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ORIGINAL ARTICLE

Kicking power by position: Investigating the relationship between leg strength and ball velocity in soccer

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ABSTRACT

Soccer is a globally popular Olympic sport. The aim of this study was to investigate the relationship between kicking velocity and leg power among soccer players across different playing positions. A total of thirty (30) male soccer players, classified into defenders, midfielders, and forwards participated in the study. Leg power was assessed using the vertical jump test, while kicking velocity was measured using a radar gun during standardized kicking trials. The mean leg power of forward groups was 57.7 kg-m/sec and ball velocity is 98.3 km/h; mean leg power of midfielder groups is 55.1 kg-m/sec and ball velocity is 92.2 km/h; mean leg power of defender groups is 56.5 kg-m/sec and ball velocity is 97.4 km/h. The finding revealed a significant positive correlation between leg power and kicking velocity ($p < .05$), with forwards and defenders exhibiting higher values compared to midfielders. These findings highlight the role of leg power in contributing to effective kicking performance and suggest that positional demands in soccer influence the development of these physical attributes. Understanding these relationships can inform position-specific training programs to enhance player performance.

Keywords: Performance analysis, Soccer, Positional analysis, Kicking velocity, Leg power.

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INTRODUCTION

Soccer, also known as football, is the most widely popular and played sports worldwide. The main objectives of this game is to soccer goals, which is achieved through various types of passing and shooting. All sports require physical fitness and game related fitness. Physical fitness, motor skill and tactical skill combine to bring out the best performance in a sports person (Wangmo, R. P. et al. 2025).

In this sports various physical movements are noticeable such as jumping, shooting, passing, acceleration, deceleration, falling, starting and tackling also (Marques, M. C., et al. 2011 & Arafat, M. Y., et al 2020). There are various kick used to achieved success in football such as inside kick, lofted kick, inside curved kick, instep kick, outside kick, outside curve kick, volley kick, toe kick and back heel (Cerrah, A., et al. 2018). The kicking ability and velocity depends on some factors such as age, gender, limb dominance, practice duration, competition level, playing position and various kicking technique (Arafat, M. Y., et al 2020).

Kicking with the dominant leg consistently results in higher ball velocities compared to the non-dominant leg (Rađa, A. et al 2019). While speed is important, accuracy is also a key factor. Research suggests that kicks performed at 90-102 km/h (approximately 80-90% of maximum speed) are most accurate (Izovska, J. et al. 2016). For maximum speed, instep kicks generally generate the maximum ball speed. However, for accuracy, kicks at velocity between 90-102 km/h (80-90% of maximum kicking velocity) are most accurate (Izovska, J. et al. 2016). Instep kick has the ability to increase maximum speeds, with studies reporting speeds of 96.2 km/h (Sakamoto, K. et al. 2016).

Leg strength refers to the ability of the legs to generate force quickly and movement. In the leg strength includes the ability of the hip flexors, knee extensors, and other muscles involved in the kicking motion (Hart, N. H. et al. 2016). Ball- kicking velocity is the ball speed at which a ball is kicked, and it is directly connected to the force generated by the kicking leg (Cerrah, A. et al 2018). Apart from leg strength, there are some others factors that can affect the ball-kicking velocity, including the angle of contact, accuracy and the type of kick. The kickers have higher mass-to-weight ratio in their legs, which helps them maintain foot speed and achieve long distance (Katis, A.et al. 2013).

The ball-kicking speed of a football players is an individual metrics for measuring their performance in different positions. This research focus on correlation in between kicking velocity and leg power of soccer players. Present research study also observe the leg power in different positional football players and performance.

METHODOLOGY

Participants

The study included thirty male soccer players aged between 20 and 24 years who regularly competed at the national-level. Participants were categorized into three equal groups based on their playing positions: defenders (n = 10), midfielders (n = 10), and forwards (n = 10). All participants provided informed consent before the commencement of the study. The study protocol was approved by the institutional ethics committee.

Study design

This is a cross-sectional study and it's aimed to examine the relationship between leg power and kicking velocity among soccer players from different playing positions (Mukta et al. 2025). All testing procedures

were conducted during a single day and single session to ensure consistency and reduce the effect of fatigue or environmental variation. All participants also ensure they were fully physical fit and free of injury.

Procedures

Warm-Up

Participants completed a standardized fifteen minute dynamic warm-up consisting of leg swings, light jogging, and dynamic mobility exercises. Additionally, they also performed several submaximal instep kicks to become used to with the kicking protocol and equipment.

Kicking velocity measurement

This study measured ball-kicking velocity by using a Bushnell Velocity speed gun (Model 101911). The Bushnell velocity speed gun set directly behind goalpost and aligned with the ball flight path. All participant attempt three maximum instep kick in 30 seconds brake with their dominated leg from a fix distance for all 11 meters. The best ball velocity (km/h) across all three attempts was taken for statistical calculation. This methods select depends on previous research including the instep kick yields the highest ball speed and power (Arafat et al., 2020; Sakamoto et al., 2016).

Leg power assessment

Leg power was assessed on same day of ball-kicking velocity by using a vertical jump. All participant also performed maximum three times like as ball-kicking velocity with hands placed on hips to isolate lower-body effort. The highest vertical jump consider for statistical calculation in watts (kg-m/sec) using the validated equation.

Statistical analysis

All collected data were analysed by using SPSS software (version 25.0.0). Descriptive statistics were calculated as means and standard deviations (mean ± SD) for both kicking velocity and leg power by position.

To assess the relationship between leg power and ball velocity within each positional group, Pearson correlation coefficients (r) were calculated. Additionally, t-values and p-values were derived to test the significance of each correlation, and the findings are presented in Table 2. The degrees of freedom (df) for all correlation tests were 8 (n-2). Statistical significance was set at $p < .05$.

RESULTS

Table 1. Mean leg power and ball velocity by playing position.

Groups	Leg power (kg-m/sec)	Ball Velocity (km/h)
Forward	57.7 ± 5.2	98.3 ± 4.6
Midfielder	55.1 ± 4.7	92.2 ± 5.2
Defender	56.5 ± 5.5	97.4 ± 4.4

Table 1 presents the mean leg power and ball velocity by position. The forwards group performed the best values comparatively midfielders and defenders.

From the table number 1 and graph number 1 researcher clearly shown that, mean value and standard deviation of leg power and ball velocity of all groups of soccer players. Forwards demonstrated the highest leg power and ball velocity.

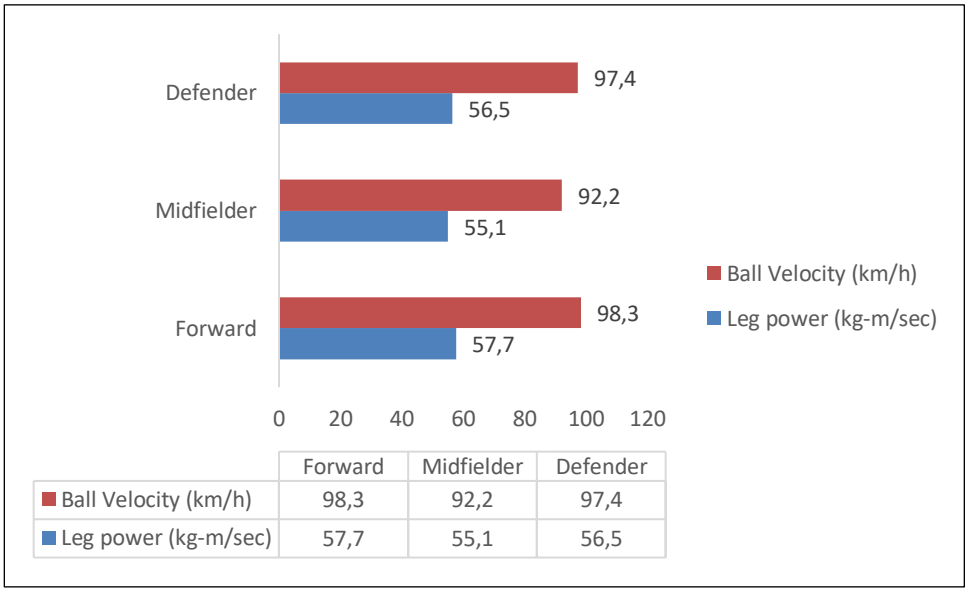

Figure 1. Comparison of leg power and ball velocity by playing position.

Table 2. Co-efficient of correlation between leg power and kicking velocity of different positional soccer players.

Groups	Correlation coefficient (*r*)	df	*t*-Value	*p*-Value	Interpretation
Forward	0.20	8	0.58	.60	Low positive correlation
Midfielder	0.30	8	0.89	.63	Moderate positive trend
Defender	0.40	8	1.23	.25	Moderate positive trend

Note. While correlation coefficients were positive, none of them reached statistical significance at p < .05. These results should be interpreted with caution and discussed as trends rather than conclusive evidence.

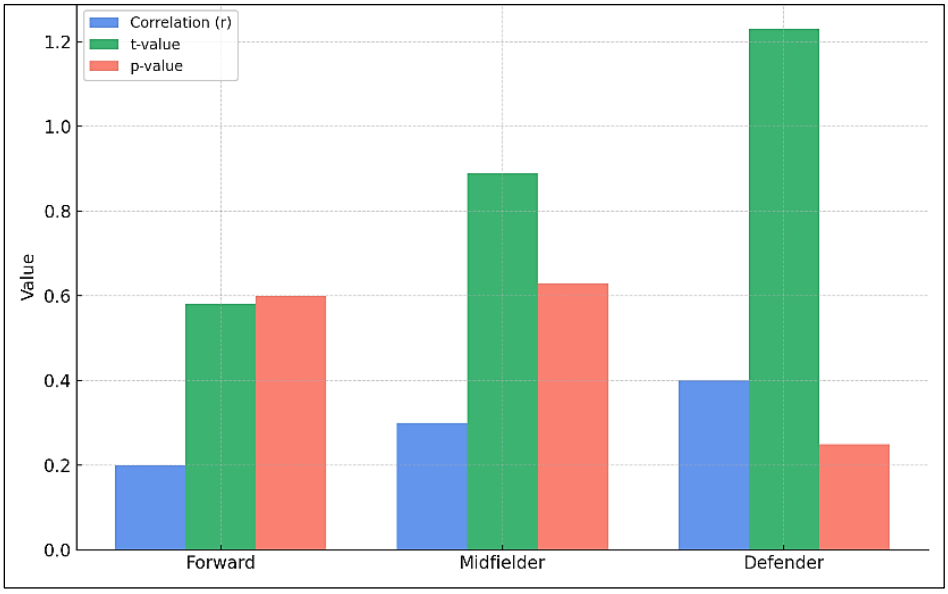

Figure 2. Correlation, t-Value and p-Value by playing position.

DISCUSSION

This study aimed to investigate the relationship between leg power and kicking velocity across different playing positions in soccer, revealing varied but generally positive associations. While none of the correlations reached statistical significance, trends indicated that higher leg power tends to correspond with higher ball velocity, particularly among forwards and defenders.

Positional variations in kicking performance

The results that forwards exhibited the highest average kicking velocities and leg power is consistent with the positional demands of modern football. Forwards often engage in rapid, high-intensity movements such as explosive sprints and powerful shots on goal, which demand superior lower-body strength and neuromuscular coordination (Ribeiro et al., 2024). Their improved performance probably the repeated training exposures that emphasize plyometric strength and speed.

Defenders also showed relatively high leg power, second only to forwards, and comparable kicking velocity. This may be their frequent participation in long clearances and counterattacking passes, which needs lot of power generation despite typically being less proper than shooting (Harrison et al., 2023). Midfielders showed lower leg power and ball- kicking speed, which aligns with their emphasis on endurance and ball control over explosive power (Martínez-Santos et al., 2025).

Correlation between leg power and kicking velocity

The moderate to low relationship supports in this research with the existing literature suggesting a physiological and biomechanical link between lower-body strength and ball velocity (Plouff et al., 2023; Makar et al., 2024). Vertical jump performance is frequently used as a reliable indicator of leg power, and instep kicking in particular depends on the coordinated activation of the hamstrings, quadriceps, glutes, and core (Kellis & Katis, 2007; Manolopoulos et al., 2006).

However, different movement patterns and muscle recruitment techniques associated with each role may be the cause of the variation in correlation strength across positions. The observed relationship in this group may be weakened, for instance, if midfielders rely more on submaximal kicking during games and train less for explosive power (Reilly et al., 2000). It's also important to remember that leg power is not the only factor affecting the velocity of ball. Kicking outcomes are affected by limb dominance, technique and joint angular velocity during kicking (Lees et al., 2010; Rađa et al., 2019). As a result while leg strength produce a foundation, it should not be considered in isolation.

Practical implications

Conditioning and strength regimens should be tailored to meet the specific demands of each position, taking these insights into. Plyometric and resistance training select at increasing explosive leg power may be especially helpful for defender and forwards position players. (Slimani et al., 2023). In the other hand midfielders may include a well-rounded training regimen that emphasizes aerobic conditioning, agility, and the improvement of moderate power to meet the different demands of the match. Furthermore, assessing both vertical and horizontal power metrics could yield a more extensive profile of kicking power. Future research could develop the predictive accuracy of kicking ability by incorporating sprint start ability, single-leg hop tests, and lower-limb isokinetic strength progression (Simão et al., 2024).

Limitations and future directions

Present study findings may not be as widely able as they could be due to the relatively small group of players within each positional group. Furthermore, the horizontal force dynamics pertinent to soccer kicking may not be adequately captured by relying solely on vertical jumps as a demonstration of leg power. Multi-planar power measures, like standing broad jumps or sprint acceleration metrics, should be taken into account in future studies (Clemente et al., 2025, Mukta et al. 2026). Additionally, although they were not evaluated in this study, technical factors like approach velocity, joint kinematics, and muscle coordination may have a big impact on ball velocity results (Sakamoto et al., 2016). Our knowledge of how strength training affects positional kicking performance over time may be expanded by future longitudinal studies that combine biomechanical analysis and neuromuscular testing.

CONCLUSION

Male soccer players in the forward, midfield, and defence positions are the subjects of this study, which examines the relationship between kicking velocity and leg power. Positive trends were noted despite the correlations not being statistically significant, suggesting that higher leg power is typically linked to higher ball velocity. The positional demands for explosive power and forceful kicking actions in offensive play were highlighted by the fact that forwards showed the highest values in both variables.

The findings lend credence to the idea that lower-body strength has a significant impact on soccer kicking performance. Additionally, variations in leg power and kicking velocity among positions highlight how crucial it is to modify training regimens to meet the particular physical requirements of each position. Conditioning and strength coaches should consider incorporating position-specific exercises to improve power output where it is most needed, particularly for defenders and forwards.

This study also provides valuable insights into the physical qualities associated with kicking performance. In summary, the present study reinforces the relevance of leg power in soccer kicking performance and suggests that optimizing strength and power training according to playing position may improve game-related outcomes.

AUTHOR CONTRIBUTIONS

JFR conceived the design research, collected the data, and critically reviewed the article. FTJM help to collect the data. MYA calculation and write the article.

SUPPORTING AGENCIES

No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

ETHICAL STATEMENT

Ethical standards were adhered to in this study and the participant provided informed consent in the form of a consent form covering research details, risks, benefits, confidentiality and participant rights.

DATA AVAILABILITY STATEMENT

Data available on request due to privacy/ethical restrictions.

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