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Match activity profiles and maximum sprint speed by position during the 2023 FIFA U-17 World Cup

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Abstract

The Object of the study aims to analyze and compare activity profiles and maximum sprint speed among playing position in youth elite football, for this purpose, we studied total distance covered, distances covered in all speed zones, high-speed runs, sprints, and maximum speed. On a sample composed of 240 U-17 players (884 match observation) taking part of all matches of 2023 FIFA U-17 World cup, and data were obtained through the FIFA Training Centre platform, where this platform presents post match summary reports for all games of the tournament. After collecting the results and having treated them statistically, we conclude Statistically significant differences ($p < 0.001$) were found across all variables. On this basis, the study recommended to implement position-specific training programs, Integrate maximum speed development in youth training, monitor and adjust match loads by position and use activity profile data in talent identification.

1. Introduction

Football is a complex sporting activity, in other words, the player's performance depends on the combination of his technical, tactical, physical, psychological and mental abilities, and each playing position has specific characteristics that differ according to the requirements and the technical and tactical orientations (defensive and offensive animation) imposed by the technical staff. Many high-level coaches also believe that physical preparation has an important place in modern football, so the physical activity that a modern high-level football player performs during a football match must be precisely defined (Dellal A. , 2020). The physical demands of match-play have become a central focus for coaches, fitness trainers, analysts and sport scientists, understanding the physical demands of players especially in terms of running distances and sprinting abilities has become important for optimizing performance, preventing injuries, and talent development. These physical demands are note constant across the field, they differ signifiacntly depending on playing position. (Bradely & al, 2009) Although, many studies have explored activity profiles in adult football, including total distance covered, running distances, and sprints (Chmura & al, 2017; (Clemente & al, 2013)), there is comparatively less research focused on elite youth players, while some information is available about the physical and physiological demands of highly trained young soccer players during match play (Castagna & al, 2003;(Stroyer & al, 2004)). Previous researchs in youth football (Buchheit & al, 2010; (Rebelo & al, 2014) had analysed total covered and the high-intensity distances, in contrast, are often characterized by lower-intensity distances and maximum sprinting speed. However, Youth competitions such as the FIFA U-17 World Cup offer a valuable opportunity to analyze the physical profile of participating talet in real-match conditions.

The 2023 FIFA U-17 World Cup in Indonesia provided an ideal context to analyse the physical demand at the elite youth fotball. The aim of this study is analysing and comparing the running distances across different speed zones and the maximum speed recorded by players according to their playing positions. Knowing these differences is important for coaches and youth football development.

2. Method and Materials

This study employed a comparative quantitative research design to investigate whether playing position influences match-play physical

performance indicators (total distance covered, distance covered in speed zones, high speed runs, sprints, top speed) among U-17 footballers during the FIFA U-17 World Cup held in Indonesia (2023).

2.1. Participants

The research material consisted of 504 male U-17 soccer players from 24 teams taking part in the U-17 FIFA world cup Indonesia 2023. The physical activity of all player, excluding the goalkeepers (due to the distinct nature of their physical demands), who played for the whole duration of the match (without extra time) was analyzed. The number of such players in all 52 matches in the seven rounds of the tournament was: n= 240. The player's mean body height was 178 ± 2 cm , body mass 68 ± 4 kg and age 16.6-16.8 years (FIFA High Performance, 2023) .

2.2. Materials

The data used in this study were obtained through the FIFA Training Centre platform (FIFA, 2023), where this platform presents post match summary reports for all games of the tournament. All 52 games during FIFA U-17 World Cup Indonesia 2023 were analysed using a multi-camera optical tracking system (TRACAB Gen5, ChyronHego) . All player movements were captured by high-definition cameras operating at 25Hz. The validity of this system was quantified by FIFA to verify the capture process and subsequent accuracy of the data (FIFA, Electronic Performance & Tracking Systems Test Report: Tracab Gen5, 2023). After system calibration and various stringent quality control process, the data was analysed using match analysis software (Bradley, 2023), This produced a data set on each team and each player's activity pattern during a match using specified speed zones as follows:

Table 1 The speed zones

Speed zone	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Speed	0 – 7 Km/h	7 – 15 Km/h	15 – 20 Km/h	20 – 25 Km/h	› 25 Km/h

2.3. Design and Procedure

The analysis was carried out using the data obtained through the platform of FIFA Training Centre as mentioned previously. In terms of player-related data, the dependent variables of the total distance covered(m), the distance covered in every speed zone (m), high speed runs (zone 4) (times), number of sprint (zone 5), and top speed.

Playing position is considered to be an independent variable, the goalkeepers were excluding due to the distinct nature of their physical demands, so the players' positions were divided into 4 groups: 1) central

defender (CD); 2) fullback (FB); 3) midfielder (M; defensive and attacking midfielder); 4) forward (F; Striker and winger). The analysis in this study determine the physical demands of the independent variable at youth elite football.

However, in order to allow for an accurate and fair comparison, the research sample consisted the players who played the whole duration of the match (without extra time),with taking consideration of match observations of every playing position.

Table 2 Distribution of sample according to playing positions and match observations

Playing position	Number of players	Percentage (%)	Match observations (min-max)
Central defender (CD)	n= 50	20,83 %	213 (1-7)
Fullback (FB)	n= 46	19,2 %	189 (1-7)
Midfielder (M)	n= 75	31,26 %	227 (1-7)
Forward (F)	n= 69	28,6 %	219 (1-7)
Total	n= 240	100%	884

2.4. Statistical Analysis

A normality test was conducted to assess whether the data followed a normal distribution, both the Shapiro-Wilk and Kolmogorov-Smirnov tests were used, the results showed that all variables are normally distributed ($p < 0,05$).

Descriptive statistics (mean, standard deviation, minimum, maximum) were calculated for each dependent variable.

To determine whether significant differences existed between playing positions, a One-Way ANOVA was conducted for each dependent variable. Where significant differences were found ($p < 0,05$), Tukey's HSD post hoc test was used to identify the specific positional pairs with significant differences.

All statistical calculations were made using the IBM SPSS Statistics software (ver. 23).

3. Results

The study showed that all players taking part in the 2023 U-17 World Cup in Indonesia covered a mean distance of 9781.6 ± 1266 m per match, the mean distance covered at speed zone 1 was 3761.2 ± 583.4 m, and 4215.7 ± 793.4 m at speed zone 2, 1195.2 ± 352.8 m at zone 3, 501.1 ± 199.5 m at zone 4, and the mean distance covered at speed zone 5 was 152.8

± 97.2 m, with players averaging 104.5 high speed runs (zone 4) and 38.7 sprints (zone5) per match, finally the mean top speed recorded was 30.7 ± 1.8 km/h.(Table 3) .

After examining positional differences with one-Way ANOVA, significant positional differences were found in all dependent variables ($p < 0,05$).

Total distance covered :

The comparison of the mean total distance covered per match among the playing positions showed statically significant differences ($F = 23.12$; $p < 0.001$) (Table 4). More specifically, the post hoc tests showed that midfielders covered the largest distance in comparison to central defenders (mean difference = +1115.55 m), ($p < 0.001$), fullbacks (+873.8 m), ($p < 0.001$), and forwards (+771.8 m), ($p < 0.001$). in brief, the central defender position shows the least distance covered.

Distance covered at speed zone 1 (0-7 km/h) :

The analysis of the mean covered distance at speed zone 1 among the playing positions showed statically significant differences ($F = 11.46$; $p < 0.001$) (Table 4). More specifically, post hoc tests showed that the largest distance covered at speed zone 1 was covered by central defenders in comparison to midfielders (mean difference = +389.09 m), ($p < 0.001$), fullbacks
(+180.3 m), ($p < 0.05$), but not for forwards ($p = 0.179$). While, the midfielder position shows the least distance covered at this speed zone.

Distance covered at speed zone 2 (7-15 km/h) :

The comparison of the mean distance covered at speed zone 2 among the playing positions showed statically significant differences ($F = 36.16$; $p < 0.001$) (Table 4). More specifically, the post hoc tests showed that midfielders covered the largest distance in comparison to central defenders (mean difference = +771.76 m), ($p < 0.001$), fullbacks (+622.47 m), ($p < 0.001$), and forwards (+796.74 m), ($p < 0.001$). in brief, the forward position shows the least distance covered.

Distance covered at speed zone 3 (15-20 km/h) :

A comparison of the mean distance covered at speed zone 3 among the playing positions showed statistically significant differences ($F = 78.12$; $p < 0.001$) (Table 4). More specifically, the post hoc tests showed that midfielders covered the largest distance in comparison to central defenders (mean difference = +526.44 m), ($p < 0.001$), fullbacks (+332.33 m), ($p <$

0.001), and forwards (+305.23 m), ($p < 0.001$). while, the central defender position shows the least distance covered.

Distance covered at speed zone 4 (20-25 km/h) :

The analysis of the mean covered distance at speed zone 4 among the playing positions showed statically significant differences ($F = 47.47$; $p < 0.001$) (Table 4). More specifically, the post hoc tests showed that central defenders covered the least distance at this speed zone in comparison to fullbacks (mean difference = -153.94 m), ($p < 0.001$), midfielders (-165.26 m), ($p < 0.001$), and forwards (-197.58 m), ($p < 0.001$).While, there was no statically significant differences between fullbacks and midfielders , fullbacks and forwards.

Distance covered at speed zone 5 (›25 Km/h) :

The comparison of the mean distance covered at speed zone 5 among the playing positions showed statically significant differences ($F = 21.09$; $p < 0.001$) (Table 4). More specifically, the post hoc tests showed that forwards covered the largest distance in comparison to central defenders (mean difference = +68.96 m), ($p < 0.001$), midfielders (+73.95 m), ($p < 0.001$), but not for fullbacks ($p = 0.458$). The position that showed the second largest distance covered in this speed zone was the fullback in comparison to central defenders (mean difference = +51.73 m), ($p < 0.001$), midfielders (+56.72), ($p < 0.001$), but not for forwards ($p = 0.458$). in brief, the midfielder position shows the least distance covered.

High speed runs (speed zone 4) :

The comparison of the mean number of high speed runs among the playing positions during U-17 World Cup Indonesia 2023 shows statically significant differences ($F = 67.779$; $p < 0.001$) (Table 4). More specifically, the post hoc tests showed that the largest number of high speed runs was recorded by midfielders in comparison to central defenders (mean difference = +36.71), ($p < 0.001$), fullbacks (+20.72), ($p < 0.001$), and forwards (+18.16), ($p < 0.001$). there was also statically significant differences for both forwards and fullbacks in comparison to central defenders (+18.55), (+15.99) respectively, ($p < 0.001$). while, the least number of high speed runs was recorded by central defenders.

Number of sprints (speed zone 5) :

The analysis of the mean number of sprints among the playing positions shows statically significant differences ($F = 48.143$; $p < 0.001$) (Table 4). In more detail, the post hoc tests showed that the most number of sprints was recorded by forwards in comparison to central defenders (mean

difference = +15.28), ($p < 0.001$), midfielders (+5.27), ($p \leq 0.001$), and with a little less significance in comparison to fullbacks (+4.47), ($p = 0.007 < 0.05$). In brief, the central defender position shows the least number of sprints.

Top speed :

A comparison of the mean top speed among playing positions shows statically significant differences ($F = 12.842$; $p < 0.001$) (Table 4). Specifically, post hoc tests showed that the highest top speed was recorded by forwards in comparison to central defenders (mean difference = +0.991 km/h), ($p < 0.001$), midfielders (+1.277 km/h), ($p \leq 0.001$), but not for fullbacks ($p = 0.082$). Briefly, the midfielder position shows the lowest to speed.

Table 3 Descriptive statistics (IBM SPSS Statistics software ver. 23)

Variable	Mean	Minimum	Maximum	SD
Total distance covered (m)	9781.6	1056.4	13228.0	1266.1
Speed Zone 1 (0-7 km/h) (m)	3761.2	2179.6	9723.2	583.4
Speed Zone 2 (7-15 km/h) (m)	4215.7	2134.1	6939.3	793.4
Speed Zone 3 (15-20 km/h) (m)	1195.2	403.2	2688.0	352.8
Speed Zone 4 (20-25 km/h) (m)	501.1	47.5	1116.8	199.5
Speed Zone 5 (›25 km/h) (m)	152.8	6.7	756.0	97.2
High speed runs (Zone 4) (n)	104.5	34	185	25.7
Sprints (Zone 5) (n)	38.7	12	79	10.0
Top speed (km/h)	30.7	25.0	35.7	1.8

Table 4 One-Way ANOVA comparison between playing positions (IBM SPSS Statistics software ver. 23)

		Sum of squares	df	Mean square	F	Sig.
Total distance	Between groups	98811377,996	3	32937125,999	23,120	,000
	Within groups	750766926,215	881	1424605,173		
	Total	849578304,211	884			
Zone1: 0-7 km/h (m)	Between groups	11049583,152	3	3683194,384	11,462	,000
	Within groups	169347751,522	881	321342,982		
	Total	180397334,674	884			
Zone2: 7-15 km/h (m)	Between groups	56920088,087	3	18973362,696	36,157	,000
	Within groups	276541117,807	881	524745,954		
	Total	333461205,893	884			
Zone3: 15-20 km/h (m)	Between groups	20306232,447	3	6768744,149	78,121	,000
	Within groups	45661727,193	881	86644,644		
	Total	65967959,640	884			
Zone4: 20-25 km/h (m)	Between groups	3228298,635	3	1076099,545	47,471	,000
	Within groups	11946367,309	881	22668,629		
	Total	15174665,944	884			
Zone5: 25+ km/h (m)	Between groups	525565,289	3	175188,430	21,094	,000
	Within groups	4376704,269	881	8304,942		
	Total	4902269,558	884			
High speed runs (Zone4)	Between groups	97438,091	3	32479,364	67,779	,000
	Within groups	252535,706	881	479,195		
	Total	349973,797	884			
Sprints (Zone5)	Between groups	16776,259	3	5592,086	48,143	,000
	Within groups	61213,847	881	116,155		
	Total	77990,105	884			
Top Speed (km/h)	Between groups	115,705	3	38,568	12,842	,000
	Within groups	1582,696	881	3,003		
	Total	1698,401	884			

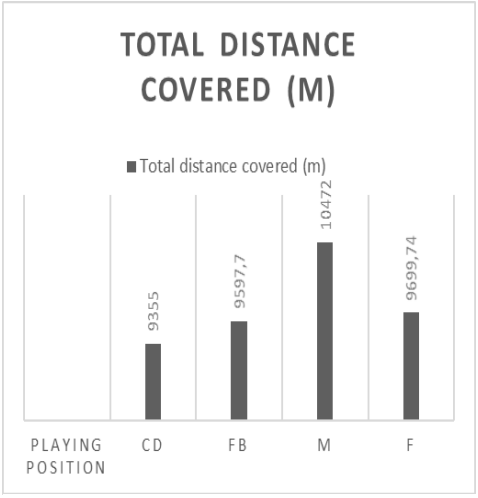

Figure 1 Mean total distance covered by playing position

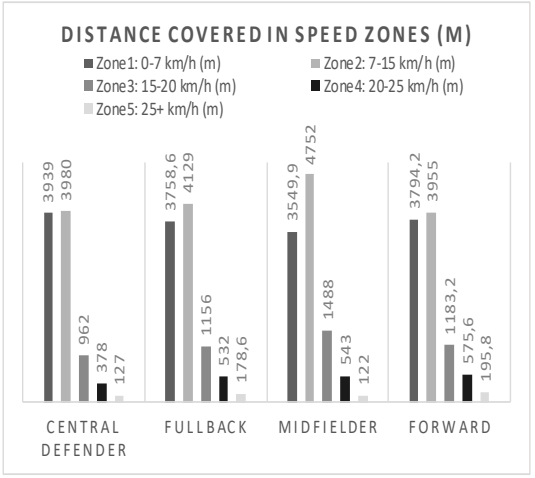

Figure 2 Mean distances covered in different speed zones by playing position

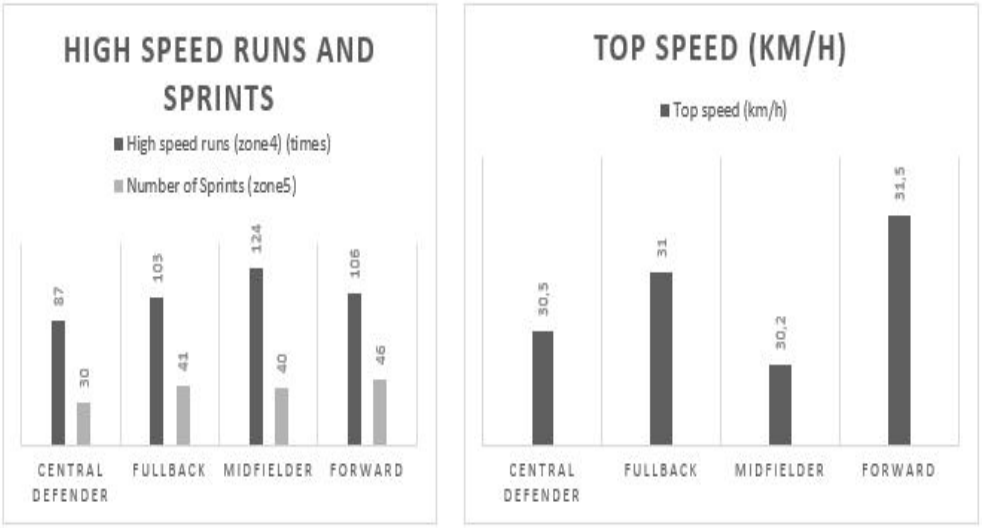

Figure 3 High-speed runs, sprints and top speed means by playing position

4. Discussion

The physical profile of players in professional team sports has been well described, especially in relation to individual playing positions (Dellal & al, 2012). The main of the present study was to analyse and compare the variables that were influenced by tactical positions at the 2023 U-17 World Cup. The total distance covered by the players in each game varies according to the position played, it has been reported that the highest distances are covered by midfield players, while the least distance usually covered by central defenders (Reilly & al, 2008). Also, on youth football, the study of (Buchheit & al, 2010) shows that the midfielders covered the greater total distance, central defenders the lowest. Similary, (Rebelo & al, 2014) found the similar results in U-17 Portuguese players, where midifielders covered the highest total ditance, reflecting their involvement in all phases of play. This study confirms that midfielders cover the most total distance, followed by forwards and fullbacks (Figure 1). Generally, the highest total distance covered per game is achieved by midfielders due to their dual offensive and defensive responsibilities (Bloomfield & al, 2007, Reilly & Thomas, 1976). The relatively lower total distance covered by central defenders showed in the current study align with the position's responsibilities, which are typically more static and focused on tactical positioning with short actions rather than extensive running. This was confirmed by (Buchheit & al, 2010).

As the study showed that central defenders covered the most distance covered in low-intensity zone (speed zone 1) (Figure 2), this aligns with the results of (Buchheit & al, 2010), who observed that central defenders in youth football engage in low-intensity, due to their deeper positioning and defensive responsibilities. While the midfielders covered the least distance in this speed zone, suggesting to their active role and more dynamic, with less time spent in walking phases. Midfielders covered the most distance at speed zone 2 (7-15 km/h), while the least distance was covered by forwards (Figure 2), these findings are in line with the study of (Rebelo & al, 2014), which showed that midfielders in youth competitions have the most prolonged connection in both offensive and defensive sequences, which required a continuous moderate-intensity efforts. While forwards recorded the lowest values at this speed zone, which perhaps be explained by their motion sequences that focuses on short, high-intensity efforts.

According to (Bradely & al, 2009), (Harley & al, 2010) high-intensity running in youth football is important for maintaining tactical shape, especially in the midfield zone, where players must create and close down spaces, recovery runs, pressing and transitions. While, central defenders due to their limited motions, covered the least distance with high-intensity running. The present study shows that there was significant statically positional differences at speed zone 3 (high-intensity running) (Figure 2), where midfielders players during 2023 World Cup U-17 covered the highest distance, central defenders recorded the least distance covered in this speed zone. These results confirm the transitional role midfielders play in attacking and defending phases.

The analysis of distance covered at speed zone 4 by players who take part in 2023 U-17 World Cup showed that central defenders covered less distance comparing to all other position. On the other side, fullbacks, midfielders, and forwards showed similar values of very high intensity running, with no statistically significant differences among them (Figure 2). These results suggest that at U-17 group age , forwards and wide players begin to display movement patterns combined with higher levels of play. In line with the study of (Jastrzebski & al, 2013), these distances are important for counter-attacks, overlapping runs, and high pressing, which are progressively focused in modern youth football tactics.

Forwards covered the highest distance at speed zone 5 (> 25 km/h) comparing to the other playing positions (Figure 2), these results are in line

with (Mujika & al, 2009) and (Di Salvo & al, 2007), who agreed that forwards in both youth and professional football perform more sprints to create spaces, exploit defensive intervals and attack in depth. With Midfielders showed the least sprinting activity, which reflects their role of covering large distances rather than short.

The present study shows that midfielders performed the most number of high-speed runs, these results refers to their repeated engagement in dynamic transitions and pressing. While, the lowest number of high-speed runs where recorded by central defenders, suggesting their comparatively static roles. On the other hand, forwards got the most number of sprints, more than midfielders and defenders (Figure 3), referring to the explosive and high-intensity actions of forward in both youth and professional football, the study of (Di Salvo & al, 2007) agree this fact.

Concerning top speed, forwards recorded the highest top speed followed by fullbacks, while midfielders recorded the lowest values (Figure 3). This results correspond with demands of forwards to reach top speeds during counterattacks and accelerate quickly to create spaces or chances, secondly fullbacks achieved the highest top speed, due to their tactical roles demands, by their participation in the attacking phases. According to (Buchheit & al, 2010), the ability to reach high values of top speed is a identifying factor for attacking players at elite football.

Conclusion

The purpose of this study was to analyse certain differences among playing positions and to quantify the demands placed on soccer players in each playing position during the 2023 FIFA U-17 World Cup matches. Furthermore, The total distance covered by players, distances covered across five speed zones, high-speed runs, sprints and top speed. The study showed statically significant differences among playing positions, Concluding that each tactical position has its specific demands. These results highlight the development of position specific physical profiles in youth football. Coaches, scouts, analysts are encouraged to consider findings in implement position-specific training programs, integrate maximum speed development in youth training, monitor and adjust match loads by position and use activity profile data in talent identification.

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