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Arm explosive power, hand–eye coordination, and motor ability in students' badminton lob performance

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ABSTRACT

This study examined the direct and indirect effects of arm muscle explosive power, hand–eye coordination, and motor ability on badminton lob performance among athletes at the UNP Badminton Academy. A quantitative causal-correlational design was employed involving 12 athletes selected through total sampling. Standardized field tests measured all variables, and path analysis was performed after confirming normality, linearity, and multicollinearity assumptions. Arm muscle explosive power ($\beta = 0.393$, $p = 0.020$), hand–eye coordination ($\beta = 0.430$, $p = 0.010$), and motor ability ($\beta = 0.484$, $p = 0.005$) significantly improved lob performance, whereas indirect effects through motor ability were not significant. The model explained 88.7% of the variance in lob performance ($R^2 = 0.887$). Motor ability was the strongest predictor, while physical capacities contributed independently. These findings support integrated evidence-based training emphasizing explosive power, coordination, and motor ability to optimize badminton lob performance.

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Introduction

Badminton is one of the fastest racket sports, requiring athletes to execute technical skills under high movement speed, limited decision-making time, and continuously changing shuttle trajectories (Abebe, 2020; Lisi et al., 2025). Among the essential techniques, the lob stroke is strategically important because it enables players to create recovery time, reposition opponents, and initiate offensive opportunities. Effective lob execution requires the integration of muscular power, neuromuscular coordination, and technical precision rather than technical skill alone (Munajad et al., 2026; Sari & Ahdika, 2023). Consequently, contemporary badminton training increasingly emphasizes evidence-based physical conditioning integrated with sport-specific technical development.

Recent studies have shown that physical and motor capacities substantially influence badminton performance. Upper-body explosive power contributes to racket-head velocity, hand–eye coordination enhances stroke accuracy, and motor ability supports efficient movement execution during rallies (Ali & Siong, 2023; Raj et al., 2021; Shen et al., 2020). Furthermore, integrated training programs combining physical conditioning and technical practice have been reported to improve badminton-specific performance more effectively than isolated training approaches (Salim et al., 2024). These findings indicate that technical performance is determined by the interaction of multiple physical and motor components.

Despite these advances, important research gaps remain. Most previous studies have investigated physical attributes individually and primarily focused on general performance indicators such as smash velocity, agility, or footwork, while limited attention has been given to the determinants of lob performance. In addition, previous investigations have predominantly applied correlation or regression analyses, which only estimate direct relationships and do not adequately explain the mechanisms through which physical capacities jointly influence technical performance (Valldecabres et al., 2017; Wijayanto & Purnama, 2025). Therefore, a more comprehensive analytical approach is required to examine both direct and indirect relationships among these variables.

Another limitation concerns the role of motor ability, which has generally been examined as an independent predictor rather than as a mediating mechanism linking physical capacities to technical performance (Edmizal et al., 2023; Tao & Wang, 2022). Based on ecological dynamics and motor learning theory, technical performance emerges through the interaction of physical, perceptual, and coordinative systems. Accordingly, this study proposes motor ability as a mediating variable and applies path analysis to investigate the structural relationships among arm muscle explosive power, hand–eye coordination, motor ability, and badminton lob performance. This constitutes the principal novelty of the study by providing a multidimensional explanation of badminton technical performance.

This study contributes both theoretically and practically to badminton and sport science research. Theoretically, it extends current knowledge by integrating physical, coordinative, and motor variables within a single causal model. Practically, the findings are expected to guide coaches in designing evidence-based training programs that simultaneously develop explosive power, perceptual-motor coordination, and comprehensive motor ability to improve lob performance. Such integrated training is increasingly recommended in long-term athlete development frameworks because it facilitates the transfer of physical adaptations into sport-specific skills (Al-selmi et al., 2024; Rahayu et al., 2024; Triansyah et al., 2023).

Accordingly, this study aims to analyze the direct and indirect effects of arm muscle explosive power, hand–eye coordination, and motor ability on badminton lob performance among athletes at the UNP Badminton Academy. It is hypothesized that arm muscle explosive power, hand–eye coordination, and motor ability each have significant direct effects on lob performance, while motor ability mediates the relationships between the physical performance variables and technical lob execution.

Method

This study employed a quantitative research design with a causal correlational approach to examine the direct and indirect relationships among arm muscle explosive power, hand–eye coordination, motor ability, and badminton lob performance. A path analysis model was applied to evaluate the structural relationships among the variables, with arm muscle explosive power (X_1) and hand–eye coordination (X_2) as exogenous variables, motor ability (M) as the mediating variable, and lob performance (Y) as the endogenous variable. The study involved 12 athletes from the UNP Badminton Academy who actively participated in regular training. Because the population was limited, total sampling was employed, allowing all eligible athletes to be included and minimizing sampling bias. Although the sample size was relatively small, path analysis was selected because the model contained a limited number of observed variables and was intended to examine the hypothesized direct and indirect relationships within a single structural framework.

Data were collected using standardized and widely adopted field tests with established validity and reliability in sports performance assessment. Arm muscle explosive power was measured using the Seated Medicine Ball Throw, hand–eye coordination using the Hand–Wall Toss Test, motor ability using the Barrow Motor Ability Test (standing broad jump, softball throw, zig-zag run, wall pass, medicine ball put, and 60-yard dash), and badminton lob performance using the French Clear (Lob) Test. All assessments were administered in a standardized sequence by trained assessors under identical testing conditions following a standardized warm-up protocol. Descriptive statistics were calculated prior to hypothesis testing, followed by the Shapiro–Wilk normality test, linearity test, and multicollinearity assessment using tolerance and variance inflation factor (VIF). The proposed structural model was subsequently analyzed using path analysis in SPSS with statistical significance established at $p < 0.05$.

Results and Discussions

This study examined the direct and indirect relationships between arm muscle explosive power (X_1), hand–eye coordination (X_2), motor ability (M), and badminton lob performance (Y) among athletes at the UNP Badminton Academy using path analysis. Prior to hypothesis testing, descriptive statistics and assumption tests were conducted to ensure that the data met the requirements for multivariate analysis. Subsequently, three structural models were evaluated to estimate both direct and mediated effects among the study variables. The findings are presented sequentially in the following tables.

Table 1. Descriptive Statistics of the Research Variables

Variable	n	Mean	SD	Minimum	Maximum
Arm Muscle Explosive Power (X_1)	12	50.00	10.00	34	64
Hand–Eye Coordination (X_2)	12	50.00	10.00	31	62
Motor Ability (M)	12	51.00	5.22	39	59
Lob Performance (Y)	12	50.00	10.00	35	68

Table 1 summarizes the descriptive characteristics of all study variables. Arm muscle explosive power, hand–eye coordination, and lob performance exhibited identical mean scores (50.00), whereas motor ability showed a slightly higher average (51.00) with the lowest variability (SD = 5.22). These results indicate that the participants demonstrated relatively homogeneous motor ability, while greater variation was observed in the physical and technical performance variables. Overall, the descriptive statistics suggest that the dataset adequately represents the performance characteristics of the athletes and provides a suitable basis for subsequent inferential analyses.

Table 2. Results of Assumption Tests

Assumption Test	Result	Interpretation
Normality (Shapiro–Wilk)	p = 0.074–0.820	All variables normally distributed
Linearity	p = 0.177–0.994	Linear relationships confirmed
Multicollinearity	Tolerance = 0.773–0.873; VIF = 1.146–1.294	No multicollinearity detected

The assumption tests demonstrated that all variables fulfilled the statistical requirements for path analysis. The Shapiro–Wilk test produced significance values greater than 0.05 for every variable, indicating normal data distribution. Likewise, all linearity tests were significant ($p > 0.05$), confirming linear associations among the variables. Furthermore, tolerance values exceeded 0.10 and VIF values remained well below 10, demonstrating the absence of multicollinearity among the independent variables. These findings confirm that the regression and path analysis models were statistically appropriate for hypothesis testing.

Table 3. Path Analysis Results

Relationship	β	t	p	Decision
X_1 to Y	0.393	2.903	0.020	Significant
X_2 to Y	0.430	3.368	0.010	Significant
M to Y	0.484	3.795	0.005	Significant
X_1 to M	0.354	1.061	0.316	Not significant
X_2 to M	0.007	0.019	0.985	Not significant
X_1 to X_2	0.361	1.224	0.249	Not significant

The path analysis revealed three statistically significant direct effects on badminton lob performance. Motor ability demonstrated the strongest standardized effect ($\beta = 0.484$, $p = 0.005$), followed by hand–eye coordination ($\beta = 0.430$, $p = 0.010$) and arm muscle explosive power ($\beta = 0.393$, $p = 0.020$). Conversely, arm muscle explosive power did not significantly predict motor ability ($\beta = 0.354$, $p = 0.316$), hand–eye coordination showed no meaningful influence on motor ability ($\beta = 0.007$, $p = 0.985$), and arm muscle explosive power was not significantly associated with hand–eye coordination ($\beta = 0.361$, $p = 0.249$). These findings indicate that the three predictor variables independently contributed to lob performance, whereas the hypothesized mediating pathways through motor ability were not statistically supported.

Table 4. Structural Model Evaluation

Model	R	R^2	Adjusted R^2	Interpretation
Final Structural Model	0.942	0.887	0.844	Excellent model fit

The final structural model demonstrated excellent explanatory power, with a multiple correlation coefficient of R = 0.942 and a coefficient of determination ($R^2 = 0.887$). This indicates that 88.7% of the variance in badminton lob performance was jointly explained by arm muscle explosive power, hand–eye coordination, and motor ability, while only 11.3% of the variance remained attributable to other factors not included in the model.

The high coefficient of determination highlights the substantial contribution of these physical and motor variables in predicting lob performance among UNP Badminton Academy athletes and confirms the robustness of the proposed path model.

To facilitate the interpretation of the structural relationships identified through the path analysis, the final structural model is presented in Figure 1. The figure illustrates the standardized path coefficients among arm muscle explosive power, hand–eye coordination, motor ability, and badminton lob performance. Solid arrows indicate statistically significant direct effects, whereas dashed arrows represent non-significant relationships. The model also displays the coefficient of determination (R^2), demonstrating the proportion of variance in lob performance explained collectively by the predictor variables.

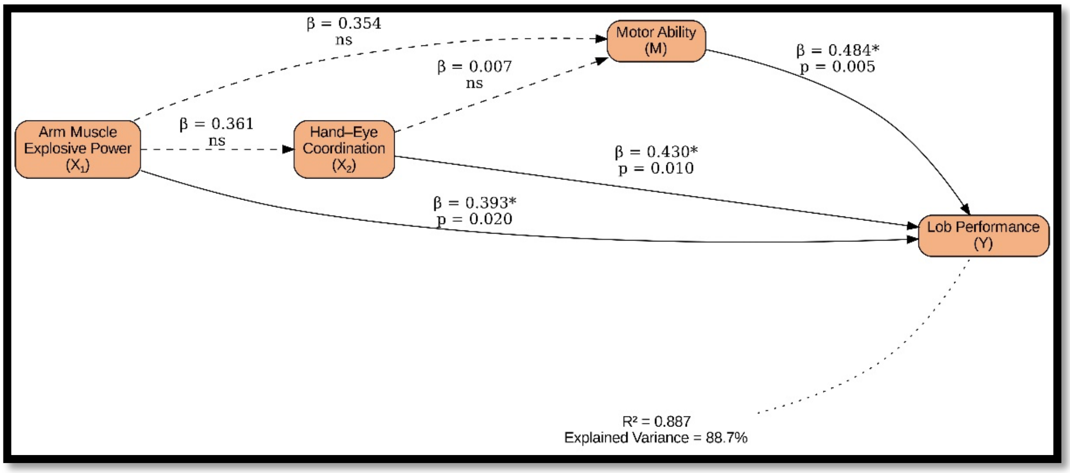

Figure 1. Structural Path Model of Arm Muscle Explosive Power, Hand–Eye Coordination, Motor Ability, and Lob Performance

The present study demonstrates that arm muscle explosive power, hand–eye coordination, and motor ability collectively provide a strong explanation of badminton lob performance, accounting for 88.7% of the variance ($R^2 = 0.887$). This finding indicates that successful lob execution depends on the integration of physical and motor components rather than a single physiological factor. Although the explanatory power is high, the findings should be interpreted cautiously because the study involved only 12 athletes, which may limit model stability and generalizability. The remaining 11.3% of unexplained variance suggests that other factors, including lower-limb explosive power, biomechanics, reaction time, tactical decision-making, psychological readiness, and competitive experience, may also influence lob performance. Overall, these findings reinforce the multidimensional nature of badminton performance, in which physical fitness, neuromuscular coordination, and motor competence interact to determine technical success.

These findings are consistent with previous studies showing that badminton performance is influenced by the interaction of muscular power, movement speed, coordination, and technical proficiency rather than isolated physical capacities (Alvarizi et al., 2026; Yuliawan et al., 2026). Likewise, biomechanical evidence demonstrates that efficient force transfer through the kinetic chain and coordinated neuromuscular control improve stroke consistency during competition, while integrated training combining strength, agility, coordination, and technical practice produces greater performance improvements than single-component programs (Al-Haliq, 2020; ZT et al., 2026). Compared with previous research, this study extends current knowledge by simultaneously evaluating these variables within a structural path model, providing stronger empirical support for ecological motor learning theory, which emphasizes continuous interactions among the performer, task, and environment (Chinara, 2022; Ochor & Amasiatu, 2025; Rajab et al., 2025).

From a theoretical perspective, the principal novelty of this study lies in demonstrating that motor ability ($\beta = 0.484$) contributed more strongly to lob performance than hand–eye coordination ($\beta = 0.430$) and arm muscle explosive power ($\beta = 0.393$). These findings indicate that technical performance is not determined solely by force production but also by the integration of coordinative and motor control processes. This multidimensional perspective provides stronger evidence than previous studies that examined these variables separately and supports the view that technical skills emerge from the interaction of physical, coordinative, and environmental factors during movement execution.

The significant effect of arm muscle explosive power on lob performance ($\beta = 0.393$, $p = 0.020$) confirms that upper-body explosive capacity is an important determinant of effective overhead strokes. Greater explosive power facilitates rapid racket acceleration and efficient force transfer through the kinetic chain, thereby improving shuttle trajectory and stroke depth. However, its contribution was lower than that of motor ability, indicating that explosive strength alone is insufficient to optimize technical performance. These findings are consistent with previous studies reporting that explosive strength improves the rate of force development (Chandra et al., 2023; Wang et al., 2024), while efficient kinetic-chain utilization enhances stroke velocity and accuracy (Pito, 2024; Pratama, 2020). Similarly, plyometric and explosive resistance training have been shown to improve badminton performance by increasing neuromuscular efficiency and sport-specific power production (Gabijan-Bas, 2026; Turna, 2025; Yudiani et al., 2025).

From a practical perspective, the findings suggest that badminton training should integrate motor ability, hand–eye coordination, and arm muscle explosive power within sport-specific practice rather than emphasizing a single physical component. Exercises such as medicine ball drills, plyometric training, coordination exercises, and repetitive lob practice may effectively enhance technical performance (Low et al., 2023; Nurmalisa & Apriani, 2024; Shoukat et al., 2024). These recommendations align with long-term athlete development frameworks advocating integrated resistance, technical, and perceptual-motor training (Mangun & Subarkah, 2024; Rusdiana et al., 2026; Syed Zubir, 2026; Wiyanto et al., 2026). Nevertheless, the small sample size and the absence of significant indirect effects indicate that the proposed model should be interpreted cautiously. Future studies should include larger and more diverse samples while incorporating additional variables, such as lower-limb explosive power, reaction time, biomechanics, and psychological factors, to further explain badminton lob performance.

Conclusions

This study concludes that arm muscle explosive power, hand–eye coordination, and motor ability are significant determinants of badminton lob performance among athletes at the UNP Badminton Academy. Path analysis demonstrated that all three variables exerted significant direct effects on lob performance, with motor ability showing the strongest contribution, followed by hand–eye coordination and arm muscle explosive power. Conversely, the indirect relationships of arm muscle explosive power and hand–eye coordination through motor ability were not statistically significant, indicating that these physical capacities contribute independently rather than through a mediating mechanism. Overall, the structural model explained 88.7% of the variance in lob performance, highlighting the importance of integrating physical conditioning, perceptual-motor coordination, and comprehensive motor ability in badminton training. These findings provide empirical evidence supporting the development of multidimensional, evidence-based training programs to optimize technical performance and enhance competitive achievement in badminton athletes.

References

Abebe, A. G. (2020). Comparison Of The Effects Of Plyometric And Resistance Training On Speed, Agility And Explosive Power: The Case Of Gondar University Regular Sport Science Students.

Al-Haliq, M. (2020). The Effect Of A Training Program Using Speed-Specific Strength Exercises On Sensory-Motor Perception In Learning Stroke Forehand Smash In Badminton Material For Students Of The Hashemite University. International Journal Of Human Movement And Sports Sciences, 8(6), 299–307.

Al-Selmi, A., Haseeb, S., Hasib, N. R., & Razzaq, Z. A. S. A. (2024). How Precision, Strength And Flexibility Affect Badminton Skills. International Journal Of Disabilities Sports And Health Sciences, 7(Special Issue 2): The Second International Scientific Conference: Sports For Health And Sustainable Development,(Shsd, 2024)), 184–191.

Ali, S. K. B. S., & Siong, N. U. (2023). Effectiveness Of A Comprehensive Module In Improving Serving Skills And Lob Shots During Badminton Training. Journal Of Physical Education And Sport, 23(5), 1130–1141. Https://Doi.Org/10.7752/Jpes.2023.05141

Alvarizi, R., Barlian, E., & Edmizal, E. (2026). The Effect Of Shuttlecock Throwing Training On The Clear Shot Ability Of Badminton Players At The Unp Badminton Academy. Jurnal Master Penjas & Olahraga, 7(1), 895–902.

Chandra, S., Sharma, A., Malhotra, N., Rizvi, M. R., & Kumari, S. (2023). Effects Of Plyometric Training On The Agility, Speed, And Explosive Power Of Male Collegiate Badminton Players. Journal Of Lifestyle Medicine, 13(1), 52.

Chinara, A. (2022). Impact Of Eye Exercises Technique In Combination Withcognitivepsycho Motor Training On Visual Reaction Time Amongbadmintonplayers.-An Experimental Study. Absmari.

Edmizal, E., Barlian, E., Sin, T. H., Ahmed, M. A., Nugraha, R., Okilanda, A., Putra, J. A., & Haryanto, J. (2023). Exploring The Interplay: Hand Muscular Power, Hip Flexibility, And Lob Shot Proficiency In

Badminton. Journal Of Physical Education And Sport, 23(12), 3318–3324.

Gabijan-Bas, M. J. (2026). Enhancing Badminton Playing Skills Using Agility Training And Reaction-Time Training. Usfd Journal Of Physical Education Pedagogy & Sports Performance, 2(2), 56–67.

Lisi, R., Colombo, F., Rodano, R., & Frigo, C. A. (2025). Sliding Benchmarks Might Prevent De-Selection Of Talented Badminton Players......... 21-31.

Low, M. J., San Tan, A. L., Chan, E. W. M., & Low, J. Y. (2023). Flywheel Eccentric Overload Training Versus Plyometric Training On Countermovement Jump Parameters, Badminton-Specific Agility And Flexibility Amongst University Badminton Players. Malaysian Journal Of Movement, Health & Exercise, 12(2), 86–94.

Mangun, F. A., & Subarkah, A. (2024). The Effect Of Hand-Eye Coordination And Confidence On Badminton Smash Shot. Gladi: Jurnal Ilmu Keolahragaan, 15(02), 187–198.

Munajad, S. K., Rismayanthi, C., Hermawan, H. A., & Solikhin, M. N. (2026). Effects Of The Battle Shuttlecock Game On Vo2max And Lob Technique In Children Aged 9–12 Years. Pedagogy Of Physical Culture And Sports, 30(1), 24–37. Https://Doi.Org/10.15561/26649837.2026.0103

Nurmalisa, N., & Apriani, L. (2024). Contribution Of Arm Muscle Power And Eye And Hand Coordination To Long Serve Skills In Badminton Players. Indonesian Journal Of Sport Management, 4(3).

Ochor, D. C., & Amasiatu, A. N. (2025). The Impact Of Eye-Hand Coordination On Badminton Skill Mastery Among Undergraduate Sports Science Students At The University Of Port Harcourt. Science, 9, 100077.

Pito, A. R. De C. (2024). Fitness And Sports Performance In Badminton Athletes: Assessment Of Fitness Markers And Their Relationship With Badminton Sports Performance.

Pratama, F. (2020). The Correlation Of Arm Muscle Explosive Power, Leg Muscle Explosive Power, And Hand-Eye Coordination Towards The Smash Of Badminton Player. 1st International Conference Of Physical Education (Icpe 2019), 135–139.

Rahayu, S., Kusuma, Y., Wira, D., & Pratama, R. S. (2024). Effectiveness Of Training Programme Models And Hand-Eye Coordination On The Skills Of Children's Badminton Players. Pakistan Journal Of Life & Social Sciences, 22(2).

Raj, A., Consul, P., & Pal, S. K. (2021). Fast Neural Accumulator (Nac) Based Badminton Video Action Classification. Advances In Intelligent Systems And Computing, 1250 Aisc, 452–467. Https://Doi.Org/10.1007/978-3-030-55180-3_34

Rajab, A., Fahrizal, F., Kamaruddin, I., Adil, A., & Hudain, M. A. (2025). Influence Of Arm Muscle Strength And Concentration On Badminton Long Service Ability In Elementary Schools. Etdc: Indonesian Journal Of Research And Educational Review, 4(2), 349–361.

Rusdiana, A., Komaini, A., Saputra, S. A., Musa, R. M., Ahmad, A., & Subagja, R. A. (2026). Badminton Performance Analysis Of Leg Power, Force And Reaction Time Using A Digital Measurement System. Retos, 78, 319–326.

Salim, M. A., Williamdy, W., & Steven, E. (2024). Ai-Powered Badminton Shot Classification. Proceedings - 2024 2nd International Conference On Technology Innovation And Its Applications, Ictiia 2024. Https://Doi.Org/10.1109/Ictiia61827.2024.10761547

Sari, J. R., & Ahdika, A. (2023). Modeling The Badminton Stroke Pattern Through The Sequential Pattern Discovery Using Equivalent Classes (Spade) Algorithm. Mendel, 29(1), 37–44. Https://Doi.Org/10.13164/Mendel.2023.1.037

Shen, L., Zhang, H., Zhu, M., Zheng, J., & Ren, Y. (2020). Measurement And Performance Evaluation Of Lob Technique Using Aerodynamic Model In Badminton Matches. Advances In Intelligent Systems And Computing, 1028 Aisc, 53–58. Https://Doi.Org/10.1007/978-3-030-35048-2_7

Shoukat, I., Farooqi, S. S. R., & Ul Haq, M. Z. (2024). Outcome Of Plyometric Training On The Performance Of Female Badminton Players Of The Islamia University Of Bahawalpur. Global Regional Review, 9(1), 92–103.

Syed Zubir, S. M. M. (2026). Dose–Response And Modality Effects Of Recreational Badminton Versus Closed Skill Exercise On Physical, Physiological, And Cognitive Outcomes In Older Adults. Universiti Teknologi Mara (Uitm).

Tao, S., & Wang, M. (2022). Stroke Recognition In Badminton Videos Based On Pose Estimation And Temporal Segment Networks Analysis; [结合姿态估计和时序分段网络分析的羽毛球视频动作识别]. Journal Of Image And Graphics, 27(11), 3280–3291. Https://Doi.Org/10.11834/Jig.210407

Triansyah, Y., Suharjana, S., & Rahmatullah, M. I. (2023). The Influence Of Exercise And Coordination Methods Hand Eye Coordination On The Accuracy Of Badminton Service. Advances In Health And Exercise, 3(2), 38–45.

Turna, O. (2025). A Randomized Controlled Study On The Effect Of 8-Week Integrative Neuromuscular Training On Physical Performance And Technical Proficiency In Prepubertal Badminton Players. Acta Gymnica, 55, 1.

Valldecabres, R., De Benito, A.-M., Casal, C. A., & Pablos, C. (2017). 2015 Badminton World Championship: Singles Final Men's Vs Women's Behaviours. Journal Of Human Sport And Exercise, 12(Proc3), 775–788. Https://Doi.Org/10.14198/Jhse.2017.12.Proc3.01

Wang, D., Wang, L., Liu, X., & Fan, H. (2024). A Comparative Study Of Lower Limb Strength During Vertical Jump Of Male College Students In Table Tennis, Badminton And Tennis. J. Men's Health, 1(8).

Wijayanto, I., & Purnama, B. (2025). Application Of Cnn-Lstm In Dynamic Pose Classification In Badminton Using Landmark Tracking. 2025 5th International Conference On Intelligent Cybernetics Technology And Applications, Icicyta 2025, 491–496. Https://Doi.Org/10.1109/Icicyta68677.2025.11362378

Wiyanto, A., Pratama, D. S., & Wantoro, J. (2026). Analysis Of The Physical Performance Of Young Badminton Players Through The Role Of Technology In The Development Of Sustainable Movement. 8th International Conference On Education And Social Science Research (Icesre 2025), 418–429.

Yudiani, W., Ilham, I., Nugraha, U., Saputra, E., & Yuliawan, E. (2025). Effects Of Smash Drill Training And Arm Power On Smash Accuracy And Skill Among Badminton Athletes. Health-Saving Technologies, Rehabilitation And Physical Therapy, 6(1), 29–40.

Yuliawan, D., Lusianti, S., Himawanto, W., Bekti, R. A., & Nurkholis, M. (2026). Determinants Of Badminton Technical Skills: Integrating Physical Conditioning And Motor Skills Through Structural Equation Modeling. Indonesian Journal Of Physical Education And Sport Science, 6(2), 554–565.

Zt, D. O., Adil, A., & Mappanyuki, A. A. (2026). The Influence Of Explosive Power, Flexibility And Self-Confidence On The Smash Skills Of Badminton Athletes At High School. Etdc: Indonesian Journal Of Research And Educational Review, 5(3), 1677–1688.