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Do central midfielders from higher-ranked teams perform differently? Evidence from Indonesia Liga 1

Muhamad Fahmi Hasan[1abcde,*], Kartono Pramdhan[2abcd], & Normandi Alpha Junio[1bcd]

Institut Teknologi Bandung, Indonesia[1]
Sekolah Tinggi Keguruan dan Ilmu Pendidikan, Indonesia[2]

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ABSTRACT

Background: Central midfielders (CMs) have essential roles in modern soccer as a connector between the attacking and defensive lines, maintaining game tempo, ball circulation, and supporting team organisation during transition. However, limited evidence about the physical and technical performance of CMs in teams from different ranks is scarce, especially in non-European leagues. **Objectives:** This study aimed to compare the physical and technical performance of CMs from high-, middle-, and low-ranked teams in Liga 1 Indonesia. **Methods:** 381 match observations from 34 CMs were analysed using the Kruskal–Wallis test with Bonferroni post hoc comparisons and ordinal eta-squared to estimate the effect size. **Results:** All variables, except progressive passes, showed significant differences. The largest effect size was observed for acceleration, and the medium effect size for deceleration, confirming that explosive actions were the strongest discriminators between CMs across ranking levels. Significant others' variables displayed small effect sizes (total distance, high-intensity running distance, pass accuracy, successful passes, short passes, medium passes, and long passes). The highest values of acceleration, deceleration, high-intensity running distance, pass accuracy, successful passes, and short passes were observed in the high-ranked CMs. **Conclusion:** CMs' technical and physical performance differs by team ranking, with high-ranked CMs characterised by greater explosive movement and accurate short-passing circulation. The results give useful reference points for developing CM in Indonesia. This study was limited to a single season within one league and didn't take into account other contextual factors. Future research should consider contextual factors in the analysis.

Keywords: Central midfielder; physical performance; technical performance; soccer

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Muhamad Fahmi Hasan, Department of Sport Science, School of Pharmachy, Institut Teknologi Bandung, Bandung, Indonesia
fahmi.hasan@itb.ac.id

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INTRODUCTION

The development of technology in soccer, increases the interest in match performance analysis in elite competition (Modric et al., 2022). Nowadays, time-motion analysis technology can illustrate the players'

movement profiles, as movement patterns can be recorded in quantitative values (Hands & Janse de Jonge, 2020). The global, local, and optical tracking systems are tools that can measure technical and physical players' match performance (Mara et al., 2017). This technology can assist coaches in tailoring the training programme to prepare the players for the competition demand.

The two main aspects that are commonly used to assess match performance are technical and physical (Šunjić et al., 2024). The metrics to measure physical aspects that are frequently used are total distance, high-intensity running, and explosive movement such as acceleration and deceleration (Modric et al., 2020). Meanwhile, passing variation, shooting, and dribbling are the main metrics to assess technical performance (Andrzejewski et al., 2022). In elite-level competition, high technical performance is critical to win the match (Moalla et al., 2018), but this aspect can not be obtained without support from the physical aspect (Barnes et al., 2014).

Modern soccer demands players with high physical and technical attributes (Morgans et al., 2024). Primarily for CMs, who have a complex role in controlling the game tempo, distributing the ball, covering position, and supporting the shape of the team in attack, transition, and defence (Modric et al., 2025). The critical role in the technical aspect for CM is as a connector between the defending and attacking lines in the pass system, with a high score of centrality and prestige, also distributing and receiving the ball from various directions (Clemente et al., 2020). The same with Alves et al., finding that CMs are the pivot of ball distribution in various tactical systems such as 4-1-4-1 and 4-3-3 (Alves et al., 2025). The complex role of CMs demands a high technical and physical level to compete in the modern soccer era.

On the physical aspect, Modric et al., reported that CMs in the UEFA Champions League recorded the highest total distance compared to other positions (Modric, Versic, et al., 2023). in line with Aquino et al, who compare all positions' running performance in Brazilian team formations (4-2-3-1) and (4-4-2) and explain that CMs in both formations have greater total distance than others (Aquino et al., 2018). Morgans et al demonstrated that CMs in the English Premier League show greater acceleration and deceleration than Ligue 1 (Morgans, Ju, et al., 2025). In the German Bundesliga, CMs covered the highest total distance and high-intensity running distance, compared to all positions (Altmann et al., 2021). From the Central European League Region, CMs in the first division showed the most significant total distance covered (Kryściak et al., 2025). In the youth elite phase, CAM (Central Attacking Midfielder) and CDM (Central Defensive Midfielder) in the youth Netherlands National Team covered both the highest total distance and moderate-intensity running, respectively (de Haan et al., 2025).

CMs technical performance in Copa America shows greater total passes and pass accuracy compared to other positions (i.e, CD (central defender), FB (fullback), WM (wide midfielder), FW (forward) (Kubayi, 2021). Aligned with Fang et al., in the Chinese Super League, which explains the most intense five minutes of the match (peak 5), CMs recorded the highest value for all passing metric variables (Fang et al., 2025). A report from the English Premier League demonstrated that CMs in both home and away games have higher passing accuracy compared with defenders and forward positions (Redwood-Brown et al., 2019). In contrast, Perrotta et al., in their studies showed that CDs have greater successful passes than CMs, but CMs have higher total assists and shots on target than other positions in the Serie A league context (Perrotta et al., 2025). In comparison between the top European leagues, Dellal et al., reported that CDMs in La Liga recorded a greater percentage of successful passes than English Premier League CDMs; on the other hand, English Premier League CAMs have a higher value in terms of the number of passes toward the opponent's goals than La Liga CAMs (Dellal et al., 2011).

Even though previous studies have provided important insights into the physical and technical needs of CMs in top-level soccer, most were conducted in the European League. Additionally, previous studies have mostly examined match performance based on the player's position, the team's formation, the venue, or the level of competition. There is limited evidence on how the physical and technical performance of CMs varies with their team's ranking in a domestic professional league, especially in the Indonesian Liga 1. Investigating this issue is essential because team rankings can reflect differences in tactical demands, level of possession, possession patterns, and transition frequency, all of which can influence the match actions required of central

midfielders. Therefore, this study provides the first profile of central midfielder match performance based on team ranking in the Indonesian League 1.

In line with this, this study aims to compare the physical and technical performance of central midfielders from top, middle, and bottom-ranked teams during the 2024-2025 Indonesian League 1 season. This study hypothesises that central midfielders from top-ranked team exhibit higher explosive running performance, particularly in acceleration and deceleration, as well as more efficient short passing performance than central midfielders from middle- and lower-ranked teams. The findings of this study are expected to provide position-specific benchmarks for player development, recruitment processes, and training programme design in Indonesian professional football.

METHODS

Participans

A total of 34 CMs from 14 teams competing in the 2024-2025 Indonesian League 1 season were involved in this study. Players were selected from an official match performance database based on established eligibility criteria. In total, 381 player-match observations met the criteria and were included in the final analysis. Each player contributed at least four full match observations in the same playing position.

The inclusion criteria for this study were as follows: (1) the player was registered and played as a non-goalkeeper or outfield player (Altmann et al., 2021); (2) the player completed the entire match, i.e., 90 minutes of regular time plus stoppage time (Modric et al., 2019); (3) the player played as a CMs throughout the match; and (4) the player completed at least four full matches as CMs to mitigate the influence of incidental contextual conditions and account for variations in running performance between matches (Bush et al., 2015; Paul et al., 2015).The exclusion criteria for this study were as follows: (1) players who played as goalkeepers; (2) players who did not complete a full match; (3) players who changed playing positions before the end of the match; and (4) players who completed fewer than four full matches as central midfielders. Only observations with complete physical and technical performance data were included in the analysis.

Design

This study used a retrospective observational design, utilising secondary match performance data from the 2024-2025 Indonesian League 1 season. The physical and technical performance of central midfielders was compared across three groups based on their final standings: top-ranked teams, middle-ranked teams, and bottom-ranked teams. The study involved no intervention, and all analyses were conducted using previously recorded match data.

Ethical Approval

This research has obtained approval from the Research Ethics Committee of Universitas ‘Aisyiyah Bandung, Indonesia, with approval number 1532/KEP.01/UNISA-BANDUNG/X/2025 issued on October 21, 2025. Permission to access and analyse the data was obtained from the relevant data providers. All data has been anonymised and managed confidentially for research purposes.

Procedures

Physical and technical performance data were obtained from PT. Liga Indonesia Baru, the official competition operator of Liga 1 Indonesia. Physical performance variables were collected using a global positioning system (GPS) device (Catapult Vector S7) with a sampling frequency of 10 Hz, which has been widely used and validated in elite soccer performance analysis. The physical performance metrics included total distance covered (m), high-intensity running distance (> 19.8 km/h), number of accelerations (> 3 m/s²), and decelerations (< -3 m/s²). Technical performance variables consisted of pass accuracy, successful passes, progressive passes, short passes (0–10 m), medium passes (11-25 m), and long passes (> 25 m). Teams were categorised into three groups based on their final league standings in the 2024-2025 season: high-ranked (top 4 teams), middle-ranked (positions 5-11), and low-ranked (bottom 3 teams).

Data Analysis

The normality of data distributions was checked by the Shapiro-Wilk test. Data are descriptively presented with the means and standard deviation. Because there is at least one group of data in each metric that did not follow a normal distribution ($p < 0.05$), the Kruskal-Wallis test was used to compare the groups of high-ranked, middle-ranked, and low-ranked teams. If the Kruskal-Wallis test shows a significant difference, the analysis continues with post-hoc pairwise comparisons using the Bonferroni correction to control the risk of type I error. Ordinal eta-squared (η^2H) was conducted as an effect size, with classification range small (≥ 0.01), medium (≥ 0.06), and large (≥ 0.14) (Breslow, 2014). SPSS statistical software 26.0 was used to analyse all statistical data, with a significance threshold of $p < 0.05$.

RESULTS AND DISCUSSION

Results

Table 1 shows the descriptive statistics of CMs' physical and technical performance in matches, organised by different team rankings. The physical performance factors include the total distance covered, the distance run at high intensity, acceleration, and deceleration. On the other hand, the technical performance factors consist of pass accuracy, the number of successful passes, and progressive passes, as well as short, medium, and long passes. All data is shown as the average with the standard deviation for the entire sample and for each group of team rankings, which includes high-ranked, middle-ranked, and low-ranked teams.

Table 1. Descriptive Statistics for CMs Physical and Technical Match Performance

Metrics	Total Mean ± SD	High-Ranked Mean ± SD	Middle-Ranked Mean ± SD	Low-Ranked Mean ± SD
Total Distance (m)	9884 ± 834	9869 ± 884	10039 ± 839	9607 ± 636
High Intensity Distance (m)	454 ± 176	480 ± 170	444 ± 144	421 ± 232
Acceleration (count)	23 ± 11	31 ± 13	19 ± 8	19 ± 6
Deceleration (count)	30 ± 12	36 ± 14	28 ± 8	26 ± 9
Pass Accuracy (%)	0.85 ± 0.08	0.86 ± 0.07	0.83 ± 0.08	0.84 ± 0.08
Succesful Passes (count)	37 ± 14	40 ± 16	35 ± 12	32 ± 12
Progressive Passes (count)	2.68 ± 2.33	2.78 ± 2.46	2.66 ± 2.19	2.51 ± 2.37
Short Passes (count)	34 ± 13	38 ± 9	32 ± 7	29 ± 11
Medium Passes (count)	2.42 ± 2.31	2.13 ± 2.01	2.84 ± 2.59	2.18 ± 2.14
Long Passes (count)	0.38 ± 0.69	0.30 ± 0.63	0.37 ± 0.63	0.56 ± 0.88

Table 2 shows significant Kruskal-Wallis differences were found between rank groups ($p < 0.05$) in CMs' physical and technical match performances, with differences in large ES for acceleration ($\eta^2H = 0.23$). Medium ES in: (i) deceleration ($\eta^2H = 0.08$). Small ES in: (i) total distance ($\eta^2H = 0.04$); high-intensity distance ($\eta^2H = 0.02$); pass accuracy ($\eta^2H = 0.02$); successful passes ($\eta^2H = 0.04$); short passes ($\eta^2H = 0.05$); medium and long passes ($\eta^2H = 0.01$).

Particularly, high-ranked CMs recorded the highest high-intensity distances (significantly different from low-ranked), the highest number of accelerations and decelerations (significantly post-hoc different to other rank groups), the highest percentage of pass accuracy (significantly different to medium-ranked), and the highest number of short passes (significantly post-hoc different from other rank groups). Middle-ranked CMs show the highest total distance (significantly different compared to low-ranked) and the highest number of medium passes (significantly different compared to high-ranked). Finally, low-ranked CMs carried out the highest score of long passes (significantly different compared to high-ranked).

Tabel 2. Differences Between CMs Rank Group for Physical and Technical Match Performances Analysed By Kruskal–Wallis, with Bonferroni Pairwaise Post-Hoc Test

Metrics	Kruskal–Wallis χ^2 (p)	Effect Size η2H	Post Hoc
Total Distance (m)	20.84 (0.000)	0.04	HR > LR; MR > LR
High Intensity Distance (m)	12.71 (0.002)	0.02	HR > LR
Acceleration (count)	79.00 (0.000)	0.23	HR > MR; HR > LR
Deceleration (count)	31.93 (0.000)	0.08	HR > MR; HR > LR
Pass Accuracy (%)	11.13 (0.004)	0.02	HR > MR
Succesful Passes (count)	19.32 (0.000)	0.04	HR > MR; HR > LR
Progressive Passes (count)	1.13 (0.569)	0.00	-
Short Passes (count)	24.96 (0.000)	0.05	HR > MR; HR > LR
Medium Passes (count)	8.00 (0.018)	0.01	MR > HR
Long Passes (count)	8.09 (0.018)	0.01	LR > HR

Discussion

The results of this study showed that physical and technical match performance for CMs at every team ranking level in Liga 1 Indonesia 2024-2025. But not all the variables differed significantly this way. There was a large effect size for acceleration and a moderate effect size for deceleration. For further analysis, total distance, high-intensity running distance, pass accuracy, successful passes, short passes, medium passes, and long passes showed statistically significant differences; however, effect sizes were small. The results should be interpreted with the view that acceleration and deceleration are more robust markers for differentiating CMs by team ranking, whilst the other significant variables should be interpreted with caution.

In addition, CMs from high-ranking teams had the highest values for the following physical performance indicators: acceleration, deceleration, effort, and high-intensity running distance. Acceleration seemed to discriminate against CMs, with high-ranking teams recording the highest counts, significantly and with a large effect size. This is a relevant finding because CMs need to change their position frequently during attacker, defender, and transitional sequences (Aquino et al., 2020). As one of the central figures linking the defensive and attacking phases of play, previous research has indicated that CMs typically cover higher distances whilst contributing with high-intensity movement patterns (Altmann et al., 2021; Modric, Grabrilo et al., 2023; Kryściak et al., 2026). Within this context, acceleration applies not just to sprinting actions but also to short, repeated entries into multi-directional movements that serve multiple functions: opening passing lanes, applying pressure on opponents, supporting ball circulation, and preserving team structure (Modric et al., 2019; Morgans, Ju et al., 2025). The larger deceleration values in high-ranked teams were also in line with these results, given that large amounts of deceleration are often associated with situations such as stopping or changing direction, or reorganising when travelling at high velocities during a match. The larger deceleration values in high-ranked teams were also consistent with these results, given that large decelerations are often associated with stopping, changing direction, or reorganising while travelling at high velocity during a match. Therefore, the combination of acceleration and deceleration indicates that CMs in high-ranking teams are likely to experience greater variation in movement intensity, which aligns with the growing relevance of explosive actions in elite soccer (Morgans, Ceylan et al., 2025).

From a technical aspect, CMs of high-ranking teams achieved the highest pass accuracy, successful passes, and short passes. These findings highlight that short-passing circulation and maintaining pass accuracy during match play were more closely associated with the role of CMs in high-ranked teams. Such a result supports the observation that CMs tend to operate more frequently as a connector between the defensive and attacking lines through short receipt and distribution of the ball (Modric et al., 2025). Clemente et al. (2020) explained that CMs when their team win tend to receive and distribute the ball more around the field, they would rank highly in terms of centrality within passing networks (Clemente et al., 2020). Similarly, Alves et al. (2025) showed that CM players can serve as passing connectors between other players when examined across a wide range of tactical systems (Alves et al., 2025). Thus, the greater short-pass volume and pass accuracy in high-performing teams may simply be indicative of a more organised, possession-oriented style of play. Yet, given

the small effect sizes for pass accuracy, successful passes, and short passes, these differences should not be overinterpreted as large practical gaps between ranking groups. Instead, they suggest that CMs from higher-ranked teams are more likely to be associated with short, accurate ball movement than those from middle- and low-ranked teams. Previous studies have also found that technical quality, most specifically in relation to passing efficiency, is a strong correlate of successful match performance in elite soccer (Barnes et al., 2014; Dellal et al., 2011; Kubayi, 2021).

The highest total distance and the medium passes were observed among CMs in middle-ranked teams. There was a particularly significant increase in total distance compared to high and low-ranked CMs, suggesting middle-ranked CMs require more playing area during matches. However, the small effect sizes also demonstrate that total distance differences were minimal in practical terms. Therefore, a higher total distance should not automatically be interpreted as better performance. Previous studies have emphasised that total distance, along with the high-intensity distance of CMs, does not differ according to the match result, because CMs are always involved throughout the game, including attacking, defending, and transition (Pranjic et al., 2022). The highest total distance in middle-ranked CMs may reflect a tactical context in which play dictates the need to contribute to both attacking and defensive transitions, resulting in higher running volumes. Also, the use of more intermediate passing distances by middle-ranked CMs was to connect play between short circulation and more direct progression, which may help explain their higher number of medium passes; however, given its small effect size, this result should be approached with caution.

The CMs of low-ranking teams had the highest values for long passes but the lowest for total distance, high-intensity running distance, successful passes, and short passes. Similar to previous studies that explained bottom-ranked teams, which have the lowest ball possession, with low defensive line tend to record smaller total distance covered and high-intensity running distance (Branquinho et al., 2026; Morgans et al., 2024). The highest long-pass score indicates a tendency toward more direct ball progression from central areas (Taheri-Araghi et al., 2025; Barthelemy et al., 2024). However, the small effect size indicates that this was not a large difference in practice. Further, CMs from low-ranking teams were more likely to play long passes but less likely to engage in short-pass circulation and successful pass accumulation than CMs from high-ranking teams. This condition might also be linked to less ball possession or reduced availability of passing alternatives, although this study did not specifically investigate the number of passes over elapsed time, without accounting for match context, such as pass location.

Another key finding was that there were no significant differences in progressive passes between the high, mid-, and low-ranking teams. This result also indicates that the effect of team ranking level may not be strong on CMs' progressive passes in Liga 1 Indonesia. However, despite differences in some physical and passing-volume indicators across all four ranking levels, CMs' progressive passing output at varying-level teams seemed fairly similar. This finding was similar to the Liga 1 Technical Report 2024-205, which explained that Liga 1's attacking style generally relies on flank sides, with entry passes into the opponent's final-third areas predominantly on the left and right flanks (I-League, 2025). In addition, there is limited progress towards the central and half-space areas vertically (I-League, 2025). The small space and high density/compactness in the middle area of the opponent's defensive third, when defending in high-level modern soccer, make the ball flow during the attacking phase mostly through the flanks to execute the attacking phase into an assist or goal (Guimarães et al., 2021; Forcher et al., 2024). From a practical perspective, these results suggest that the CM development program should emphasise the ability to repeatedly accelerate and decelerate, short passing under pressure, scanning for space, and decision-making in tight spaces. These characteristics seem to better describe CMs from higher-ranked teams. This aligns with contemporary CMs, who are praised for their ability to combine physical capacity, technical quality, and tactical knowledge during match play (Barbero-Álvarez et al., 2024; Yi et al., 2020).

Practical Implication

The findings of this study suggest that developing CM players should emphasise repeated acceleration and deceleration, technical execution under pressure, and decision-making in a training environment representative of a match. Conditioning programmes should not rely solely on continuous or linear running, as these exercises

may not necessarily reproduce the changes in speed, direction, and tactical intent that CM players frequently experience during a match. Position-specific conditioning can include repeated short accelerations, controlled decelerations, changes of direction, and direct technical actions such as receiving, turning, and passing the ball. For example, short-range acceleration and deceleration drills can be combined with multidirectional movements and ball actions. Players might accelerate to create space, decelerate before receiving the ball, turn under pressure, and then pass to a supporting teammate. These activities can replicate the stop-and-go and repositioning demands encountered in CM players from high-ranked teams, while integrating both physical and technical components.

Small-sided games can be an effective method for integrating these demands. Formats such as 4v4 plus a neutral player or 5v5 with an overload in the central area can encourage CMs to scan, create passing angles, maintain ball circulation, and react quickly after changes of possession. A narrower playing area can increase pressure, the frequency of short passes, and the demands on decision-making, while a longer or wider area can provide more opportunities for high-intensity movement and ball progression. Rules requiring an immediate response after losing the ball can also be used to encourage counter-pressing, quick repositioning, and repeated acceleration-deceleration actions.

Decision-making drills should require CMs to scan before receiving the ball, recognise opposing pressure, choose the appropriate passing distance, and quickly adjust their position after releasing the ball. Coaches can also manipulate numerical superiority, touch limits, scoring zones, or the direction of play to present players with different tactical challenges. These drills should present relevant information similar to that in a match to ensure players' physical actions remain connected to their tactical objectives.

Therefore, position-specific conditioning needs to integrate physical, technical, and tactical aspects. The goal is not simply to increase the number of accelerations or the volume of short passes, but to improve the player's ability to execute these actions at the right time and in response to relevant match information. Training load also needs to be monitored, as repeated accelerations and decelerations place significant mechanical and neuromuscular demands.

Limitations

Several limitations need to be considered when interpreting the results of this study. First, the study only included CMs playing in the 2024-2025 Indonesian League 1 season. Therefore, the results may not be generalisable to other positions, other competitions, or different seasons. Comparisons with other Asian leagues with different tactical, environmental, and competitive characteristics are needed to determine whether the CM profiles found are specific to the Indonesian League 1 or also occur in other Asian competitions.

Second, this study's dataset includes repeated match observations of the same player. Therefore, each observation is not completely independent because the physical and technical performance of the same player can be influenced by relatively stable individual characteristics. Using player identity as a random effect can help control for this dependency, but it may not fully capture additional clustering related to team, opponent, match, or tactical system. Future research is recommended to use multilevel models that simultaneously account for repeated observations within players, players within teams, and matches against different opponents.

Third, this study used a retrospective observational design. The researchers did not manipulate team rankings, tactical strategies, physical preparation, or match conditions. Therefore, the relationships found should be viewed as associative, not causal. It cannot be concluded that higher acceleration, deceleration, or short passing participation leads to a team achieving a better league ranking. Highly ranked teams may create a tactical environment that produces these performance outputs, while team ranking and CM performance can also be influenced by other factors such as overall team quality, coaching strategy, ball possession, and opponent strength.

Fourth, ranking groups are determined based on final league positions without directly accounting for contextual variables in each match. Match location, match status, opponent ranking, team formation, ball possession, player roles, and tactical strategies can all influence physical and technical performance during

matches (Villaseca-Vicuña et al., 2026; Aquino et al., 2020; Barrera et al., 2021). Therefore, grouping players based on final team ranking does not necessarily fully reflect the tactical context experienced in each match.

Finally, technical analysis is primarily limited to passing indicators. Other actions relevant to the CM's role, such as receiving the ball between the lines, scanning behaviour, ball carries, defensive pressure, interceptions, duels, pass direction, pass location, pressure when receiving the ball, and contributions to build-up and actions in the final third, have not been analysed. Future research should integrate tracking data, event data, and tactical indicators to provide a more comprehensive picture of CM performance. Also, longitudinal studies spanning multiple seasons would also be beneficial for assessing whether the performance profiles identified in this study are stable or change over time.

CONCLUSION

The study found that the physical and technical match performance of CMs differed across high-, middle, and low-ranked teams in Liga 1 Indonesia 2024-2025. The most statistically significant differences were observed in acceleration and deceleration metrics, where CMs from high-ranking teams had the highest counts, illustrating that explosive movement demands are the best differentiators of CMs across team ranking levels. In line with the highest value in short-passing metrics, high-ranked CMs exhibit a profile characterised by frequent explosive actions and accurate short-passing circulation.

The total distance and medium passes were synchronously high among middle-ranking CMs, indicating higher running volume and greater involvement in intermediate passes. Meanwhile, low-ranked CMs had the most long passes, showing they played more directly. In practice, the CMs' development programme should prioritise repeated acceleration and deceleration ability, short passing under pressure, scanning, and decision-making in tight spaces. Whilst those traits were evidently desirable qualities for most CMs playing for higher-ranked teams. Future research should incorporate contextual variables, such as match status (home/away), the quality of the opposition faced, team formation, and ball possession, to provide a more comprehensive understanding of CMs' performance.

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CONFLICT OF INTEREST

The authors declare that there are no potential conflicts of interest in the research, writing, or publication of this article. All data collection, analysis, and reporting of results were conducted independently without any influence from any party.

AI DISCLOSURE STATEMENT

QuillBot, an AI-powered writing tool, was used solely for paraphrasing, language refinement, grammar checking, and final proofreading. It was not used to generate, analyse, or interpret the research data or results. The authors take full responsibility for the content, accuracy, and integrity of the manuscript.

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