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Running performance profiles of different types of central midfielders in soccer

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Abstract

Introduction. The advancements in technology in recent years have provided a large volume of data on the running performance (RP) of soccer players, thus enabling more research. Aim of Study. The aim of this study was to investigate whether there are differences in RP among different types of central midfielders (CMs) in formations with three CMs and a back four. Material and Methods. Four different types of CMs are present in the abovementioned formations according to the InStat Scout data, namely a) attacking central midfielder (AMC), b) central midfielder (MC), c) single defensive central midfielder (sDMC), and d) defensive central midfielder paired with another DMC (pDMC). One-way ANOVA was applied four times to find differences among the different types of CMs in total distance covered (TD) as well as distances covered at low (LSD), moderate (MSD), and high intensity (HSD). Results. It was found that only in HSD there were statistically significant differences. Specifically, sDMCs showed lower values compared to MCs (p = 0.001, d = 0.533) and AMCs (p = 0.002, d = 0.574). Conclusions. The differences found among the various types of CMs can provide useful information for coaches' choices regarding both team formation and player positions, depending on each player's individual characteristics.

KEYWORDS: physical performance, soccer, positions, formations, defensive midfielder, attacking midfielder.

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Introduction

Soccer is an intermittent sport where technique, tactics, physical fitness, and player personality combine to ultimately determine a player's performance [4, 20, 26]. Historically, a notational analysis allowed for the assessment of technical and tactical factors [18], while sports psychologists used questionnaires and performance profiling techniques to adequately evaluateplayers' psychosocial factors [34]. In contrast, a traditional time-motion analysis using notational methods was extremely time-consuming and could not accurately provide information on players' physical performance. However, modern technological advancements have revolutionized analysis methods, as Electronic Performance and Tracking Systems (EPTS) can now generate large volumes of data on physical performance [6]. The term EPTS was introduced by FIFA to describe all methods of tracking players' positions, including GPS, optical tracking, and local positioning systems. A system is considered reliable if it received special approval from FIFA, which occurs after successful evaluation through specific checks [14]. Optical tracking has the advantage over the other two systems of being entirely non-invasive, as it does not require a player to wear any device [28]. Systems that use optical tracking methods can accurately provide information such as player speed, accelerations, and distances covered at various intensity levels.

The current ability to collect large volumes of data has led to significant progress in related research. From the literature, it appears that several researchers studied the running performance (RP) of teams, i.e. for all team

players competing in a match [2, 10, 30, 32]. However, most researchers studied the RP of players according to their position in a team formation. Different authors used different positions for their studies. For example, most authors used the positions of central defender, side defender, central midfielder, side midfielder, and central forward in their studies [3, 22, 23, 27]. The issue in this approach is that all central midfielders (CMs) are grouped into the same category, even though they may have entirely different roles on the field.

Some more recent studies [1, 5], but also an older one [12], separated defensive central midfielders (DMCs) from attacking central midfielders (AMCs). However, some formations have one defensive midfielder (e.g., 4-1-4-1) and others have two defensive midfielders (e.g., 4-2-3-1), which can cause variations in their RP. Additionally, the classification of box-to-box midfielders is not mentioned, as they do not really belong to either category, being neither purely defensive nor attacking midfielders, but between the two categories [31]. The issue with box-to-box midfielders was addressed by Ju et al. [19], who instead of positions in the formation, used the roles of players on the field. Specifically, three roles were used for CMs: box-to-box midfielders, central defensive midfielders, and central attacking midfielders. Thus, this study covered all three main roles that a CM can have in a soccer match but did not take into account that these roles might have different RP based on the team's formation.

Based on the above literature review, the author thought it would be useful to conduct a study that covers all cases for the positions of CMs. Such a study would have significant practical importance for coaches and fitness coaches of teams. However, because it would be extremely difficult to conduct a study that covers all formations, while there would also be (both methodological and practical) problems arising from the fact that some formations have two CMs and others have three, the author decided to focus on formations in which teams have three CMs and play with a back four. Formations with three central defenders were not considered, as these formations have completely different requirements for the RP of players based on their position [16], and generally have significant differences from formations with two central defenders (back four) [7, 24, 25, 29].

Aim of Study

To address the gaps in the literature mentioned above while making a useful contribution for practitioners in soccer, it has been hypothesized that players who play as CMs have different physical demands depending on their specific position in the team's formation. Therefore, the aim of the present study was to investigate the RP profile of CMs based on their specific position in the team's formation, when it includes a total of three CMs and a team plays with a back four.

Material and Methods

Study design

In this study, data of the RP of players who competed in the Turkish Super League during the 2021-2022 season was used. From the total available data, only the data of players who played as CMs in teams that used formations with four defenders and three CMs was included. Figure 1 shows all the team formations used by coaches that met these criteria. As seen in Figure 1, the arrangement of CMs in the team formation could

GK – goalkeeper, CB – center back, RB – right back, LB – left back, DM – defensive midfielder, RM – right midfielder, LM – left midfielder, CM – central midfielder, AM – attacking midfielder, RW – right winger, LW – left winger, CF – center forward

Figure 1. Team formations with four defenders and three central midfielders according to InStat Scout: a) 4-4-1-1, b) 4-2-3-1, c) 4-3-3, d) 4-1-4-1

take two forms: a) two DMC + one AMC, and b) one DMC + two MC. Therefore, CMs could have four main roles: a) AMC, b) MC, c) single DMC (sDMC), and d) DMC paired with another DMC (pDMC).

Data collection

The data for the RP of players was obtained using an optical tracking system by InStat Fitness and provided to the authors in an Excel format with written consent from the company for research purposes (2022, 8 November). InStat Fitness's optical tracking technology is FIFA certified for its high precision and reliability [15]. For the 2021-2022 season, this system was the official EPTS for the Turkish Super League. The data on team formations and player positions was sourced from the InStat Scout platform (https://football.instatscout.com/, 2022) [17]. this platform offers a range of highly reliable statistical data from soccer matches (Cohen's kappa = 0.93) [9].

Sample

This study examined the data from the 2021-2022 season of the Turkish first division, involving 20 teams across 38 matchdays, each with 10 games. InStat Scout provided data for the first 24 matchdays (apart from 2 matches for which there was no data), covering a total of 238 matches. For each match, there was individual and team running variable data (two Excel sheets). In the sheet with the individual data, two additional columns for the team's initial formation and the player's position were added. All observations were removed if: a) the team formation did not have four defenders and three CMs, b) they did not concern players who were one of the three CMs, and c) they did not concern players who participated for the entire 90 minutes. Thus, the final sample consisted of 542 observations of players who played the full 90 minutes, with their team starting with the formation of four defenders and three CMs, and they were one of the three CMs.

Variables

The InStat's optical tracking system provides data on total distance covered by players (TD) as well as distances covered at six different intensity levels [32], as shown in Table 1. For this study, the three lowest intensity levels were combined into one variable, and the two highest into another, as in previous research [30]. Thus, the study had four dependent variables: a) TD, b) distance covered at low speeds (LSD, <4 m/s), c) distance covered at moderate speeds (MSD, 4-5.5 m/s), and d) distance covered at high speeds (HSD, >5.5 m/s) [30]. The fixed factor was the player's position (variable POSITION), which could take four values: a) AMC, b) MC, c) sDMC, and d) pDMC.

Table 1. Intensity levels for InStat and their adaptation for the current study

InStat intensity levels	Adapted intensity levels
Speed up to 0.2 m/s (standing)	low speed (LSD)
Speed 0.21-2 m/s (walking)	
Speed 2.01-4 m/s (jogging)	
Speed 4.01-5.5 m/s (running)	moderate speed (MSD)
Speed 5.51-7 m/s (high-speed running)	high speed (HSD)
Speed over 7 m/s (sprint)	

Statistical analysis

A one-way ANOVA analysis was applied to each of the four dependent variables (TD, LSD, MSD, HSD) after verifying the normal distribution of the data in all categories (AMC, MC, sDMC, pDMC) by applying the Kolmogorov–Smirnov test. The Levene's test was used to examine the equality of variances. The Bonferroni test was employed for post hoc multiple comparisons. In cases where statistically significant differences were found, Cohen's d was calculated to assess the effect size (practical significance of the results). All statistical analyses were performed using the SPSS software package (version 29.00, IBM Corporation, Armonk, NY, USA) with a confidence level of $p < 0.05$. The effect sizes were defined as follows: trivial ($d < 0.19$), small ($d = 0.2$-0.49), medium ($d = 0.5$-0.79), and large ($d > 0.8$) [11]. Error bars were created with SPSS, while Power BI was used for a radar chart. Before creating the radar chart, Z-values of the dependent variables in the categories of the fixed factor were calculated to provide a common scale of values and thus better visualization.

Ethics

This research is a part of a larger project on the application of new technologies in soccer performance analysis, approved by the bioethics committee of the local University on October 12, 2022 (approval code: 1973). Written permission from the InStat Ltd company was received on November 8, 2022, authorizing the use of their data for research and publication purposes.

Results

Table 2 presents the descriptive statistics. Specifically, it shows the number of observations (cases) for each of

the four categories of the POSITION variable as well as the mean values of the four running variables.

Table 2. Descriptive statistics

POSITION	Cases	LSD	MSD	HSD	TD
AMC	92	8245.86	2250.98	1043.87	11538.65
MC	124	8268.93	2318.41	1043.52	11628.70
sDMC	107	8234.43	2281.63	915.56	11429.68
pDMC	219	8223.00	2280.30	975.53	11477.20
Total	542	8239.64	2284.30	990.85	11512.91

Note: LSD – low speed distance, MSD – moderate speed distance, HSD – high speed distance, TD – total distance, AMC – attacking midfield center, MC – midfield center, sDMC – single defensive midfield center, pDMC – pair defensive midfield center

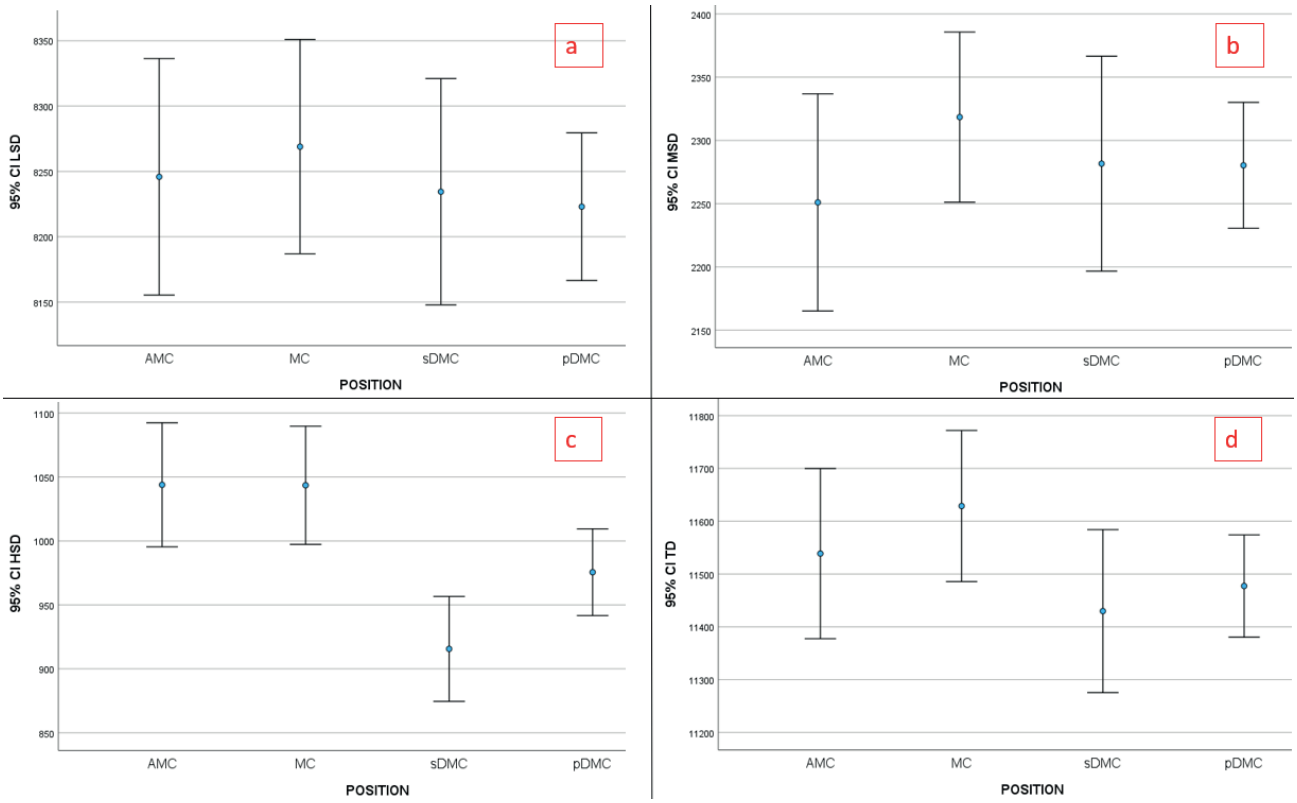
Table 3 shows the results of the ANOVA analysis. From the results it appears that there are statistically significant differences ($p < 0.001$) only in the HSD variable. Figure 2 displays the error bars for the four POSITION categories across the four running variables.

Table 3. ANOVA analysis

Variable	Sum of squares	df	Mean square	F	Sig.	Eta-squared
LSD	173462.54	3	57820.85	0.30	0.827	0.002
MSD	250701.63	3	83567.21	0.53	0.661	0.003
HSD	1260458.04	3	420152.68	7.00	<0.001	0.038
TD	2743948.56	3	914649.52	1.54	0.202	0.009

Note: LSD – low speed distance, MSD – moderate speed distance, HSD – high speed distance, TD – total distance

The Bonferroni multiple comparisons test for the HSD variable showed statistically significant differences between sDMC and AMC as well as between sDMC and MC. Specifically, Table 4 indicates that sDMCs cover significantly shorter high-intensity distances compared to AMCs ($p = 0.002$) and MCs ($p < 0.001$). The Cohen's d coefficients were calculated at 0.574 and 0.533, respectively, indicating a moderate effect in both cases. Lastly, Figure 3 presents the performance profiles of AMC, MC, sDMC, and pDMC based on the mean Z-values of LSD, MSD, HSD, and TD.



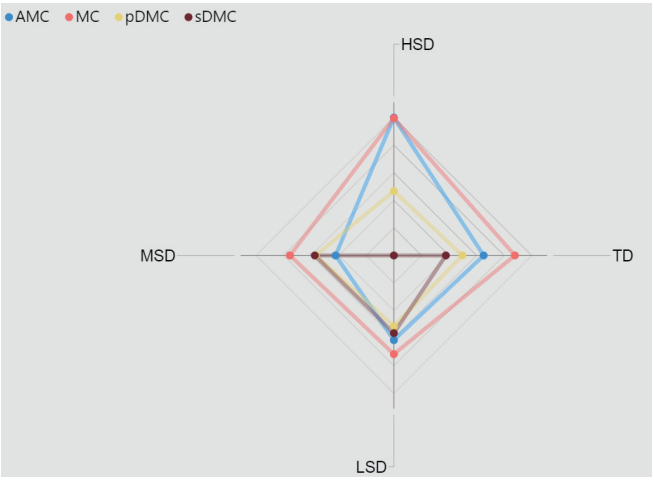
LSD – low speed distance, MSD – moderate speed distance, HSD – high speed distance, TD – total distance, AMC – attacking midfield center, MC – midfield center, sDMC – single defensive midfield center, pDMC – pair defensive midfield center

Figure 2. Error bars: a) LSD, b) MSD, c) HSD, d) TD

Table 4. Multiple comparisons test for the HSD variable

(I) POSITION	(J) POSITION	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
AMC	MC	0.35	33.71	1.000	–88.91	89.62
	sDMC	128.31	34.83	0.002	36.07	220.55
	pDMC	68.34	30.44	0.151	–12.26	148.94
MC	AMC	–0.35	33.71	1.000	–89.62	88.91
	sDMC	127.96	32.33	0.001	42.35	213.56
	pDMC	67.98	27.53	0.083	–4.93	140.89
sDMC	AMC	–128.31	34.83	0.002	–220.55	–36.07
	MC	–127.96	32.33	0.001	–213.56	–42.35
	pDMC	–59.97	28.90	0.231	–136.49	16.55
pDMC	AMC	–68.34	30.44	0.151	–148.94	12.26
	MC	–67.98	27.53	0.083	–140.89	4.93
	sDMC	59.97	28.90	0.231	–16.55	136.49

Note: HSD – high speed distance, AMC – attacking midfield center, MC – midfield center, sDMC – single defensive midfield center, pDMC – pair defensive midfield center



LSD – low speed distance, MSD – moderate speed distance, HSD – high speed distance, TD – total distance, AMC – attacking midfield center, MC – midfield center, sDMC – single defensive midfield center, pDMC – pair defensive midfield center

Figure 3. Running performance profiles of AMCs, MCs, pDMCs, and sDMCs

Discussion

The aim of this study was to investigate the RP profiles of CMs based on their specific roles within formations that include three CMs and a back four. The roles analyzed were AMC, MC, sDMC, and pDMC. The main findings indicated significant differences in HSD covered among these roles, with sDMCs covering significantly less distance at high speeds compared to AMCs and MCs. Additionally, no significant differences were found in TD, LSD, and MSD among the roles.

As previously mentioned, there are no similar studies that examined the RP of all the positions that a CM can have in various formations. However, there are studies that separated DMCs from AMCs. For example, a) Asian-Clemente et al. [5] have found that AMCs cover greater distances than DMCs at speeds >21 km/h (5.83 m/s), b) Altmann et al. [1] have found that AMCs cover greater distances than DMCs in high-speed and sprint running, with no difference in TD, and c) Dellal et al. [13] have found that AMCs cover significantly greater distances than DMCs at speeds of 21-24 km/h (5.83-6.66 m/s), with no difference in TD. Additionally, Ju et al. [19], who investigated the RP of roles that a player can have regardless of a team's formation, found that DMCs cover less distance in high-intensity running compared to AMCs and box-to-box CMs. Furthermore, comparing the RP of the role with the RP of the general position (CM), they have found that DMCs covered 30% less distance in HSD, while AMCs covered 22% more distance than CMs.

The findings of all abovementioned studies agree with the findings of the current research, in which the author has found that DMCs cover shorter distances in HSD than MCs and AMCs. However, the detailed

methodology followed in the present study allowed the author to discover that this difference exists only for sDMCs and not for pDMCs. The findings also agree with the previous studies that there are no differences in TD among the various types of CMs. Additionally, the current research has found that the same applies to LSD and MSD, which had not been investigated in previous studies. One possible explanation for these findings is the tactical role of DMCs. Coaches often ask them to remain closer to defense to provide protection and prevent opposing attacks. This role limits their involvement in offensive and finishing actions that require sprinting runs [32]. Furthermore, DMCs tend to maintain a more stable and central position on the field, covering fewer high-intensity meters compared to MCs and AMCs, who are more involved in both offensive and defensive transitions. Indeed, the research of Plakias et al. [32] has shown that transitions increase the demands of high-intensity running. Additionally, DMCs might manage their energy differently, avoiding frequent high-intensity runs to remain effective throughout a match, as their role necessitates continuous and steady defensive participation.

This study, providing the analysis of the RP profiles of CMs based on their specific roles within a team formation, has many advantages. The innovation of this research lies in its detailed categorization of CM roles (AMC, MC, sDMC, pDMC). By focusing on formations with three CMs and a back four, this study addresses a significant gap in the literature, providing valuable insights that can directly inform coaching practices. The ability to tailor training programs based on specific positional demands represents significant advancement in sports science [19]. Coaches can now develop more precise and effective conditioning programs, optimizing player performance and reducing the risk of injury. Moreover, this research can inform tactical decisions, helping coaches understand physical capabilities required for different roles and adjust team formations and players' positions accordingly. The findings also have broader implications for talent identification and development [8]. Understanding the specific physical demands of different CM roles can aid in scouting and development of young talents, ensuring players are trained in a manner that aligns with their potential future roles on the field.

Although the study has numerous advantages, it is not without limitations. The most significant limitation of the present research is that the data for team formations and player positions are based on an initial lineup at the start of a match. Furthermore, the data on players' RP was collected for an entire match, following a static method rather than a dynamic one, which could offer more detailed information based on changing situations (e.g., scoreline) during the game [33]. Another limitation is the focus on a single league (Turkish Super League), which may limit the generalizability of the findings to other leagues with different playing styles and competitive levels. Additionally, the study only considered the formations with a back four, excluding formations with three central defenders, which could present different running demands. Future research should explore RP profiles across different leagues, levels of competition, and various tactical formations to validate and extend these findings. Additionally, using a dynamic method instead of a static one can provide contextualized information, increasing the practical significance of findings [21]. For example, investigating the impact of tactical adjustments during matches and their influence on RP could provide deeper insights into the dynamic nature of soccer.

Conclusions

The findings of this study indicate that there are significant differences in HSD among different types of CMs in the formations with three CMs and a back four. Specifically, sDMCs cover significantly less HSD compared to both MCs and AMCs. These differences can be attributed to the distinct tactical roles and responsibilities assigned to each type of CM. sDMCs are generally tasked with providing defensive stability, which limits their involvement in high-intensity sprints, unlike their more offensively oriented counterparts. The insights from this study provide valuable information for coaches in terms of player positioning and team formation, allowing for more strategic decisions based on the specific RP profiles of their CMs. Future research should consider expanding the scope to include various league levels and formations to validate these findings and explore their broader applicability.

Conflict of Interest

The author has no conflicts of interest to report.

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