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The Relationship Between Leg Muscle Power, Coordination, and Balance on Shooting Skills of Soccer Players

Rama Yudha Pratama[1], Sulistiyono[2]

[1,2] Department of Sport Science, Yogyakarta State University, Yogyakarta Indonesia

ABSTRACT: This study aimed to examine the relationship between leg muscle power, eye–foot coordination, and balance with the shooting skills of soccer players, both individually and simultaneously. A quantitative correlational research design was employed. The population consisted of 250 soccer players registered in Soccer Schools (SSB) across Sleman Regency. Using purposive sampling, 80 male players aged 12–17 years were selected based on the criteria of being actively involved in training, physically healthy and injury-free during data collection, and having experience in official competitions. Leg muscle power was assessed using the Standing Broad Jump Test, eye–foot coordination using the Soccer Eye–Foot Coordination Test, balance using the Stork Stand Test, and shooting skills using a shooting accuracy test. Data were analyzed using multiple regression analysis. The results indicated a significant relationship between leg muscle power and shooting skills ($r = 0.632$, $p < 0.05$), contributing 10.03% to shooting performance. Eye–foot coordination also showed a significant relationship with shooting skills ($r = 0.849$, $p < 0.05$), with a contribution of 21.81%. Balance demonstrated the strongest relationship with shooting skills ($r = 0.876$, $p < 0.05$), contributing 47.46%. Furthermore, leg muscle power, coordination, and balance simultaneously showed a significant relationship with shooting skills ($F = 101.789$, $p < 0.05$), accounting for a total contribution of 79.30%.

KEYWORDS: Leg Muscle Power, Coordination, Balance, Shooting Skill

INTRODUCTION

Soccer is one of the most popular team sports worldwide and plays a crucial role in sports development, physical education, and youth character formation. Beyond competitive achievement, soccer serves as an educational medium that promotes discipline, cooperation, responsibility, and the development of motor and cognitive abilities. Team performance is not solely determined by tactical strategies but also depends heavily on individual players' mastery of fundamental technical skills, including passing, dribbling, ball control, and shooting (Ji et al., 2023; Cao, 2024; Farizan & Soon, 2023).

Among these skills, shooting is particularly important because it directly determines goal scoring and match outcomes. Shooting accuracy is therefore widely used as a key indicator of player performance. Shooting is a complex motor skill that requires the integration of neuromuscular coordination, postural stability, and psychological control during execution (Shimotashiro & Shinya, 2024; Afrizal & Soniawan, 2021). From a biomechanical perspective, effective shooting relies more on leg muscle power than maximal strength, as the kicking action demands rapid and explosive force production within a very short time frame. Previous studies have shown that leg muscle power significantly contributes to kicking performance, although its relationship with shooting accuracy remains less consistently reported (Mohendra et al., 2024).

In addition to leg muscle power, eye–foot coordination is essential for synchronizing visual perception with precise motor execution, enabling accurate timing, ball contact, and directional control (Saleh, 2024; Setiawan & Jatra, 2025). Balance also plays a vital role, as shooting is performed while the body is supported on one leg, requiring both static and dynamic postural control to maintain stability and consistency of ball direction (Zemková & Zapletalová, 2022; Sujadesman, 2025).

Observations in youth soccer schools (SSB) in Sleman Regency indicate that although many players demonstrate good general physical fitness, shooting accuracy and consistency remain relatively low. This condition suggests a gap between physical conditioning and technical performance, which may be influenced by training programs that emphasize repetition rather than evidence-based integration of power, coordination, and balance. Therefore, examining the relationships among leg muscle power, coordination, balance, and shooting skills is essential to provide empirical evidence for developing more effective and scientifically grounded youth soccer training programs.

METHOD

This study employed a quantitative descriptive design with a correlational approach to examine the relationships between leg muscle power, eye–foot coordination, balance, and shooting skills among youth soccer players. The population consisted of all soccer players enrolled in Soccer Schools (SSB) in Sleman Regency. A purposive sampling technique was applied based on the following inclusion criteria: male players aged 12–17 years, actively training at SSB, physically healthy, injury-free during data collection, and having prior experience in official competitions. A total of 80 players met these criteria and were selected as the sample.

Instruments (1) Leg Muscle Power – Assessed using the Standing Broad Jump Test, which measures explosive lower-limb power. (2) Eye–Foot Coordination – Evaluated using the Soccer Eye–Foot Coordination Test, assessing the integration of visual perception and motor execution. (3) Balance – Measured using the Stork Stand Test, which evaluates both static and dynamic postural stability. (4) Shooting Skill – Assessed via a shooting accuracy test, focusing on the precision of ball placement toward target zones. All instruments were validated through expert review by experienced soccer coaches and sport scientists. Reliability was determined using a pilot test on 10 players, yielding Cronbach's alpha values above 0.80 for all measures, indicating high internal consistency. Collected data were analyzed using multiple linear regression to determine the individual and combined contributions of leg muscle power, coordination, and balance to shooting performance. Statistical significance was set at $p < 0.05$. This study was conducted following ethical guidelines for human research. Written informed consent was obtained from all participants and their parents or guardians. Participants were informed of their right to withdraw at any time, and confidentiality of data was strictly maintained.

RESULT

The descriptive statistics of leg muscle power, coordination, balance, and shooting skills of soccer players aged 13–17 years at Soccer Schools (SSB) in Sleman Regency are presented in Table 1.

Table 1. Descriptive Statistics

Statistic	Leg Muscle Power	Coordination	Balance	Shooting Skills
N	80	80	80	80
Mean	144.50	11.90	38.83	10.70
Median	145.50	10.00	30.52	11.00
Mode	147.00	9.00	29.16	11.00
Std. Deviation	15.24	4.76	19.03	3.13
Minimum	111.00	6.00	11.31	4.00
Maximum	177.00	25.00	99.41	17.00

The results indicate that the average leg muscle power among participants was 144.50 cm, with a standard deviation of 15.24, suggesting moderate variability. Coordination scores averaged 11.90, with a relatively wide range from 6 to 25, indicating diverse coordination abilities among players. Balance showed a mean of 38.83 with the largest variability (SD = 19.03), reflecting substantial differences in postural control within the group. Shooting skills had a mean of 10.70 out of the maximum observed score of 17, with a standard deviation of 3.13, suggesting that while some players demonstrated high accuracy, others had considerable room for improvement. Overall, these descriptive statistics provide a preliminary overview of the physical and technical profiles of youth soccer players in Sleman, highlighting the variation in power, coordination, balance, and shooting performance, which may influence subsequent correlation and regression analyses.

Normality Test

The normality of the data was assessed using the Kolmogorov-Smirnov test, as shown in Table 2.

Table 2. Kolmogorov-Smirnov Normality Test

		Unstandardized Residual
N		80
Normal Parameters[a]	*Mean*	,0000000
	Std. Deviation	1,39803185
Most Extreme Differences	*Absolute*	,095
	Positive	,063
	Negative	-,095
Kolmogorov-Smirnov Z		0,095
Asymp. Sig. (2-tailed)		0,071

The results indicate that the residuals are normally distributed, as the Asymp. Sig. value (0.071) is greater than 0.05. This suggests that the assumption of normality for multiple regression analysis is satisfied.

Linearity Test

Linearity between independent and dependent variables was examined, and the results are presented in Table 3.

Table 3. Linearity Test

Dependent – Independent Variables	Sig. Deviation from Linearity
Shooting Skills (Y) * Leg Muscle Power (X1)	0.453
Shooting Skills (Y) * Coordination (X2)	0.200
Shooting Skills (Y) * Balance (X3)	0.063

The linearity test results indicate that the relationships between shooting skills and each independent variable—leg muscle power, coordination, and balance—are linear, as all significance values are greater than 0.05. This confirms that the data meet the linearity assumption required for multiple regression analysis.

Hypothesis Test Results

The results of the partial correlation analysis are presented in Table 4.

Table 4. Partial Correlation Test

Variable	r Value	Sig.
Leg Muscle Power (X1)	0.632	0.013
Coordination (X2)	0.849	0.039
Balance (X3)	0.876	0.000

The analysis indicates the following:

1) Leg Muscle Power (X1) and Shooting Skills: The correlation coefficient (r = 0.632) is greater than the critical value (r-table = 0.219) with a p-value of 0.013 (< 0.05), indicating a significant positive relationship. This means that higher leg muscle power is associated with better shooting skills among soccer players aged 13–17 years in SSBs in Sleman Regency.
2) Coordination (X2) and Shooting Skills: The correlation coefficient (r = 0.849) exceeds r-table (0.219) with a p-value of 0.039 (< 0.05), indicating a significant positive relationship. Better coordination corresponds to improved shooting skills.
3) Balance (X3) and Shooting Skills: The correlation coefficient (r = 0.876) is greater than r-table (0.219) with a p-value of 0.000 (< 0.05), also indicating a significant positive relationship. Improved balance is strongly associated with enhanced shooting skills.

The simultaneous influence of leg muscle power, coordination, and balance on shooting skills was examined using an F-test, as shown in Table 5.

Tabel 5. Simultaneous F-Test

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	620.395	3	206.798	101.789	0.000
Residual	154.405	76	2.032		
Total	774.800	79			

The F-value (F = 101.789) exceeds the F-table value (2.72) with a significance level of 0.000 (< 0.05), confirming that the regression model is statistically significant. This indicates that leg muscle power, coordination, and balance jointly influence shooting skills and the model can be used to predict shooting performance. The coefficient of determination (Adjusted R^2) is 0.793, indicating that 79.30% of the variance in shooting skills is explained by the three independent variables, while 20.70% is attributed to other factors outside this study. Individually, leg muscle power contributes 10.03% (relative contribution 12.65%), coordination contributes 21.81% (relative contribution 27.50%), and balance contributes most dominantly with 47.46% (relative contribution 59.85%). These results demonstrate that all three variables significantly explain variations in shooting skills among youth soccer players in Sleman Regency.

DISCUSSION

1) Relationship between Leg Muscle Power and Shooting Skills

The present study demonstrated a significant relationship between leg muscle power and shooting skills among soccer players in SSBs in Sleman Regency. A correlation coefficient of 0.632, exceeding the critical value of 0.219, indicates a moderately strong association, suggesting that improvements in lower-limb explosive strength are accompanied by enhancements in shooting performance. These findings underscore the conceptual understanding that the ability to generate force explosively is a fundamental component of effective shooting technique.

This result aligns with Zhang et al. (2023), who highlighted that the rapid contraction of muscles to generate high force in a short duration is crucial for movement quality in sports. In shooting, rapid force transfer from the lower limb to the ball is essential, and higher power enables players to maximize this transfer within the brief contact period. Previous studies by Rusli (2025), Burhaein et al. (2020), and Adi & Wijaya (2025) similarly reported positive correlations between lower-limb power and shooting performance across various age groups. Başkaya et al. (2024) found that explosive leg strength directly affects kick speed and power in adolescent players.

The contribution of leg muscle power to shooting skills, measured at 10.03%, indicates a tangible yet non-dominant effect, explaining approximately one-tenth of the variance in shooting ability. Ramadhana et al. (2023) reported that players with higher explosive capabilities generate faster ball speeds due to accelerated leg action. Biomechanically, the shooting motion involves phases such as backswing, synergistic muscle contraction, and follow-through, engaging quadriceps, hamstrings, gluteus maximus, and gastrocnemius muscles simultaneously. Lees et al. (2022) emphasized that maximal impulse generated during these phases determines the momentum transferred to the ball.

However, shooting performance is not solely dependent on leg power. Hernandez-Martinez et al. (2025) highlighted that coordination, balance, core stability, and technical control critically influence shot accuracy. While power enhances ball speed, accuracy depends on the control of body position, foot placement, and limb trajectory. This implies that power development should be integrated with other components to optimize overall shooting performance.

The observed correlation suggests that leg muscle power may be particularly impactful for youth players in developmental stages, as neuromuscular adaptations occur more rapidly. Zabaloy et al. (2022) noted that physical variability is higher among younger athletes, and enhancements in power often translate into improved technical skills such as shooting. Supporting evidence from Ramirez-Campillo et al. (2023) indicates that plyometric training enhances kick speed through the stretch-shortening cycle, highlighting the importance of explosive training in technical skill development.

Despite its significance, leg power accounts for only 10.03% of shooting performance variation, with the remaining 89.97% influenced by factors such as balance, visuomotor coordination, technical consistency, focus, and playing experience (Ramadhana et al., 2023). Training programs should, therefore, adopt a multidimensional approach combining strength, plyometric, and technical drills (Oliver et al., 2023; Sinulingga et al., 2025), progressing intensity cautiously to prevent injury (Hernandez-Martinez et al., 2024). Future research could benefit from more specific measurement tools, such as motion analysis or ball-speed sensors, to accurately capture shooting-related leg power (Lees et al., 2022).

2) Relationship between Coordination and Shooting Skills

The study revealed a very strong correlation between coordination and shooting skills ($r = 0.849$, $p = 0.039$), indicating that coordinative ability is a primary determinant of shot accuracy. Coordination regulates the sequence, rhythm, and timing of hip, knee, and ankle joint activations, allowing complex movements to be executed as stable kick patterns. Hunter et al. (2022) confirmed that lower-limb motor control predicts successful kicking performance in youth players.

Previous research (Burhaein et al., 2020; Ridwan & Putra, 2021; Mohendra et al., 2024) similarly found strong positive relationships between coordination and shooting performance. Biomechanically, segmental coordination facilitates optimal energy transfer from the hip and thigh to the lower leg, enhancing control over ball speed and direction (Zhang et al., 2025). Ecological dynamics perspectives further emphasize that coordination emerges adaptively from interactions among player, task, and environment, with game-based training proving particularly effective (Seifert et al., 2022).

The 21.81% contribution of coordination to shooting variation highlights its substantial role. Machine learning analyses of fundamental movement skills have similarly identified coordination as a critical predictor of technical ability (Duncan et al., 2024). Interventions combining plyometric and technical drills enhance timing and rhythm, minimizing postural variability and improving shot stability (Shimotashiro & Shinya, 2024). Proper measurement instruments, such as foot-eye coordination tests, are recommended to accurately assess this variable (Veira et al., 2017; Camata et al., 2025). Training programs should include ladder drills, small-sided games, and variable shooting drills to develop functional coordination. Game-based and ecological training

approaches have been shown to improve shooting skills more effectively than isolated technical practice (Carlsson et al., 2025; Gilson et al., 2025).

3) Relationship between Balance and Shooting Skills

The correlation between balance and shooting skills (r = 0.876) and its 47.46% contribution demonstrate that postural stability is a critical determinant of successful kick execution. Approximately half of the variance in shooting skills can be attributed to the ability to maintain postural control. Previous studies (Ramadhana et al., 2023; Ridwan & Putra, 2021; Haryadi et al., 2024) support this finding, reporting higher accuracy and lower movement variability among players with superior balance.

Mechanistically, balance ensures continuity across movement phases, from approach to plant foot placement and ball contact. Disrupted balance leads to inconsistent limb trajectories and ball contact points, negatively affecting shot accuracy (Zemková & Zapletalová, 2022). Cross-sport comparisons suggest soccer players develop efficient postural strategies, enabling rapid, explosive movements while maintaining shooting precision (Lauenroth et al., 2023). Dynamic balance is particularly influential during the transition from plant foot to swing leg (Henni et al., 2020). Anticipatory postural adjustments (APA) also contribute to preparation for explosive movements, allowing for more stable and accurate kicks (Pau et al., 2021).

Balance training interventions, such as FIFA 11+, single-leg stance, dynamic balance drills, Bosu-ball exercises, and perturbed shooting, have demonstrated improvements in neuromuscular integration and technical performance. Ecological dynamics approaches further suggest that situationally varied drills enhance adaptive postural coordination under game-like pressures.

4) Combined Effects of Leg Muscle Power, Coordination, and Balance on Shooting Skills

Simultaneous analysis revealed that leg muscle power, coordination, and balance collectively have a significant effect on shooting skills ($F = 101.789 > F\text{-table } 2.72$, $p < 0.05$), explaining 79.30% of performance variance. This indicates that these three physical-motor variables operate synergistically as an integrated system rather than independently.

Leg power provides mechanical energy, coordination ensures efficient energy transfer, and balance maintains postural stability. Biomechanically, this integration optimizes momentum transfer from the center of mass to the swinging leg, affecting ball speed, accuracy, and movement consistency. Studies by Nunome et al. (2025), Rodríguez-Lorenzo et al. (2018), Cheen et al. (2024), Meylan et al. (2022), and Zemková & Zapletalová (2022) corroborate that power, coordination, and balance collectively influence shooting performance.

Practically, these findings emphasize the necessity of integrative training programs combining plyometrics, coordination drills, and dynamic balance exercises. Drills incorporating game-like conditions and perturbations optimize skill transfer, ensuring that improvements in one component complement others. Despite the strong correlations observed, the correlational design limits causal inference; experimental longitudinal studies are recommended to further examine the effects of systematic training on youth shooting performance.

CONCLUSIONS

Based on the results of the present study, the following conclusions can be drawn regarding the relationship between leg muscle power, coordination, balance, and shooting skills among adolescent soccer players in SSBs in Sleman Regency:

1) There is a significant positive correlation between leg muscle power and shooting skills ($r = 0.632$, $p < 0.05$). Players with higher lower-limb explosive strength tend to execute faster and more powerful kicks. Leg muscle power contributes 10.03% to the variance in shooting performance, highlighting its role as a fundamental but not dominant factor in skill execution.
2) Coordination exhibits a very strong positive relationship with shooting skills ($r = 0.849$, $p < 0.05$) and contributes 21.81% to performance variation. This indicates that the ability to synchronize joint movements and maintain precise motor control is critical for achieving accurate and stable shots.
3) Balance has the strongest influence on shooting skills, with a correlation coefficient of $r = 0.876$ and a contribution of 47.46%. Effective postural control enables players to maintain stability during the kicking motion, ensuring consistent technique, accurate ball direction, and optimal force transfer.
4) Leg muscle power, coordination, and balance together explain 79.30% of the variance in shooting skills. This demonstrates that shooting is a complex, multi-segment skill requiring the integrated function of strength, motor coordination, and postural stability. These three components interact synergistically to determine overall performance.

Practical Implications: For youth soccer development, training programs should adopt an integrative approach that simultaneously develops leg muscle power, coordination, and balance. Plyometric exercises, coordination drills, dynamic balance training, and game-based shooting drills are recommended to enhance the efficiency, precision, and consistency of shooting skills.

Overall, this study confirms that physical-motor components are essential determinants of shooting performance in adolescent soccer players, and their integrated development is crucial for optimizing technical execution.

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