has been shown to significantly enhance strength and speed during the swing movement in a spike. A specialized physical training program

			targets simultaneous improvements in arm strength and trunk rotational power.
The relationship between explosive power, elbow angle, and jump height with smash accuracy in volleyball games: correlational studies.	Martinez Edison Putra, Fauzi, Faidillah Kurniawan, Novi Resmi Ningrum, Nugroho Susanto.	This study employed a descriptive research design that incorporated correlational methods.	The correlation analysis between explosive power (X1) and smash accuracy (Y) yielded an R value of 0.566 and an R-squared value of 0.321, indicating that explosive power accounts for 32.1% of the variability in smash accuracy.
“Ballistic Six” Upper-Extremity Plyometric Training For The Pediatric Volleyball Players.	Elif Turgut, Ozge Cinar-Medeni, Filiz F. Colakoglu, Gul Baltaci	This study employed an experimental approach with a pretest-posttest design.	The study demonstrated that plyometric training offers potential benefits for improving explosive power, strength, endurance, and reaction time in the inactive arm.
The Contribution of Arm Muscle Explosive Power and Flexibility to Smash Accuracy in Badminton at STKIP Meranti.	Dedi Nofrizal	This study used a correlational research design.	The explosive power of the arm muscles contributes 25.30% to the smash accuracy in badminton athletes who are members of the STKIP Meranti Club, Kepulauan Meranti Regency.
The Relationship of Arm Muscle Strength and Hand-Eye Coordination with Forehand Smash Accuracy in Badminton.	Anang Setiawan, Fauzan Effendi, Muhammad Toha	This study employed a descriptive method using a quantitative approach.	Arm muscle strength and hand-eye coordination have a significant relationship in determining accurate and well-targeted forehand smash results.
The Effect of Push-Up Training on Smash Accuracy in Men's Permata Volleyball Club.	Aprizal Fikri, Muslimin, Samsudin, Hernawan, Firmansyah Dlis, James Tangkudung, Widiastuti, Arif Hidayat	The research method used was an experimental method with a pretest-posttest design.	Based on these results, push-up training was found to improve the smash skills of male volleyball players in the Permata Club.

Smash is an offensive technique in volleyball aimed at driving the ball into the opponent's defensive area to score points. The success of a smash is determined not only by strength but also by speed and accuracy when striking the ball (Putri et al., 2021). These elements—speed and accuracy—are influenced by physical condition, particularly arm explosive power. Arm explosive power can be defined as the ability of the arm muscles to generate maximum force in the shortest possible time, combining strength and speed (Febby, 2020). This is consistent with the explanation provided (Hose Pernando & Andika, 2023). Who stated that explosive power is the ability of muscles to exert force quickly and explosively. This ability allows an athlete to produce powerful, fast, and difficult-to-defend shots.

Several studies have consistently supported the finding that arm muscle explosive power significantly contributes to smash accuracy. Asnaldi (2020) specifically noted that explosive power accounts for 41.22% of the accuracy outcome. This figure indicates that arm explosive power is not merely a supporting factor, but a determining one in the success of a smash. Other studies have also emphasized a statistically significant positive correlation between upper limb explosive power and the speed and performance of the smash (Indora et al., 2022). This suggests that the greater the explosive strength of the arm muscles, the higher the achievable smash accuracy, as athletes gain better control over the ball's trajectory and speed. Additionally, optimal arm

explosive power helps reduce the risk of injury by promoting more efficient and controlled movements (Wang et al., 2025).

The positive correlation between arm explosive power and smash accuracy has been reinforced by various studies. Shahad Kadhum Hameed and Intisar Kadhim Abdalkarem found a significant correlation between explosive power and smash skill accuracy. Another study by Martinez Edison Fauzi and Faidillah Kurniawan reported a correlation coefficient (R) of 0.566 and a coefficient of determination (R-square) of 0.321, indicating that explosive power explains 32.1% of the variability in smash accuracy. These findings are consistent with other research showing that athletes with superior arm explosive power tend to have better motor control, allowing them to direct the ball with high precision even at high speeds (Slovák et al., 2024). Further research also emphasizes that during competition, athletes must possess quick reaction abilities and high explosive power to effectively respond to dynamic game situations (N. L. Solikah et al., 2025).

In addition to accuracy, smash speed is also a factor strongly influenced by arm explosive power. Junsheng Wang et al. highlighted that trunk involvement significantly enhances power and speed during swing movements in spiking. This indicates that a smash is not merely an isolated arm movement, but the result of an integrated kinetic chain. By coordinating body movements sequentially from the lower to the upper limbs, players can more accurately anticipate the ball's trajectory and the opponent's defensive positioning. This synchronization allows for a more effective execution of the smash (Sarvestan et al., 2018). Full-body movement integration enables efficient energy transfer from the legs to the arms, maximizing the power and speed of the strike (Marpaung & Priyonoadi, 2020). Therefore, training programs that focus solely on arm strength without considering the contributions of other body segments may fail to produce optimal improvements in smash performance.

To improve arm explosive power, plyometric training has been proven highly effective. Elif Turgut et al., in their study on "Ballistic Six" upper-extremity plyometric training for pediatric volleyball players, demonstrated that plyometric exercises offer potential benefits in enhancing explosive power, strength, and endurance. Plyometric training involves rapid and explosive movements, making muscular strength one of the most critical factors in giving athletes a competitive advantage during matches (Silva et al., 2019). Several studies also suggest that plyometric exercises help develop gross motor skills (Almeida et al., 2021).

Coaches should consider integrating varied and progressive plyometric exercises into volleyball athletes' training routines. It is essential to ensure that athletes have an adequate strength foundation before engaging in intensive plyometric training to prevent injury. Incorporating plyometric exercises into volleyball training programs during the preparatory period can lead to more substantial performance improvements (Guimarães et al., 2023). A comprehensive training program should also include core strength and flexibility exercises to support efficient smash movements and reduce the risk of injury.

## Conclusion

Based on the literature review, it can be concluded that arm muscle explosive power plays a significant role in improving smash accuracy in volleyball. Several studies indicate that the contribution of arm explosive power to smash accuracy ranges from 25% to 41%, making it a determining factor rather than merely a supporting one. Athletes with higher arm explosive power tend to have better motor control and are able to deliver faster and more accurate smashes. Plyometric training has been proven effective in enhancing arm explosive strength and should be incorporated into structured and progressive training programs. Additionally, the integration of lower-body strength and core muscles is essential to support smash effectiveness. Therefore, the development of arm explosive power should be a key component in efforts to improve volleyball smash performance.

## References

- Abdalkarim, E. K. (2023). *Explosive power of the arms and its relationship with speed of the arm angle , the angle of ball ' s flight and the accuracy of spiking skill of volleyball players*. 4(April), 1-7.
- Almeida, M. B. de, Leandro, C. G., Queiroz, D. da R., José-da-Silva, M., Pessoa dos Prazeres, T. M., Pereira, G. M., das-Neves, G. S., Carneiro, R. C., Figueredo-Alves, A. D., Nakamura, F. Y., Henrique, R. dos S.,

- & Moura-dos-Santos, M. A. (2021). Plyometric training increases gross motor coordination and associated components of physical fitness in children. *European Journal of Sport Science*, 21(9), 1263–1272. <https://doi.org/10.1080/17461391.2020.1838620>
- Arista, S., & Drs.Hermanzoni. (2019). Tingkat Kondisi Fisik Atlet Bolavoli Putri. *Jurnal Patriot*, 1(2), 429–437. <http://patriot.ppj.unp.ac.id/index.php/patriot/article/view/479>
- Asnaldi, A. (2020). Hubungan Kelentukan dan Daya Ledak Otot Lengan Terhadap Ketepatan Smash Bolavoli. *Physical Activity Journal*, 1(2), 160. <https://doi.org/10.20884/1.paju.2020.1.2.2556>
- Cahyono, E. A., Sutomo, & Harsono, A. (2019). Literatur Review: Panduan Penulisan dan Penyusunan. *Jurnal Keperawatan*, 12.
- Erianti, Astuti, Y., & Zulbahri. (2020). Contribution of Explosive Power Muscle Arms and Concentration of Floating Service in Volleyball. 460(Icpe 2019), 270–275. <https://doi.org/10.2991/assehr.k.200805.074>
- Febby, P. (2020). The Correlation of Arm Muscle Explosive Power, Leg Muscle Explosive Power, and Hand-Eye Coordination Towards the Smash of Badminton Player. 460(Icpe 2019), 135–139. <https://doi.org/10.2991/assehr.k.200805.038>
- Fikri, A., Muslimin, Samsudin, Hernawan, Dlis, F., Tangkudung, J., Widiastuti, & Hidayat, A. (2021). The effect of push-up exercises on the precision of men's permata club volleyball smash. *International Journal of Human Movement and Sports Sciences*, 9(6), 1104–1108. <https://doi.org/10.13189/saj.2021.090604>
- Guimarães, M. P., Silva, R. D. O., Dos Santos, I. A., Da Silva, G. P., Campos, Y. A. C., Da Silva, S. F., & De Azevedo, P. H. S. M. (2023). Effect of 4 weeks of plyometric training in the pre-competitive period on volleyball athletes' performance. *Biology of Sport*, 40(1), 193–200. <https://doi.org/10.5114/biolsport.2023.112971>
- Hose Pernando, Y., & Andika, R. (2023). Overview of Ability Levels of Physical Conditions of Athletic Athletes Center for Student Training Education (PPLP). *Siber International Journal of Sport Education (SIJSE)*, 1(1), 26–36. <https://doi.org/10.38035/sijse.v1i1.20>
- Indora, N. K., Anand, P., Chettri, S., & Kumar, V. (2022). Correlation of Upper Limb Explosive Power with Smash Velocity and Performance in Badminton Players: A Cross-sectional Study. *Journal of Clinical and Diagnostic Research*, April. <https://doi.org/10.7860/jcdr/2022/53088.16381>
- Marpaung, H. I., & Priyonoadi, B. (2020). The Correlation between Leg-arm Muscle Power and Volleyball Players' Open Smash Ability. 379–385. <https://doi.org/10.5220/0009786803790385>
- Miura, K., Tsuda, E., Kogawa, M., & Ishibashi, Y. (2020). The effects of ball impact position on shoulder muscle activation during spiking in male volleyball players. *JSES International*, 4(2), 302–309. <https://doi.org/10.1016/j.jseint.2019.12.009>
- Nofrizal, D. (2019). Kontribusi Daya Ledak Otot Lengan Dan Kelentukan Terhadap Ketepatan Smash Dalam Cabang Olahraga Bulutangkis Anggota Klub Stkip Meranti Kabupaten Kepulauan Meranti. *Curricula : Journal of Teaching and Learning*, 4(2), 69. <https://doi.org/10.22216/jcc.2019.v4i2.1124>
- Putra, M. E., Fauzi, Kurniawan, F., Ningrum, N. R., & Susanto, N. (2024). The relationship between explosive power, elbow angle, and jump height with smash accuracy in volleyball games: Correlational studies. *Health, Sport, Rehabilitation*, 10(1), 65–75. <https://doi.org/10.58962/HSR.2024.10.1.65-75>
- Putri, S. A. R., Dlis, F., Samsudin, Fajar, M., Wanto, S., & Sari, P. S. (2021). The effect of smash training using hanging balls on the accuracy of open smash. *International Journal of Human Movement and Sports Sciences*, 9(1), 135–139. <https://doi.org/10.13189/saj.2021.090119>
- Razak, A., Syamsuryadin, S., Fauzi, F., Rini Sukamti, E., Marpaung, D. R., & Manihuruk, F. (2023). Relationship Between Arm Muscle Strength and Leg Muscle Explosiveness Against Smash Volleyball Athletes: A Literature Study. *International Journal of Multidisciplinary Research and Analysis*, 06(02), 2019–2022. <https://doi.org/10.47191/ijmra/v6-i2-24>
- Sarvestan, J., Cheraghi, M., Sebyani, M., Shirzad, E., & Svoboda, Z. (2018). Relationships between force-time curve variables and jump height during countermovement jumps in young elite volleyball players. *Acta Gymnica*, 48(1), 9–14. <https://doi.org/10.5507/ag.2018.003>
- Setiawan, A., Effendi, F., & Toha, M. (2020). Dikaitkan Dengan Kekuatan Otot Lengan Dan Koordinasi Mata-Tangan. 10, 50–56.
- Silva, A. F., Clemente, F. M., Lima, R., Nikolaidis, P. T., Rosemann, T., & Knechtle, B. (2019). The effect of plyometric training in volleyball players: A systematic review. *International Journal of Environmental Research and Public Health*, 16(16). <https://doi.org/10.3390/ijerph16162960>

- Sin, T. H., Nopianto, N., & Fardi, A. (2020). The effect of arm muscle power and confidence on the ability of the volley smash ball. *Journal of Educational and Learning Studies*, 3(1), 1. <https://doi.org/10.32698/0812>
- Slovák, L., Sarvestan, J., Alaei, F., Iwatsuki, T., & Zahradník, D. (2024). Upper limb biomechanical differences in volleyball spikes among young female players. *International Journal of Sports Science and Coaching*, 19(4), 1738–1746. <https://doi.org/10.1177/17479541231211679>
- Solikah, N. L., Firmansyah, A., Widodo, A., Wahyudi, H., Valentina, D. R., Putro, A. B., Prasetya, M. R. A., & Elgammal, M. (2025). The difference between male and female countermovement jump performance in junior basketball players. *Sportis: Scientific Technical Journal of School Sport, Physical Education and Psychomotricity*, 11(3), 6. <https://doi.org/10.17979/sportis.2025.11.3.11860>
- Solikah, S. R., & Shofiani, A. K. A. (2023). Literature Review: Analysis of Articles on the Application of the Problem Based Learning Model in Indonesian Language Learning. *Jurnal Prosiding SENAPASTRA (Seminar Nasional Pendidikan Bahasa Dan Sastra Indonesia)*, 27.
- Urgut, E. L. I. F. T., Edeni, O. Z. G. E. C. I., & Olakoglu, F. I. F. C. (2019). "b s " u -e p t p v p. 33(5), 1305–1310.
- Wang, J., Qin, Z., & Wei, Z. (2024). Power and velocity performance of swing movement in the adolescent male volleyball players – age and positional difference. *BMC Sports Science, Medicine and Rehabilitation*, 16(1), 1–10. <https://doi.org/10.1186/s13102-024-00898-2>
- Wang, J., Qin, Z., Zhang, Q., & Wang, J. (2025). Lower limb dynamic balance, strength, explosive power, agility, and injuries in volleyball players. *Journal of Orthopaedic Surgery and Research*, 20(1). <https://doi.org/10.1186/s13018-025-05566-w>