



HJSE

Holistic Journal of Sport Education

E-ISSN: 2809-9974

<https://journal.uniga.ac.id/index.php/penjas>

DOI: 10.52434/penjas.v5i2.44342



LEG POWER AND SMASH PERFORMANCE IN CLUB BADMINTON ATHLETES

*Rian Hidayatulloh^{1-ABCDE}, Muhammad Husni Tamim^{1-ABC}, Jumesam^{1-CD}, Mahfuz^{1-D}, Hariadi^{1-D}

¹Physical Education Study Program, Faculty of Education, Universitas Hamzanwadi, Indonesia

Keywords:

badminton,
vertical jump,
lower-limb power,
smash
performance,
correlational study

Abstract

This study examined the association between vertical-jump performance and smash-test scores among badminton athletes from PB Al Bustan Kelayu Utara. A cross-sectional correlational design involved 12 purposively selected active male athletes. Vertical-jump height represented lower-limb explosive performance, while a target-based smash test assessed smash outcomes. Data were summarized descriptively and analyzed using Pearson correlation at the 5% significance level. Vertical-jump and smash-test scores showed a strong positive correlation. The association was statistically significant, although its confidence interval was wide because of the small sample. Athletes with better vertical-jump scores tended to achieve higher smash-test scores. The finding supports monitoring lower-limb explosive performance alongside badminton technique, but it does not show that leg power alone causes superior smash performance.

Received: April 13,
2026

Accepted: June
16, 2026

Published: June 30,
2026

Authors' contribution:

A - Conception and design of the study; B - Acquisition of data; C - Analysis and interpretation of data; D - Manuscript preparation; E - Obtaining funding

Correspondence:

Rian Hidayatulloh

Email: rianhidayatulloh.220104114@student.hamzanwadi.ac.id



INTRODUCTION

The badminton smash is an attacking stroke intended to reduce the opponent's reaction time through high shuttlecock velocity and a steep trajectory. Its execution is a whole-body action that combines court positioning, lower-limb movement, trunk rotation, upper-limb sequencing, racket acceleration, and accurate shuttlecock contact. The jump smash adds a take-off and landing task, allowing the player to contact the shuttlecock from a higher position while maintaining control of direction and timing.

Modern biomechanical evidence shows that smash performance cannot be explained by one physical attribute. Among elite male players, faster shuttlecock speed was associated with shoulder and elbow positioning at contact, while vertical ground-reaction force and rate of force development were not significantly correlated with shuttlecock speed (Yeap et al., 2021). Impact location on the racket



face explains meaningful variation in shuttlecock speed and direction (Towler et al., 2020), and racket moment of inertia alters racket-head speed without necessarily changing shuttlecock speed (Towler et al., 2023). Technique, equipment, and contact quality therefore influence the outcome alongside physical capacity.

Lower-limb explosive ability remains relevant because the jump smash requires rapid force production during take-off and stable control during landing. Jump height can change contact height, smash angle, and the movement demands that follow the stroke (Yeap et al., 2026). Fatigue also reduces vertical-jump performance in young badminton players (Cheng et al., 2025). Plyometric interventions have improved jump height, agility, or jumping-smash outcomes in several badminton samples (Chandra et al., 2023; Syahriadi, 2020; Hidayat et al., 2025). These studies support lower-body training but do not establish that a field vertical-jump score directly determines smash accuracy.

PB Al Bustan Kelayu Utara coaches observed that some athletes produced smashes that were insufficiently steep or difficult for opponents to return. A practical question was whether athletes who performed better in a vertical-jump test also obtained better scores on a target-based smash test. Evidence on this association in small Indonesian club settings remains limited. The present study therefore examined the direction and magnitude of the relationship between vertical-jump performance and smash-test scores. A positive association was expected.

METHOD

Design and Participants

A quantitative cross-sectional correlational design was used. The population comprised active athletes at PB Al Bustan Kelayu Utara. Twelve active male athletes who agreed to complete all testing were selected purposively. The source manuscript did not report age, training experience, anthropometry, playing level, injury status, or an a priori sample-size calculation. These characteristics should be added before submission because they affect generalizability and statistical precision.

Vertical-Jump Test

Lower-limb explosive performance was assessed with a standing vertical-jump test. Standing reach height was recorded first; the athlete then jumped vertically and touched at the highest reachable point. Jump height was calculated as the difference between jump reach and standing reach. The manuscript labels this measure as leg-muscle power, although jump height is not a direct measure of mechanical power unless body mass and time-related variables are incorporated. The outcome is therefore described here as vertical-jump performance.

Smash-Performance Test

Smash performance was evaluated by directing shuttlecocks toward marked target areas on the opposite court. Target zones were weighted according to the

presumed difficulty of return, and successful attempts contributed to a total score. The source document does not state the number of trials, feeding procedure, target dimensions, scoring values, rest interval, test–retest reliability, or whether athletes used standing or jump smashes. These protocol details are essential for replication and should be recovered from the original test manual.

Statistical Analysis

Means summarized each outcome. Shapiro–Wilk tests were reported for vertical-jump and smash scores. The association was evaluated using Pearson's product–moment correlation at $\alpha = .05$. The significance of r was recalculated with $n - 2$ degrees of freedom, and a 95% confidence interval was calculated using Fisher's z transformation. The squared correlation is reported as shared variance, not as a causal contribution. Raw participant-level data and standard deviations were unavailable, preventing graphical inspection, outlier analysis, and independent verification.

RESULTS

The 12 athletes had a mean vertical-jump score of 82.66 and a mean smash-test score of 13.33. Standard deviations and observed ranges were not available. Shapiro–Wilk significance values were .473 for vertical-jump performance and .516 for smash performance (Table 1). With only 12 observations, however, these tests have limited sensitivity; scatterplot linearity and influential observations could not be checked without raw data.

Table 1.
Descriptive and distributional information

Variable	n	Mean	Shapiro–Wilk p
Vertical-jump performance	12	82.66	.473
Smash-test score	12	13.33	.516

Vertical-jump performance was positively correlated with smash-test score, $r = .780$. Recalculation from r and n produced $t(10) = 3.942$, $p = .003$. The 95% confidence interval for r ranged from .373 to .935. The squared correlation was .608, indicating that 60.84% of the observed variance was shared by the two measures in this sample (Table 2).

Table 2.
Pearson correlation between vertical-jump and smash-test scores

Association	n	r	95% CI	t (df)	p	r ²
Vertical jump–smash score	12	.780	.373–.935	3.942 (10)	.003	.608

DISCUSSION

Athletes with higher vertical-jump scores tended to obtain higher target-based smash scores. The point estimate was strong, although the confidence interval extended from a moderate to a very strong positive association. This uncertainty is important: a sample of 12 can produce an unstable correlation, particularly if one or two observations are influential. The result should therefore be viewed as preliminary evidence from one club.

The association is mechanically plausible for a jump smash. A higher take-off may increase contact height and create more options for a steep downward trajectory. Recent work has directly examined how jump height relates to smash and landing characteristics, emphasizing that take-off influences both stroke context and subsequent movement (Yeap et al., 2026). Training studies also show that plyometric programs can increase lower-limb explosive performance and jumping-smash outcomes (Syahriadi, 2020; Hidayat et al., 2025). Chandra et al. (2023) reported improved agility, speed, and explosive power after plyometric training in male collegiate badminton players. These findings support lower-body development as part of preparation.

Nevertheless, the present correlation should not be interpreted as proof that leg power causes 60.84% of smash ability. The r^2 value describes shared variation in this sample and does not separate direction of effect, technique, experience, body size, or other confounders. Elite-biomechanics research found that shuttlecock speed was more closely related to upper-limb configuration at impact than to vertical ground-reaction force or rate of force development (Yeap et al., 2021). Impact location on the racket face can explain a substantial proportion of speed variation (Towler et al., 2020), while racket inertia changes racket-head mechanics (Towler et al., 2023). The club's smash test may also reward accuracy and placement more than shuttlecock speed.

The vertical-jump test introduces another interpretive limitation. Jump height reflects the integrated outcome of force, impulse, technique, body mass, and flight mechanics; it is not itself mechanical power. Calling the score 'leg-muscle power' may overstate what was measured. Future studies should use a force platform or validated jump-power equation when power is the intended construct, and should distinguish standing vertical jump, countermovement jump, and badminton-specific take-off. Likewise, smash assessment should separately quantify accuracy, shuttlecock velocity, contact height, and angle.

For coaches, the result supports monitoring vertical-jump capacity, but training decisions should remain multidimensional. Lower-body plyometrics, strength, and landing control can be combined with approach timing, trunk rotation, upper-limb sequencing, racket-face control, and target practice. Fatigue monitoring is also relevant because fatigue can reduce jump height and alter movement

acceleration in badminton players (Cheng et al., 2025). A player with a high jump but inconsistent contact may not produce an effective smash, while a technically skilled player may score well without exceptional jump height.

The main limitations were the small purposive sample, single-club setting, missing participant characteristics, and incomplete test documentation. No raw data or scatterplot was available to assess linearity, bivariate outliers, or homoscedasticity. The use of a target score means findings cannot be generalized directly to shuttlecock velocity. Future research should recruit a larger, multi-club sample; prespecify sample size; report test reliability; retain participant-level data; and model vertical-jump performance together with technique, anthropometry, training experience, upper-limb strength, racket characteristics, and smash kinematics.

CONCLUSION

Vertical-jump performance was strongly and positively associated with smash-test scores among 12 male athletes from PB Al Bustan Kelayu Utara. The recalculated analysis yielded $r = .780$, $t(10) = 3.942$, $p = .003$, with a 95% confidence interval from .373 to .935. The finding supports lower-limb explosive performance as one relevant characteristic, but it does not establish causation or show that leg power alone determines smash quality. Coaches should integrate lower-body development with technical, coordinative, and racket-contact training.

ACKNOWLEDGMENTS

The authors thank the athletes and coaches of PB Al Bustan Kelayu Utara for their participation and support.

REFERENCES

- Bhosale, N., Yeole, U., & Chavarkar, M. (2020). Effect of plyometric training on jumping performance and agility in badminton players. *Indian Journal of Public Health Research & Development*, 11(6), 532–537. <https://doi.org/10.37506/ijphrd.v11i6.10594>
- 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), 52–58. <https://doi.org/10.15280/jlm.2023.13.1.52>
- Cheng, K.-C., Chiu, Y.-L., Tsai, C.-L., Hsu, Y.-L., & Tsai, Y.-J. (2025). Fatigue affects body acceleration during vertical jumping and agility tasks in elite young badminton players. *Sports Health*, 17(1), 126–134. <https://doi.org/10.1177/19417381241245908>
- Efendi, R. M., Yono, T., & Sulaiman, A. (2025). The effect of plyometric depth jump on students' jumping smash ability in badminton. *Gladi*, 16(4), 561–568. <https://doi.org/10.21009/gjik.164.08>
- Hamzah, I. A., Adi, S., & Andiana, O. (2020). Pengaruh latihan plyometric depth jump dengan diiringi musik terhadap peningkatan power otot tungkai di UKM

- badminton Universitas Negeri Malang. *Majalah Ilmiah Olahraga*, 26(2). <https://doi.org/10.21831/majora.v26i2.34012>
- Hidayat, T., Munandar, R. A., Zulfikar, I., & Kurniawan, Y. (2025). Pengaruh metode latihan plyometric terhadap kemampuan jumping smash pada atlet Porprov bulu tangkis dengan penerapan sport science. *Jurnal Pendidikan Olahraga*, 15(3). <https://doi.org/10.37630/jpo.v15i3.2745>
- Kharisma, B., & Indarto, P. (2023). Latihan plyometric sebagai sarana perubahan lompatan pemain bulutangkis. *Jurnal Ilmiah Adiraga*, 9(2), 53–66. <https://doi.org/10.36456/adiraga.v9i2.8146>
- Pan, H. (2024). A study of racket weight adaptation in advanced and beginner badminton players. *Applied Bionics and Biomechanics*, 2024, 8908294. <https://doi.org/10.1155/2024/8908294>
- Phomsoupha, M., Ibrahim, S., & Laffaye, G. (2024). Badminton racket deflection: Comparison between rigid versus flexible according to different strokes. *International Journal of Racket Sports Science*. <https://doi.org/10.30827/ijrss.33203>
- Putra, V. G. V., Mohamad, J. N., & Irwan. (2024). A novel mathematical model of the badminton smash: Simulation and modeling in biomechanics. *Computer Methods in Biomechanics and Biomedical Engineering*, 27(4). <https://doi.org/10.1080/10255842.2023.2190439>
- Syahriadi. (2020). Latihan pliometrik dan latihan berbeban terhadap jumping smash atlet bulutangkis. *Gelanggang Olahraga*, 3(2), 133–142. <https://doi.org/10.31539/jpjo.v3i2.1048>
- Towler, H., Felton, P. J., McErlain-Naylor, S. A., & King, M. A. (2020). Effect of racket–shuttlecock impact location on shot outcome for badminton smashes by elite players. *Journal of Sports Sciences*, 38(21). <https://doi.org/10.1080/02640414.2020.1792132>
- Towler, H., Mitchell, S. R., & King, M. A. (2023). Effects of racket moment of inertia on racket head speed, impact location and shuttlecock speed during the badminton smash. *Scientific Reports*, 13, 14060. <https://doi.org/10.1038/s41598-023-37108-x>
- Winata, B., Brochhagen, J., Apriantono, T., & Hoppe, M. W. (2025). Match-play data according to playing categories in badminton: A systematic review. *Frontiers in Sports and Active Living*, 7, 1466778. <https://doi.org/10.3389/fspor.2025.1466778>
- Yeap, M. W., Towler, H., Goh, S. L., Ramasamy, Y., & King, M. A. (2021). Kinetic and kinematic determinants of shuttlecock speed in the forehand jump smash performed by elite male Malaysian badminton players. *Sports Biomechanics*, 23(5), 582–597. <https://doi.org/10.1080/14763141.2021.1877336>
- Yeap, M. W., Towler, H., Ramasamy, Y., & King, M. A. (2026). The importance of jump height for the badminton smash and subsequent landing movement pattern. *International Journal of Racket Sports Science*. <https://doi.org/10.30827/ijrss.36981>