

THE RELATIONSHIP BETWEEN LOWER LIMB EXPLOSIVE POWER AND ABDOMINAL MUSCLE ENDURANCE ON SMASH VOLLEYBALL PERFORMANCE

Laula Roikhatul Jannah¹, Fitriana Puspa Hidasari^{2*}, Rizki Hazazi Ali³, Mimi Haetami⁴, Noviyanti⁵

^{1,2,3,4,5} Department of Physical Education, Universitas Tanjungpura, Indonesia

Corresponding Author: fitriana.puspa@fkip.untan.ac.id

(Submission Track: Received: 20-03-2025, Final Revision: 03-05-2025, Available Online: 05-13-2025)

Abstract. This study is a correlational research. In line with the research objective, which is to examine the relationship between the variables being studied, this study focuses on the relationship between leg muscle explosive power and abdominal muscle endurance strength with smash hitting ability. Based on statistical analysis, a correlation was found between leg muscle explosive power and smash hitting ability. This is evident from the product moment correlation test (r_{x_1y}) result of 0.689, indicating a significant relationship as the obtained r-value (0.689) is greater than the table value (0.514). Additionally, a significant relationship was found between abdominal muscle endurance strength and smash hitting ability, as shown by the product moment correlation test (r_{x_2y}) result of 0.824. Therefore, there is a highly significant relationship, with the obtained r-value (0.824) greater than the table value (0.514). After obtaining the results of x_1y and x_2y , a multiple correlation test was conducted to assess the combined correlation. The results indicated that leg muscle explosive power and abdominal muscle endurance strength have a coefficient value in relation to smash hitting ability, as seen from the multiple correlation test ($r_{x_1x_2y}$) result of 0.84. Referring to the interpretation table for the r-value, the value of 0.84 indicates a very high correlation. Explosive power of the leg muscles and endurance strength of the abdominal muscles play a significant role in the performance of the smash ability.

Keywords: Lower Limb Muscles; Abdominal Muscles; Smash Hit; Volleyball



INTRODUCTION

Sports are a vital component of human life, contributing to both physical and mental (spiritual) development (Nazarudin et al., 2025; Salsabila et al., 2025). Through consistent physical activity, individuals can improve not only their physical fitness but also their psychological well-being (Alisti et al., 2025). Regular participation in sports helps individuals maintain a balanced and healthy lifestyle, as physical fitness is essential for overall mental and emotional health (Frost et al., 2020; Raboin, 2024). One sport that demands high levels of physical conditioning is volleyball, a team-based game played by two opposing teams on a rectangular court divided by a net (Nur Janah, 2016; Pekas et al., 2019; Wubale et al., 2023).

The objective is to send the ball over the net into the opponent's side, with the goal of scoring by making the ball land in their court (Junpalee et al., 2023). The sport of volleyball requires a combination of agility, strength, speed, and coordination, which are essential for success in the game. In volleyball, several physical fitness components are vital for performance, including endurance, strength, power, flexibility, and speed (Boichuk et al., 2020; Wang et al., 2023). Explosive power, in particular, plays a significant role in the success of volleyball players, particularly in skills like jumping and spiking (Sgrò et al., 2024). Explosive power refers to the ability of muscles to overcome resistance at high speeds during a complete movement. This is crucial for actions like the jump required in performing a smash. A higher level of explosive power enables a player to jump higher and execute a stronger and more controlled smash. Given the importance of explosive power in volleyball, it is a key factor contributing to the performance of athletes, especially in offensive moves such as smashes, which are a primary scoring weapon.

Explosive power in the legs, particularly the muscles involved in jumping, plays an essential role in performing successful smashes. The strength of leg muscles directly impacts the height of a jump, which is crucial for reaching over the net and executing effective smashes (Behm et al., 2024). The leg muscles are divided into two main categories: the upper leg muscles and the lower leg muscles. The upper leg muscles include the tensor fascia lata, adductors, vastus lateralis, rectus femoris, sartorius, vastus medialis, and gluteus maximus, while the lower leg muscles comprise the tibialis anterior, peroneus longus, extensor digitorum longus, gastrocnemius, soleus, and the Achilles

tendon (Ahsan & Alzahrani, 2024; Ortiz-Padilla et al., 2022). These muscles work in harmony to provide the strength and explosive power necessary for jumping and executing volleyball smashes. In addition to leg strength, abdominal muscle endurance also plays a crucial role in enhancing volleyball performance, particularly when executing powerful and controlled smashes. Abdominal muscles, along with the core muscles, are responsible for stabilizing the body during dynamic movements. A strong and enduring core ensures that the player maintains balance and control during the explosive movements involved in a smash. The role of the abdominal muscles cannot be overstated, as they provide the foundation for the entire body's movement during the jump and smash, helping to direct the ball with precision and power. Mastery of basic volleyball techniques, such as serving, passing, and smashing, is essential for optimal performance in the game. However, these techniques cannot be executed effectively without the proper physical conditioning and muscular endurance.

Smashing the ball in volleyball is not just about brute force, it requires careful body movement, coordination, and the ability to direct the ball to the opponent's weak spots (Li et al., 2023; Pramono et al., 2023). The smash must be powerful, sharp, and accurately targeted to be successful. To achieve this, players need to train both their leg muscles for explosive power and their abdominal muscles for endurance. A combination of these physical attributes enables the player to execute a smash that is not only powerful but also strategically placed to score points. Although much research has focused on the importance of leg muscle strength in volleyball performance, there is a gap in the literature regarding the relationship between lower limb explosive power and abdominal muscle endurance in relation to smash performance (Oliinyk et al., 2021; Zemková, 2022). While studies have extensively examined the role of leg strength in vertical jump height and smash effectiveness, the role of abdominal muscle endurance in stabilizing the body during such high-intensity movements remains relatively underexplored. Furthermore, there is limited research examining how both lower limb explosive power and abdominal muscle endurance interact and contribute to a player's ability to execute successful smashes in volleyball.

This gap in the existing literature presents a significant opportunity for research that investigates the relationship between lower limb explosive power and abdominal muscle endurance on smash performance in volleyball. Understanding this relationship

could provide valuable insights into how these two physical components work together to enhance a volleyball player's ability to perform successful smashes. Such research could lead to more targeted training programs for volleyball players, emphasizing not only the development of leg strength and explosive power but also the importance of abdominal muscle endurance and core stability. Based on a review of existing research and the anatomical roles of the leg and abdominal muscles, the hypothesis of this study is that there is a significant relationship between lower limb explosive power and abdominal muscle endurance in improving smash performance in volleyball.

Athletes with greater explosive power in their legs, combined with higher levels of abdominal muscle endurance, are expected to demonstrate superior jump height, body control, and more effective smash execution. These factors are critical for maximizing performance during volleyball matches, where quick, powerful, and accurate smashes are essential for scoring points and gaining a competitive edge over opponents. By exploring the relationship between these two physical attributes and their influence on smash performance, the study aims to provide a more comprehensive understanding of the physical conditioning required for success in volleyball. It is expected that the findings will contribute to the development of more effective training programs for volleyball players, incorporating exercises to improve both explosive power and abdominal endurance.

METHODS

The participants in this study were 15 female volleyball athletes from the Nomen Nescio (NN) Pontianak Volleyball Club. The data collection techniques used in this study include tests and measurements. The data collection process involved using the Jump-MD tool to measure leg muscle explosive power, sit-up training to test abdominal muscle endurance, and a smash ability test to assess the level of skill in performing a volleyball smash. The smash ability was tested using a normal (open) smash test. The method employed in this study is a correlational research approach, which is used to determine whether there is a relationship between two or more variables. The expected results of this research can be used as a reference for athletes, coaches, and practitioners involved in sports science. The hypothesis model tested involved data analysis through product moment correlation and multiple correlation tests. The steps followed in the literature

review method included formulating research questions, setting research objectives, selecting methods, conducting data analysis, presenting results and discussion, and drawing conclusions. The data collection technique is a crucial step in research, as the main goal of the study is to gather data. The data collection methods used were tests and measurements. Statistical methods, including mathematical and statistical models, were used for analysis. The aim of using these methods was to provide clear and accurate results for the research. Therefore, in this study, the lower limb explosive power test uses the vertical jump test. In this test, athletes are required to perform three jumps using the Jump-MD device. As for the norm of the vertical jump test, it can be seen in table 1.

Table 1. Vertical Jump Test Norms for Women

Result	Vertical Jump	Category
	Very Good	50 >
	Good	39-49
	Fair	31-38
	Poor	23-30
	Very Poor	< 23

For this study, abdominal muscle endurance is measured using the sit-up test, where athletes will perform sit-ups for one minute. As for the norm of the Sit-Up Test, it can be seen in table 2.

Table 2. Sit-Up Test Categories for Women

Result	Sit-Up	Category
	Very Good	29 >
	Good	20-28
	Fair	10-19
	Poor	3-9
	Very Poor	< 2

The Smash Skill Test is designed to assess the athlete's ability to perform a smash or attack over the net with speed and precision. As for the norm of the Smash Skill Test, it can be seen in table 3.

Table 3. Norms for Evaluating Volleyball Basic Skill Level

Result	Sit-Up	Category
	Very Good	22-25
	Good	19-21
	Fair	12-18
	Poor	9-11
	Very Poor	5-8

Once the data has been collected, it will be analyzed using data processing

techniques. The data analysis method employed in this study includes the product-moment correlation test and multiple correlation analysis, which aim to address the questions outlined in the problem identification. Several aspects need to be considered when analyzing the annotated bibliography, including the identity of the source, the conclusions drawn from the text, and the relevance of the source in answering the research questions formulated.

RESULTS

This study aims to determine the relationship between leg muscle explosiveness and abdominal muscle endurance on the ability to perform a volleyball smash among female athletes at Club Nomen Nescio. The results of the study that have been conducted can be described as follows:

1. Results of the Leg Muscle Explosiveness Test, data for the study were taken from 15 female athletes at Club Nomen Nescio, using the Vertical Jump test to measure leg muscle explosiveness. The frequency distribution of the leg muscle explosiveness test results is shown in Table 4 below:

Table 4. Frequency Distribution of Leg Muscle Explosiveness Test Results

Category	Vertical Jump Result	Absolute Frequency	Relative Frequency
Very Good	50 >	12	80%
Good	39-49	3	20%
Fair	31-38	0	0%
Poor	23-30	0	0%
Very Poor	< 23	0	0%
Total		15	

From Table 4, it shows that the leg muscle explosiveness of the female volleyball athletes at Club Nomen Nescio (NN) can be classified into 5 categories with a class width of 15. In the first class (range 50–75), 12 athletes were recorded, representing 80%. In the second class (range 39–49), 3 athletes were recorded, representing 20%. The third, fourth, and fifth classes (ranges 31–38, 23–30, and <23, respectively) had no athletes.

2. Results of the Abdominal Muscle Endurance Test, data for the study were also taken from 15 female athletes at Club Nomen Nescio, using the Sit-Up test to measure abdominal muscle endurance. The frequency distribution of the abdominal muscle endurance test results is shown in Table 5 below.

Table 5. Frequency Distribution of Abdominal Muscle Endurance Test Results

Category	Sit-Up Result	Absolute Frequency	Relative Frequency
Very Good	29 >	12	80%
Good	20-28	3	20%
Fair	10-19	0	0%
Poor	3-9	0	0%
Very Poor	< 2	0	0%
Total		15	

From Table 5, it shows that the abdominal muscle endurance of female volleyball athletes at Club Nomen Nescio (NN) can be classified into 5 categories with a class width of 15. In the first class (range 29–40), 13 athletes were recorded, representing 86.66%. In the second class (range 20–28), 2 athletes were recorded, representing 13.33%. The third, fourth, and fifth classes (ranges 10–19, 3–9, and 0–2, respectively) had no athletes.

- Results of the Volleyball Smash Ability Test, data for the study were taken from 15 female athletes at Club Nomen Nescio, using the Open Smash test to measure the ability to perform a volleyball smash. The frequency distribution of the smash ability test results is shown in Table 6 below.

Table 6. Frequency Distribution of Smash Ability Test Results

Category	Sit-Up Result	Absolute Frequency	Relative Frequency
Very Good	22-25	12	80%
Good	19-21	3	20%
Fair	12-18	0	0%
Poor	9-11	0	0%
Very Poor	5-8	0	0%
Total		15	

From Table 6, it shows that the volleyball smash ability of female athletes at Club Nomen Nescio (NN) can be classified into 5 categories with a class width of 15. In the first class (range 22–25), 11 athletes were recorded, representing 73%. In the second class (range 19–21), 4 athletes were recorded, representing 26%. The third, fourth, and fifth classes (ranges 12–18, 9–11, and 5–8, respectively) had no athletes. After performing calculations to determine the interval class levels of each test, the results of the significance tests for each variable are also explained to assess the strength of the relationships between the variables. The relationship can be seen in the following explanation:

1. Significance Test Results for the Relationship Between Leg Muscle Explosiveness (X1) and Volleyball Smash Ability (Y) Among Female Athletes at Club Nomen Nescio.

Based on the calculation results using the product moment correlation formula, it is found that the correlation coefficient (r_{x1y}) = 0.689, or the calculated $r = 0.689$, while the critical r value at a significance level of 5% is 0.514. Therefore, it can be concluded that the calculated $r \geq$ critical r ($0.689 \geq 0.514$). This indicates a significant relationship between leg muscle explosiveness (X1) and volleyball smash ability (Y) among female athletes at Club Nomen Nescio (NN).

2. Significance Test Results for the Relationship Between Abdominal Muscle Endurance (X2) and Volleyball Smash Ability (Y) Among Female Athletes at Club Nomen Nescio.

Based on the calculation results using the product moment correlation formula, it is found that the correlation coefficient (r_{x2y}) = 0.824, or the calculated $r = 0.824$, while the critical r value at a significance level of 5% is 0.514. Therefore, it can be concluded that the calculated $r \geq$ critical r ($0.824 \geq 0.514$). This indicates a significant relationship between abdominal muscle endurance (X2) and volleyball smash ability (Y) among female athletes at Club Nomen Nescio (NN).

3. Significance Test Results for the Relationship Between Leg Muscle Explosiveness (X1) and Abdominal Muscle Endurance (X2) with Volleyball Smash Ability (Y) Among Female Athletes at Club Nomen Nescio

Based on the calculation results using the multiple correlation formula, it is found that the correlation coefficient (r_{yx1x2}) = 0.84, or the calculated $r = 0.84$. For more details, see table 7.

Table 7. Interpretation of r Values

Interval Class	Category
0,81-1,00	Very High Correlation
0,61-0,80	High or Strong Correlation
0,41-0,60	Moderate Correlation
0,21-0,40	Low or Weak Correlation
0,00-0,20	Very Low Correlation

Based on Table 7, it can be concluded that there is a significant relationship between leg muscle explosiveness (X1), abdominal muscle endurance (X2), and

volleyball smash ability (Y) among female volleyball athletes at Club Nomen Nescio (NN). Therefore, according to Hasan's interpretation, the value of $r = 0.84$ indicates a very high correlation.

DICUSSION

This research is essential as it addresses the crucial role that physical conditioning plays in the execution of specific skills, particularly the volleyball smash. While volleyball is a fast-paced and dynamic sport, the ability to perform powerful and accurate smashes is a key determinant of success. Previous studies have pointed out that leg muscle explosiveness and abdominal muscle endurance are vital components for executing such movements, but few have combined these elements to explore their collective impact on volleyball smash performance, especially among female athletes. The need for this study arises from the fact that volleyball players rely on various physical attributes to perform well, and understanding the contribution of specific physical characteristics like leg and core strength can help coaches tailor more effective training regimens.

In comparing this study with previous research, it is clear that while individual components such as leg explosiveness and abdominal endurance have been examined separately, few studies have combined them to assess their impact on volleyball smash performance. Research by supports the idea that leg muscle explosiveness—encompassing both strength and speed—is critical for effective smashes, as it influences jump height and reach. Similarly, studies by Tariq Ismael (2024) highlight the importance of abdominal strength for stabilizing the body during explosive actions. Then the research conducted by Bobula et al (2024) emphasized the importance of leg muscle explosiveness, particularly in relation to jump height and speed, which directly influences the effectiveness of a volleyball smash. Then the research conducted by Sun (2023) examined abdominal strength and endurance, finding that strong abdominal muscles are essential for maintaining stability and controlling movement during dynamic actions like the volleyball smash. However, there is limited research that merges these two fitness elements to examine their combined influence on the volleyball smash, especially in female athletes, making this study particularly valuable. By doing so, this research contributes new insights into the importance of overall physical conditioning in volleyball performance.

The implications of these findings for volleyball coaching are significant. The study demonstrates that both leg muscle explosiveness and abdominal muscle endurance have a considerable impact on smash performance. This suggests that coaches should focus on incorporating exercises that enhance both leg power (e.g., vertical jumps) and core strength (e.g., sit-ups) into their training programs. This balanced approach will likely lead to more effective training practices and improved performance during matches. The study also emphasizes the importance of abdominal strength for better control and stability during the execution of a volleyball smash. By improving core endurance, athletes can enhance their overall body coordination, leading to more efficient and powerful smashes. However, there are several limitations to this study. The sample size of only 15 female athletes is relatively small, which means the results may not be fully representative of the larger population of volleyball players. A larger, more diverse sample would provide more reliable results and allow for better generalization. Additionally, the study focused only on two physical components—leg muscle explosiveness and abdominal muscle endurance—without considering other factors like arm strength, flexibility, or aerobic fitness, all of which could contribute to an athlete's overall smash ability. Future studies could include a broader range of physical and technical factors, which would provide a more comprehensive understanding of the skills needed for successful volleyball performance. Another limitation is the lack of consideration of the athletes' experience level, which could affect their performance in the tests. More experienced players might rely less on raw physical power and more on technique, which could influence the relationship between physical conditioning and smash performance.

For future research, several recommendations can be made. First, studies should include a larger and more diverse sample, encompassing both male and female athletes of different age groups and competitive levels, to provide a broader perspective on the relationship between physical conditioning and smash performance. Additionally, incorporating other physical components such as arm strength, flexibility, and aerobic capacity would offer a more holistic understanding of the factors that contribute to successful volleyball performance. Longitudinal studies could also help track changes in performance over time as athletes undergo specific training programs aimed at improving leg explosiveness and abdominal endurance. Furthermore, research focusing on the

interplay between technique and physical conditioning could yield valuable insights, especially in a sport like volleyball, where both elements are critical for success. Finally, expanding the scope of research to other volleyball skills such as passing, serving, and blocking would provide a more comprehensive understanding of how different aspects of physical conditioning impact overall performance. This study highlights the significant relationship between leg muscle explosiveness and abdominal muscle endurance in the performance of a volleyball smash. The results demonstrate that improving these physical components can lead to better smash performance, ultimately contributing to overall success in volleyball. However, further research is needed to explore additional physical and technical factors that influence volleyball performance. By addressing these areas, future studies can enhance our understanding of the complex interplay between physical conditioning and skill execution, thereby providing athletes and coaches with more effective strategies for improving performance.

CONCLUSION

This study aimed to explore the relationship between leg muscle explosiveness and abdominal muscle endurance with volleyball smash ability in female athletes at the Nomen Nescio (NN) Volleyball Club. The findings show that both leg muscle explosiveness and abdominal muscle endurance significantly impact smash performance. Most participants demonstrated good to very good explosiveness and endurance, with correlation coefficients of 0.689 and 0.824, respectively, indicating a moderate to strong relationship between each physical component and smash ability. When combined, the correlation between leg explosiveness, abdominal endurance, and smash ability was very high (0.84), highlighting the importance of both factors for executing powerful and accurate smashes. These results suggest that volleyball coaches should focus on developing both leg power and core strength in their training programs. Exercises such as vertical jumps for leg explosiveness and sit-ups for abdominal endurance can enhance players' smash performance by improving both the height of their jumps and the stability required for effective body control during the attack. However, the study had some limitations, including a small sample size and the focus on only two physical components. Future research should involve a larger and more diverse sample to better generalize the findings and consider additional factors like arm strength, flexibility, and aerobic capacity. A more holistic approach would provide a comprehensive understanding of the

physical conditioning needed to improve volleyball performance, offering valuable insights for athletes and coaches alike.

REFERENCE

- Ahsan, M., & Alzahrani, A. (2024). The Effect of the Quadriceps Muscle on Sports Performance and Injury Prevention: Biomechanical Perspective. *Tuijin Jishu/Journal of Propulsion Technology*, October.
- Alisti, S., Fitri, M., Paramitha, S. T., Apriady, H., & Ockta, Y. (2025). Examining the Correlation between Mental Health, Confidence, and Pre-competitive Anxiety among Pencak Silat Athletes: Gender-based Analysis. *International Journal of Human Movement and Sports Sciences*, 13(1), 135–144. <https://doi.org/10.13189/saj.2025.130115>
- Behm, D. G., Konrad, A., Nakamura, M., Alizadeh, S., Culleton, R., Hadjizadeh Anvar, S., Pearson, L. T., Ramirez-Campillo, R., & Sale, D. G. (2024). A narrative review of velocity-based training best practice: the importance of contraction intent versus movement speed. *Applied Physiology, Nutrition, and Metabolism = Physiologie Appliquee, Nutrition et Metabolisme*, 9, 1–9. <https://doi.org/10.1139/apnm-2024-0136>
- Bobula, G., Piech, J., Płonka, A., Król, P., Czarny, W., Pinto, R., Pawlik, D., Rydzik, Ł., & Bajorek, W. (2024). Evaluation of Lower Extremities Power, Movement, Position and Effectiveness in Volleyball. *Applied Sciences (Switzerland)*, 14(21), 1–15. <https://doi.org/10.3390/app142110065>
- Boichuk, R., Iermakov, S., Kovtsun, V., Levkiv, V., Ulizko, V., Kryzhanivskyi, V., Kovtsun, V., & Kazmiruk, A. (2020). Relation of the competitive activity effectiveness of volleyball players (Girls) at the age of 16-18 with the physical development indicators. *Journal of Physical Education and Sport*, 20(2), 615–622. <https://doi.org/10.7752/jpes.2020.02090>
- Frost, R., Nair, P., Aw, S., Gould, R. L., Kharicha, K., Buszewicz, M., & Walters, K. (2020). Supporting frail older people with depression and anxiety: a qualitative study. *Aging and Mental Health*, 24(12), 1977–1984. <https://doi.org/10.1080/13607863.2019.1647132>
- Junpalee, P., Singchainara, J., & Butcharoen, S. (2023). Effects of the intelligence innovative smart ladder drill training program on developing agility of female youth volleyball players at Sriracha School. *Journal of Physical Education and Sport*, 23(4), 1025–1035. <https://doi.org/10.7752/jpes.2023.04128>
- Li, F., Li, S., Zhang, X., & Shan, G. (2023). Biomechanical Insights for Developing Evidence-Based Training Programs: Unveiling the Kinematic Secrets of the Overhead Forehand Smash in Badminton through Novice-Skilled Player Comparison. *Applied Sciences (Switzerland)*, 13(22). <https://doi.org/10.3390/app132212488>
- Nazarudin, M. N., Qin, T. Y., Okilanda, A., Ockta, Y., & Nugraha, R. (2025). Medical observations and injury analysis : All Girls Touch Rugby Championship 2024. *Physical Education and Sports: Studies and Research*, 4(1), 32–45. <https://doi.org/10.56003/pessr.v4i1.495>
- Nur Janah. (2016). Perbedaan Tingkat Keberhasilan Receive Service Bola Float Dan Top Spin Pada Tim Empat Besar Volleyball Women's World Cup 2015. *Jurnal Prestasi Olahraga, Volume V.*

- Oliinyk, I., Doroshenko, E., Melnyk, M., Sushko, R., Tyshchenko, V., & Shamardin, V. (2021). Modern approaches to analysis of technical and tactical actions of skilled volleyball players. *Physical Education Theory and Methodology*, 21(3), 235–243. <https://doi.org/10.17309/TMFV.2021.3.07>
- Ortiz-Padilla, V. E., Ramírez-Moreno, M. A., Presbítero-Espinosa, G., Ramírez-Mendoza, R. A., & Lozoya-Santos, J. de J. (2022). Survey on Video-Based Biomechanics and Biometry Tools for Fracture and Injury Assessment in Sports. *Applied Sciences (Switzerland)*, 12(8). <https://doi.org/10.3390/app12083981>
- Pekas, D., Mačak, D., & Kostić Zobenica, A. (2019). Small-sided games are more effective than instructional training for improving vertical jump performance and passing in young volleyball players. *Exercise and Quality of Life*, 11(1), 13–21. <https://doi.org/10.31382/eqol.190602>
- Pramono, H., Rahayu, T., & Yudhistira, D. (2023). the Effect of Plyometrics Exercise Through Agility Ladder Drill on Improving Physical Abilities of 13–15-Year-Old Volleyball Players. *Physical Education Theory and Methodology*, 23(2), 199–206. <https://doi.org/10.17309/tmfv.2023.2.07>
- Raboin, S. (2024). Visualizing victory: The role of imagery in empowering athletes battling obsessive-compulsive disorder. *Journal of Imagery Research in Sport and Physical Activity*, 19(s1), 1–35. <https://doi.org/10.1515/jirspa-2024-0006>
- Salsabila, A., Fitri, M., Williyanto, S., Apriady, H., & Ockta, Y. (2025). Examining personality traits and mental toughness: a comparative analysis among national and regional tarung derajat athletes. *Jurnal SPORTIF: Jurnal Penelitian Pembelajaran*, 10(4), 63–77.
- Sgrò, F., Barca, M., Mollame, F., Orofino, F., Quinto, A., & Stodden, D. (2024). The Impact of Sport-Specific Practice on Health-Related Physical Fitness Components in Young Water Polo and Volleyball Athletes. *Applied Sciences (Switzerland)*, 14(20). <https://doi.org/10.3390/app14209316>
- Sun, M. (2023). Abdominal Core Strength Training in Female Volleyball Players. *Revista Brasileira de Medicina Do Esporte*, 29, 1–4. https://doi.org/10.1590/1517-8692202329012022_0602
- Tariq Ismael, A. (2024). Analysis of the Relationship between Certain Biokinematic and Goniometric Variables of the Linear Smash with Explosive Force Upwards, Forwards, and in Volleyball Shooting. *Ascarya: Journal of Islamic Science, Culture, and Social Studies*, 4(1), 55–65. <https://doi.org/10.53754/iscs.v4i1.667>
- Wang, X., Soh, K. G., Samsudin, S., Deng, N., Liu, X., Zhao, Y., & Akbar, S. (2023). Effects of high-intensity functional training on physical fitness and sport-specific performance among the athletes: A systematic review with meta-analysis. *PLoS ONE*, 18(12 December), 1–24. <https://doi.org/10.1371/journal.pone.0295531>
- Wubale, A. A., Kebede, D. N., & Mengistie, A. B. (2023). Effects of Game-Based Training Approach on Physical Abilities in Male Youth Volleyball Players. *Pamukkale Journal of Sport Sciences*, 14(2), 206–219. <https://doi.org/10.54141/psbd.1256057>
- Zemková, E. (2022). Strength and Power-Related Measures in Assessing Core Muscle Performance in Sport and Rehabilitation. *Frontiers in Physiology*, 13(May), 1–15. <https://doi.org/10.3389/fphys.2022.861582>