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An Analysis of Positional Generic and Individualized Speed Thresholds Within the Most Demanding Phases of Match Play in the English Premier League

Ronan Kavanagh,[1,2] Kevin McDaid,[3] David Rhodes,[4] Jack McDonnell,[3] Rafael Oliveira,[5,6,7] and Ryland Morgans[2,8]

[1]Nottingham Forest FC, Nottingham, United Kingdom; [2]Football Performance Hub, Institute of Coaching and Performance, University of Central Lancashire, Preston, United Kingdom; [3]Applied Data Analytics Research Group, Dundalk Institute of Technology, Louth, Ireland; [4]Human Performance Department, Burnley Football Club, Burnley, United Kingdom; [5]Sports Science School of Rio Maior—Polytechnic Institute of Santarém, Rio Maior, Portugal; [6]Research Center in Sport Sciences, Health Sciences and Human Development, Vila Real, Portugal; [7]Life Quality Research Center, Rio Maior, Portugal; [8]School of Sport and Health Sciences, Cardiff Metropolitan University, Cardiff, United Kingdom

Objectives: To analyze the positional distances covered above generic and individualized speed thresholds within the most demanding phases of match play. Categorized by position, 17 English Premier League players' match data were analyzed over 2 consecutive seasons (2019–20 and 2020–21). The most demanding phases of play were determined using a rolling average across 4 periods of 1, 3, 5, and 10 minutes. Distance covered in the time above the standard speed of 5.5 m/s was analyzed, with individualized metrics based on the maximal aerobic speed (MAS) test data. ***Results:*** Central defenders displayed lower values for high-intensity periods when compared with fullbacks, midfielders, and wide midfielders for both generic and individualized metrics. MAS during 1-minute periods was significantly higher for forwards when compared with central defenders (82.9 [18.9] vs 67.5 [14.8] for maximum high-speed running [HSR] and 96.0 [15.9] vs 75.7 [13.8] HSR for maximum MAS activity). The maximum effect size differences between the central midfielders, wide midfielders, and fullbacks for HSR and MAS measures under the maximum HSR criterion was 0.28 and 0.18 for the 1-minute period, 0.36 and 0.19 for the 3-minute period, 0.46 and 0.31 for the 5-minute period, and 0.49 and 0.315 for the 10-minute period. ***Conclusions:*** Individualized speed metrics may provide a more precise and comparable measure than generic values. Data appear to be consistent across playing positions except for central defenders. This information may allow practitioners to directly compare individualized physical outputs of non–central defenders during the most demanding phases of play regardless of the players' positional group. This may provide coaches with important information regarding session design, training load, and fatigue monitoring.

Keywords: football, match performance, most demanding passages of play, maximal intensity periods, performance analysis, soccer

Quantification of the intensity and volume of match-play running is essential to allow an appropriate prescription of training to optimally prepare players for the ever-evolving demands.[1] Historically, generic speed thresholds have been applied to all squad athletes to facilitate the comparison of physical performance between players within and across teams and leagues.[2] However, these thresholds do not account for individual physical differences and the relative exertion imposed on the player to attain generic speed thresholds. Additionally, information surrounding match pace and distances covered (eg, running meters per minute) may be a more significant method of analyzing players who did not participate in the entire match.[3] Such information may allow a more precise prescription of the running-based exercises required for each player.[4] Accordingly, it has been well established that the selection of running tasks based solely on average match demands can lead to athletes being underprepared for subsequent match play.[5,6] Therefore, it has been argued that the design of specific training activities should pay particular attention to the most demanding phases of match play,[5–7] also recently described as the "worst-case scenarios."[1]

Numerous authors have attempted to address the worst-case scenario concept by employing various methodological approaches and measures to split the match into consecutive periods ranging from 5 to 15 minutes, with key metrics examined per minute during these periods.[5,8–10] Recently, a systematic review reported an inverse association between the duration of worst-case scenarios and running during competitive match play.[1] Furthermore, a position dependency especially when analyzing total distance running performance was observed.[1] The use of rolling periods with a fixed period, previously 1- and 5-minute periods, has been employed, where the 1-minute period has been found to be the most demanding period for a specific metric.[7] However, an alternative approach has examined the longest period that a player exceeds a standardized threshold value,[11] and in many systems, this has been set at 5.5 or 7 m/s to reflect the standard definitions of high-speed running (HSR) and sprint actions, respectively.[11]

A multitude of metrics have been previously employed to measure these most demanding phases of play.[1,5,10] The most widely used measures are distance-based metrics including HSR and sprint distances covered.[7] Furthermore, additional measures have recently been examined such as accelerations and decelerations and hybrid-type metrics such as high metabolic load distance

Kavanagh https://orcid.org/0009-0004-9695-4147
Oliveira https://orcid.org/0000-0001-6671-6229
Morgans https://orcid.org/0000-0003-2007-4827
Rhodes (david@properformance.org.uk) is corresponding author, https://orcid.org/0000-0002-4224-1959

that quantify energy expenditure through a combination of speed and acceleration/deceleration values.[6,12] While these standardized thresholds allow for the comparison of physical performance between players, positions, and leagues, the relative intensity and exertion imposed on the individual player are not considered.[13] Previously, it has been argued that an individualized approach to external load monitoring may also augment practitioner understanding of competition and positional demands.[14] Thus, highlighting the importance of applying a measure that characterizes the functional limits of physical capacity for each individual player.[14]

The analysis of distance covered above maximal aerobic speed (MAS) and maximal sprint speed (MSS) is regarded as a reliable method to provide appropriate contextual training prescription and allows the identification of an individual player's aerobic and anaerobic capacity.[15] Time spent above MAS has also been shown to correlate with improvements in aerobic fitness with a strong positive relationship ($r = .9$) between MAS and the velocity at which maximal oxygen uptake occurs.[16] Furthermore, the importance of peak speed exposure has previously been outlined,[17,18] while the number of exposures above 90% of an athlete's peak speed has been described as a "speed vaccine."[19] Notably, the difference between MAS and MSS has been previously quantified as the anaerobic speed reserve (ASR)[15] and has been used to provide a transition to sprinting.[2,15]

Therefore, the aim of this study was to analyze the positional distances covered above individualized and generic speed thresholds, within the most demanding periods of match play. To the authors' knowledge, this is the first study of its kind to be completed in the English Premier League (EPL) over 2 consecutive seasons. It was hypothesized that playing position will influence the quantity of distance covered above generic and individualized speed thresholds. Additionally, individual thresholds may allow for the comparison of workload between positions.

Methods

Design

A retrospective study was conducted analyzing EPL match data from the 2019–2020 and 2020–2021 seasons for a cohort of 17 male professional soccer players. Data were collected via an Optical Tracking System from 20 EPL stadiums. The most demanding phases of match play were categorized into a range of rolling periods including 1, 3, 5, and 10 minutes, examining the maximal physical performance measures and continuous activity above specific speed thresholds. Individualized HSR thresholds were employed based on MAS test data and were derived from the 1200-m shuttle test.[20] Individualized MSS values were determined from Second Spectrum match data.

Participants

Seventeen male professional outfield soccer players (mean [SD], age at the start of the 2019–2020 season 27.8 [3.5] y, height 183.7 [5.4] cm; weight 83.9 [7.1] kg) from an EPL team participated in the present study. The sample group consisted of outfield players classified into the following positions: fullbacks (FB, n = 4), central defenders (CD, n = 4), central midfielders (CM, n = 3), wide midfielders (WM, n = 3), and forwards (F, n = 3). Second Spectrum data were collated from 76 official league matches during the 2019–2020 and 2020–2021 EPL seasons. Only official league match data were collected for analysis, where 38 were gathered at the study team's home stadium, while the remaining matches were performed at other EPL stadiums. Data were analyzed for the full match duration including any stoppage time, as determined by the official match referee. All data evolved as a result of employment where players were routinely monitored over the course of the competitive season. The study was approved by the club,[21] and ethics was granted by the committee of the host university (BAHSS 646 dated April 17, 2019). In addition, the study was conducted in accordance with the Declaration of Helsinki. To ensure confidentiality, all data were anonymized prior to analysis.

Procedure

League match data across the 2019–2020 and 2020–2021 seasons were recorded and analyzed via the optical tracking system Second Spectrum to report physical performance data. Second Spectrum has been validated by the FIFA program to meet industry standards.[22] Data were collected via semiautomated HD cameras positioned around the stadium with a sampling frequency of 25 Hz. As previously reported, there is no scientific literature available reporting the reliability and validity of the Second Spectrum system, most likely due to the system being adopted by the EPL for the 2019–2020 season.[23]

A total of 814 individual match data points were examined with a median of 47 data points per player (range = 3–74). To ensure the most demanding phases of match play were examined, players were only considered for analysis when time spent on the field exceeded 75 minutes of the entire match.[24] This resulted in 633 full or nearly full match data points for all players with a median of 39 per player (range = 3–74). These criteria excluded only one player (CD) with the remaining 16 players having a median of 40.5 data points per player (range = 8–74).

Individualized thresholds employed to determine key metrics utilized both the player's MAS and MSS values. During the preseason period, MAS values were collected from the 1200-m maximum effort shuttle test. The 1200-m shuttle test has previously shown a strong correlation with other MAS tests.[20,25] Briefly, the test protocol started with poles set at the start point, 20 m, 40 m, and 60 m. Players were instructed to run from the start point to the 20-m pole and return to the start point, then to the 40-m pole, and return to the start point before running to the 60-m pole and returning to the start point (see Figure 1 for test protocol). This sequence was repeated as quickly as possible 5 consecutive times until the distance of 1200 m had been completed.[20] Players were informed how much time was remaining at 1-minute intervals until test completion to ensure players were performing maximally.[26] This verbal encouragement has been shown to be a motivational requirement for laboratory assessments of time to exhaustion and central fatigue.[27] Due to the change of direction within the test, a corrective equation was used: 1200/(time − 20.3 s [0.7 s for each turn]) = MAS (m/s).[25] The mean (SD) MAS value was 4.65 (0.20) m/s. This MAS test was repeated in January. MSS values were extrapolated directly from Second Spectrum match data.

The ASR measure employed a weighted MAS value and the MSS for each player using 70% and 30%, respectively, as previously reported.[2,14] The mean (SD) MSS and related ASR values were 9.09 (0.31) m/s and 5.98 (0.17) m/s, respectively. In the current body of work, this was termed as the ASR30 metric.

The Second Spectrum match data were processed directly using the Python programming language (Python 2.7) through the Spyder scientific development environment (https://www.spyder-ide.org/). Although match data can be imported and filtered through

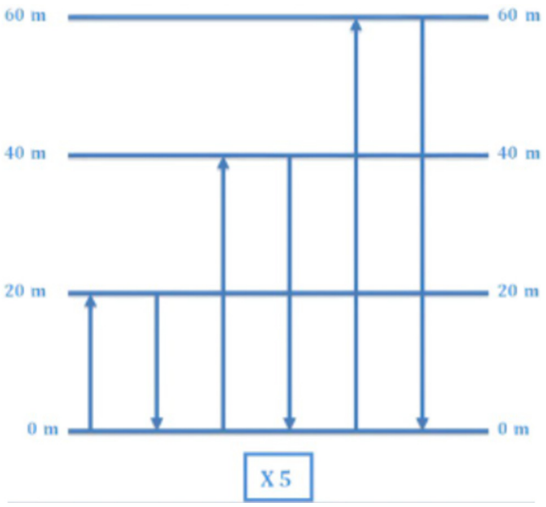

Figure 1 — Bronco 1200-m shuttle test.

several commercially available systems including Sonra (STATSports) and OpenField (Catapult Innovations), processing the data directly via programs such as Python 2.7 allows more detailed analysis of the most demanding phases. Publishing the exact algorithms used to determine the examined measures was not possible due to the technological commercial entities keen to protect their intellectual property rights. Thus, it is understandable that the full details of the conversion and filtering algorithms utilized in these systems were not provided.

For all matches, data were analyzed for the full match duration including any stoppage time. Generic player locomotive variables analyzed included total distance, distance covered above 5.5 m/s (the HSR threshold), and the distance covered above 7 m/s (the sprint threshold). Two individualized measures that included distance covered above MAS and ASR30 were also employed. The most demanding phases (or maximal intensity periods) were first computed by applying a moving average approach across each match for every player using 4 different time durations of 1, 3, 5, and 10 minutes. The maximum value for each period was recorded. Therefore, for each match, maximum values using 5 variables were calculated for each of the 4 periods. The timing of these maximal periods was also recorded. Previously, it has been argued that these periods correspond to normal training duration and have been previously applied by other researchers.[7,28] The most demanding phases of match play or maximal intensity periods were also examined based on the maximum duration that a player was continually above a specific speed threshold. In this case, 2 threshold values were selected, a generic value of 5.5 m/s and an individualized MAS value.

Statistical Analyses

The analysis was conducted with the software R (version 4.2.0, R Foundation for Statistical Computing), with the lme4 package. All variables are shown as mean (SD). A linear mixed model with a random intercept for individual players was developed for each measure under each of the criteria and periods. This was used to compare the examined physical performance variables across playing positions: CD, FB, CM, WM, and F. When there was a significant ($P < .05$) effect for playing position, Tukey tests were used to examine which positions differed. The estimated differences were standardized by the estimated between-subject SD to determine the effect size (ES) and were interpreted as <0.2, trivial; 0.2 to 0.5, small; 0.5 to 0.8, moderate; and >0.8, large.[29]

Results

Table 1 shows the mean (SD) values for the different measures for each position where the most demanding phases of play have been identified based on the total distance covered in the specified periods of 1, 3, 5, and 10 minutes. Table 1 also shows the fixed effect estimates for the models (with CD as a default position) and the associated significance levels for each fixed effect estimate with the intercept values. The interclass correlation coefficients for each model and the *P* value for the fixed effects (position) and random effects (player) are presented.

In Table 1, CM and WM consistently covered the greatest distance, followed by FB and F, with all positions significantly higher than CD (ES = 0.6–2.2). Although, FB consistently produced the highest MAS and HSR distances covered during the 1- and 3-minute periods with WM and F reporting the highest during the 5- and 10-minute periods. The significant differences identified across varying periods showed that CD covered lower HSR (ES = 0.5–1.6) and had lower MAS values (ES = 0.8–1.7) when compared with all other positions, while FB reported higher sprint distances (ES = 0.6–0.8) than CD and CM.

Table 2 presents the most demanding phases of play for HSR distance. HSR distance was consistently highest for WM, followed by FB, CM, and F positions, while CD was consistently and significantly lower for all periods (ES = 0.5–1.8). MAS distances showed similar values for FB, CM, WM, and F, although all were significantly higher than CD (ES = 0.7–1.8).

Table 3 presents the most demanding phases of play for MAS distance. MAS distance was significantly lower for CD than all other positions (ES = 1.0–1.9) with very similar values for FB, CM, WM, and F positions. While HSR for CD was significantly lower than all other positions (ES = 0.9–1.7) during 5- and 10-minute periods, F values did not significantly differ compared with CD during 1- and 3-minute periods (ES = 0.3–0.6). Furthermore, there was no significant difference in sprint distance with only significant differences observed in ASR30 distance during 5- and 10-minute periods.

Table 4 presents the most demanding phases of play for sprint distance. Sprint distance was significantly lower during all examined periods for CD when compared with FB (ES = 0.7–1.0). Furthermore, during the 5- and 10-minute periods, F (ES = 0.8–0.9) and WM (ES = 1.0–1.1) were significantly higher than CD. CM and WM were also consistently higher than CD for the sprint distance.

Table 5 presents the most demanding phases of play for ASR30 distance. ASR30 distance was higher for FB and WM followed by CM and F with the lowest values reported for CD. MAS distance was highest for WM and CM and lowest for CD.

Table 6 shows the number of values in the data set by player and position for distance over a 1-minute period. The table also shows the random effect values for the best-fitting model.

Discussion

The aim of this paper was to analyze the positional distances covered above generic and individualized speed thresholds, within the most demanding phases of match play. Similar methodological approaches have previously been employed to determine specific player position data relating to total distance, HSR, and sprint distance.[5–7] To the authors' knowledge, this is the first study of its

Table 1 Activity Measures (in Meters per Minute) for Each Position for the Most Demanding Phases of a Match for Maximum Distance for 1-, 3-, 5-, and 10-Minute Periods

	Metric	CD	FB	M	WM	F	All players	ICC
1 min	Distance	185.2 (11.7)	202.1 (16.9),[a] 18**	221.1 (11.2),[a,b,e] 38**	214.3 (15.3),[a,b] 30.6**	204.9 (13.2),[a] 22.5**	204.9 (18.9), 183.3**	.15**,**
	HSR	33 (21.3)	55.7 (27.2),[a] 23.8**	47.2 (22.9),[a] 15.6*	56.6 (25.7),[a] 24.8**	45.8 (20.5),[a] 15.1*	47 (25.2), 31.5**	.04**,-
	MAS	59 (23.2)	88.8 (28.2),[a] 31.3**	81.4 (24.9),[a] 25.4**	87.2 (26.1),[a] 34.6**	84.1 (21.7),[a] 28.8**	79.1 (27.5), 55.8**	.09**,**
	Sprint	8.9 (14)	19 (21),[a,c] 10.5**	8.4 (12.7), –0.3	13.3 (15.5), 4.3	11.6 (13.1), 3.2	12.2 (16.2), 8.4**	.04**,-
	ASR30	31.2 (21.1)	47.7 (25.9),[a,c,e] 17.3**	37.3 (21.4), 7.5	42 (23.4),[a] 12.9*	36.7 (19.8), 6.6	38.9 (23.2), 29.9**	.03**,-
3 min	Distance	144.2 (8.1)	153.2 (10.2), 9.7*	176.5 (8.3),[a,b,e] 34**	165.3 (8),[a,b] 23.6**	161.3 (10.5),[a] 17.9**	159.6 (14.9) 142.9**	.29**,**
	HSR	12.7 (8.3)	24 (11.8),[a] 11**	20.7 (10.2),[a] 8.6*	25.2 (9.8),[a] 14.3**	21.4 (10),[a] 9.3*	20.4 (11.1), 12.2**	.12**,**
	MAS	26.1 (11.3)	42.1 (13.4),[a] 15.4**	40.3 (12),[a] 15.2**	42.2 (12.3),[a] 20.6**	45.2 (11),[a] 19.3**	38.3 (13.9), 25**	.17**,**
	Sprint	2.4 (4)	6.6 (7.2),[a,c] 4*	2.9 (4.4), 0.6	4.7 (5), 2.5	4.1 (4.7), 2	4.1 (5.4), 2.3	.08*,**
	ASR30	11.7 (8.4)	20.1 (11.1),[a] 8.1*	16 (9.3), 5.3	17.8 (8.9),[a] 8.4*	16.9 (9.7), 5.6	16.3 (10), 10.8**	.12*,**
5 min	Distance	132.8 (7.2)	140.4 (9.4), 8.3	163.2 (8.4),[a,b,e] 32**	152.6 (7.9),[a,b] 22.8**	148.9 (9.3),[a] 16.9**	147.1 (14.1), 131.5**	.31**,**
	HSR	10.1 (5.9)	18.1 (8.3),[a] 7.6**	17.6 (7.1),[a] 7.7**	20.6 (7.8),[a] 10.5**	17.6 (7.2),[a] 7.9**	16.4 (8.1), 9.8**	.11**,**
	MAS	21.2 (8.1)	32.8 (10.1),[a] 10.5**	33.7 (7.9),[a] 12.8**	35.1 (9.1),[a] 16.4**	37.1 (8.6),[a] 15.8**	31.2 (10.5), 20.9**	.19**,**
	Sprint	2 (2.8)	4.6 (4.8), 2.4*	2.8 (3.6), 0.7	4.1 (3.7), 1.7	3.1 (3.5), 1.3	3.3 (3.9), 2*	.08-,**
	ASR30	9.2 (5.9)	14.9 (7.7),[a] 5.3*	13.7 (6.5),[a] 4.8*	14.7 (7.1),[a] 5.9*	13.8 (6.7), 4.5*	13.1 (7.1), 8.9**	.09*,**
10 min	Distance	120.9 (6.1)	126.8 (8.5), 6.6	148.6 (7.1),[a,b,e] 30**	138.3 (6.8),[a,b] 20.2**	136 (9),[a] 15.8**	133.7 (12.8), 119.7**	.36**,**
	HSR	7.7 (3.4)	13.9 (5.3),[a] 6.1**	14 (4.6),[a] 6.2**	16.7 (5.1),[a] 9**	14.3 (5.1),[a] 7**	12.9 (5.6), 7.6**	.1**,**
	MAS	17.1 (5.4)	25.9 (6.7),[a] 8.3**	27.4 (5.3),[a] 10.3**	28.6 (6.3),[a] 13.5**	30.5 (6.8),[a] 13.2**	25.2 (7.7), 16.9**	.18**,**
	Sprint	1.4 (1.6)	3.2 (2.6),[a,c] 1.8**	1.9 (2.1), 0.4	3.3 (2.9),[a] 1.7*	2.8 (2.4),[a] 1.6*	2.4 (2.4), 1.4**	.07**,**
	ASR30	7 (3.5)	11.2 (4.5),[a] 4.1**	10.7 (4.1),[a] 3.8**	11.9 (4.6),[a] 5.3**	11.4 (4.5),[a] 4.5**	10.2 (4.6), 6.8**	.07**,**

Abbreviations: ASR, anaerobic speed reserve; ASR30, >30% anaerobic speed reserve; CD, central defenders; F, forwards; FB, fullbacks; HSR, high-speed running; ICC, interclass correlation coefficient; M, midfielders; MAS, maximal aerobic speed; WM, wide midfielders. Note: Data are presented as mean (SD) with significance differences below (a–e) followed by estimates of fixed effects and significance of the fixed effects (<.01**, <.05*). All columns show fixed intercept effect, and the ICC column shows ICC value followed by the significance level of fixed position effects and the significance of random player effects (<.01**, <.05*) for the model. - indicates no significant difference.

Significant differences: [a]higher than the CD value, [b]higher than the FB value, [c]higher than the M value, [d]higher than the WM value, and [e]higher than the F value at the 5% significance level.

Table 2 Activity Measures (in Meters per Minute) for Each Position for the Most Demanding Phases of a Match for Maximum HSR Distance for 1-, 3-, 5- and 10-Minute Periods

	Metric	CD	FB	M	WM	F	All players	ICC
1 min	Distance	151.4 (23.1)	170.5 (27.1),[a] 19.8**	182.9 (27.7),[a,e] 32.8**	183.8 (25.2),[a,e] 34.6**	164.7 (25.6), 14.8*	170.1 (28.6), 149.9**	.05**,-
	HSR	56.8 (14.1)	73.2 (19.7),[a] 17.2**	72.9 (15),[a] 17.1*	77.9 (18.1),[a] 22.6**	66 (15.4), 11.9	68.9 (18.1), 55**	.13**,**
	MAS	67.5 (14.8)	90.4 (23.3),[a] 23.1**	90.2 (18),[a] 23.5**	94.2 (22),[a] 29.3**	82.9 (18.9),[a] 17.6*	84.4 (21.7), 65.8**	.1**,**
	Sprint	22 (18.8)	27.5 (20.7), 5.6	21.7 (18.6), –0.5	26.2 (20.9), 4.4	27.4 (18.6), 6.2	24.6 (19.6), 21.9**	.04-,-
	ASR30	54.7 (14.8)	65.2 (18.6),[a] 11.1*	63 (16.3), 9.7	64.3 (18.4),[a] 12.5*	58.9 (15.4), 6	61.2 (17.2), 53**	.06*,-
3 min	Distance	119.9 (16.4)	132.2 (17.3),[a] 12.9*	148.5 (18),[a,b] 30**	143.6 (16.3),[a] 23.6**	141.2 (15.3),[a] 22.3**	136.2 (19.9), 118.9**	.11**,**
	HSR	24.8 (6.7)	34.3 (8.6),[a] 9.6**	35.5 (6.9),[a] 11.1**	37.4 (7.7),[a] 12.9**	33.2 (7.2),[a] 9.7**	32.6 (8.7), 24.1**	.13**,**
	MAS	33.2 (8.2)	46.7 (10.8),[a] 13**	48.9 (9.8),[a] 15.8**	48.3 (9.4),[a] 16.4**	48.2 (9.1),[a] 15.2**	44.5 (11.5), 32.8**	.12**,**
	Sprint	8.2 (7)	11.5 (7.8), 3.5	7.6 (6.2), –0.4	11.1 (7.6), 2.8	11 (7.7), 4.1	9.7 (7.4), 7.8**	.1-,**
	ASR30	23.5 (7)	30 (8),[a] 6.8**	29.7 (7.2),[a] 7.1**	30 (7.9),[a] 7.7**	29 (7),[a] 6.6*	28.2 (7.9), 22.6**	.09**,**
5 min	Distance	113.7 (12.5)	122.6 (15.2), 8.8	142.6 (15.1),[a,b,e] 30**	136.4 (14.5),[a,b] 24.1**	130.2 (13.8),[a] 17**	128.4 (17.9), 113.1**	.13**,**
	HSR	17.8 (4.6)	25.9 (6.4),[a] 7.9**	26.7 (5.1),[a] 8.9**	29 (5.9),[a] 11.5**	25.5 (5.5),[a] 8.4**	24.5 (6.7), 17.5**	.15**,**
	MAS	25.7 (6)	37 (8.1),[a] 10.8**	39.1 (6.8),[a] 13.2**	39.8 (7.6),[a] 15.5**	39.2 (6.9),[a] 13.5**	35.6 (9), 25.6**	.12**,**
	Sprint	5.1 (4.5)	8.2 (5), 3.2*	5.4 (4.5), 0.4	8 (4.8), 2.9	7.4 (4.7), 3.1	6.7 (4.9), 4.9**	.11*,**
	ASR30	16.7 (5)	22.2 (5.9),[a] 5.7**	21.9 (5.3),[a] 5.9**	22.8 (5.6),[a] 7.3**	21.8 (5.2),[a] 5.8**	20.9 (5.9), 15.9**	.13**,**
10 min	Distance	108.2 (9.7)	114.7 (11.5), 7.2	133 (12.3),[a,b] 26.8**	127.8 (10.4),[a,b] 21.8**	124.7 (13.3),[a] 18**	120.9 (14.9), 106.9**	.21**,**
	HSR	12.2 (2.9)	18.6 (4.5),[a] 6.1**	19.4 (3.7),[a] 7.1**	21 (4),[a] 8.8**	19 (3.9),[a] 7.1**	17.7 (4.9), 12.2**	.16**,**
	MAS	19.6 (4.3)	28.4 (5.9),[a] 8.2**	30.3 (4.8),[a] 10.8**	30.8 (5.5),[a] 12.8**	31.7 (5.6),[a] 12.1**	27.6 (6.9), 19.5**	.17**,**
	Sprint	3.1 (2.5)	5.6 (3.1),[a,c] 2.5**	3.7 (2.8), 0.6	5.5 (3.3),[a] 2.4*	4.7 (3), 1.9*	4.4 (3.1), 3.1**	.08**,**
	ASR30	11.4 (3.1)	15.8 (4),[a] 4.3**	15.7 (3.7),[a] 4.7**	16 (3.9),[a] 5.3**	15.9 (3.8),[a] 4.6**	14.8 (4.1), 11.1**	.11**,**

Abbreviations: ASR30, >30% anaerobic speed reserve; CD, central defenders; F, forwards; FB, fullbacks; ICC, interclass correlation coefficient; HSR, high-speed running; M, midfielders; MAS, maximal aerobic speed; WM, wide midfielders. Note: Data are presented as mean (SD) with significance differences below (a–e) followed by estimates of fixed effects and significance of the fixed effects (<.01**, <.05*). All columns show fixed intercept effect, and the ICC column shows ICC value followed by the significance level of fixed position effects and the significance of random player effects (<.01**, <.05*) for the model. - indicates no significant difference.

Significant differences: [a]higher than the CD value, [b]higher than the FB value, [c]higher than the M value, [d]higher than the WM value, and [e]higher than the F value.

Table 3 Activity Measures (in Meters per Minute) for Each Position for the Most Demanding Phases of a Match for Maximum MAS Distance for the Durations of 1, 3, 5, and 10 Minutes

	Metric	CD	FB	M	WM	F	All players	ICC
1 min	Distance	162.1 (21.6)	185.7 (24.4),[a] 25.2**	195.7 (25.3),[a] 36.9**	194.4 (24.9),[a] 36.8**	184.8 (20.8),[a] 27.1**	183.7 (26.7), 159.3**	.07**,*
	HSR	50.9 (19)	65.6 (24.8),[a] 15.8*	66.4 (20.1),[a] 15.8*	72.4 (23),[a] 21**	58.5 (19.6), 10.4	62.3 (22.6), 49.2**	.11*,**
	MAS	75.7 (13.8)	100.6 (21.2),[a] 25.8**	99.4 (14.7),[a] 25.5**	101.3 (20.5),[a] 30.8**	96 (15.9),[a] 23.6**	93.9 (20), 73.2**	.14**,**
	Sprint	18.3 (19.1)	21.3 (21.7), 3.4	13.3 (17), −5.4	18.6 (20.7), 0	18 (18.3), 0.8	17.8 (19.5), 18.1**	.04-,*
	ASR30	48.5 (19.1)	55.8 (24.4), 7.8	54.4 (21.2), 6.4	56.5 (24.5), 8.9	48.7 (20.1), 1.1	52.8 (22.1), 47.5**	.02-,-
3 min	Distance	127.4 (12.8)	138.3 (15.7),[a] 11.3*	157.1 (14.4),[a,b] 31.4**	150.2 (14.4),[a,b] 26.4**	148.3 (14.8),[a,b] 22**	143.4 (18.1), 126.2**	.11**,**
	HSR	22.7 (8.2)	31.6 (10.1),[a] 9.1**	32.3 (8.9),[a] 9.9**	34.4 (9.5),[a] 11.8**	28.6 (9.6). 7*	29.6 (10.1), 22**	.12**,**
	MAS	37.3 (7.5)	51.5 (9.5),[a] 13.4**	53.3 (7.8),[a] 16.2**	52.4 (8.6),[a] 18.2**	53.3 (7.2),[a] 16.2**	49 (10.5), 36.9**	.21**,**
	Sprint	6.8 (7.2)	9.2 (7.8), 2.6	5.6 (5.7), −1	8.7 (8.2), 1.9	6.9 (6.9), 0.9	7.3 (7.2), 6.5**	.07-,**
	ASR30	21.4 (8.5)	26.8 (9.6),[a] 5.8*	25.8 (9.4), 5.3	26 (10.1), 5.7*	23.3 (9.4), 2.7	24.7 (9.5), 20.4**	.06*,-
5 min	Distance	119.4 (12)	127.8 (13.9), 8.4	147.1 (13.8),[a,b] 29.4**	139.3 (13),[a,b] 22.4**	138.5 (12.9),[a] 19.4**	133.7 (16.8), 118.4**	.18**,**
	HSR	16.3 (5.5)	24.2 (7.1),[a] 8.2**	24.8 (6),[a] 8.7**	27.8 (6.9),[a] 11.4**	23 (6.9),[a] 7.7**	22.8 (7.5), 15.7**	.13**,**
	MAS	28.8 (5.6)	40.1 (7.4),[a] 10.6**	42.4 (5.7),[a] 13.6**	41.8 (7),[a] 14.9**	42.9 (6.3),[a] 14**	38.6 (8.5), 28.5**	.21**,**
	Sprint	4.4 (4.5)	6.9 (5.2), 2.7	4.5 (4.2), 0.2	6.8 (4.9), 1.8	5.1 (4.5) 1.5	5.5 (4.8), 4.1**	.12-,**
	ASR30	15.1 (5.7)	20.4 (6.5),[a] 5.8*	19.8 (6.1),[a] 5.5*	21.1 (6.7),[a] 6.9**	18.6 (6.7), 4.4	18.8 (6.7), 14.1**	.11**,**
10 min	Distance	112.3 (9.1)	117.8 (11.1), 6.1	139.1 (10),[a,b] 28.4**	131.1 (9.7),[a,b] 22.7**	130.1 (11.8),[a,b] 18.5**	125.3 (14.6), 111**	.24**,**
	HSR	11.2 (3.4)	17.3 (5),[a] 5.8**	18 (4.2),[a] 6.7**	20.3 (4.6),[a] 9**	17.5 (4.3),[a] 6.8**	16.5 (5.3), 11.1**	.14**,**
	MAS	21.4 (4.4)	30.2 (5.4),[a] 8.2**	32.5 (4.4),[a] 11.2**	32.2 (5.2),[a] 12.8**	34 (4.8),[a] 12.6**	29.5 (6.7), 21.2**	.25**,**
	Sprint	2.7 (2.6)	4.7 (3.2),[a] 2.1*	2.9 (2.6), 0.3	4.8 (3.5), 2	4 (2.8), 1.8	3.7 (3), 2.5**	.1*,**
	ASR30	10.3 (3.5)	14.3 (4.6),[a] 3.9**	14.1 (4.2),[a] 4.1**	15 (4.5),[a] 5.3**	14.3 (3.9),[a] 4.2**	13.4 (4.5), 10**	.08**,**

Abbreviations: ASR30, >30% anaerobic speed reserve; CD, central defenders; F, forwards; FB, fullbacks; ICC, interclass correlation coefficients; HSR, high-speed running; M, midfielders; MAS, maximal aerobic speed; WM, wide midfielders. Note: Data are presented as mean (SD) with significance differences below (a–e) followed by estimates of fixed effects and significance of the fixed effects (<.01**, <.05*). All columns show fixed intercept effect, and the ICC column shows ICC value followed by the significance level of fixed position effects and the significance of random player effects (<.01**, <.05*) for the model. - indicates no significant difference.

Significant differences: [a]higher than the CD value, [b]higher than the FB value, [c]higher than the M value, [d]higher than the WM value, and [e]higher than the F value.

Table 4 Activity Measures (in Meters per Meter) for Each Position for the Most Demanding Phases of a Match for Maximum Sprint Distance for the Durations of 1, 3, 5, and 10 Minutes

	Metric	CD	FB	M	WM	F	All players	ICC
1 min	Distance	135 (27)	144.6 (29.4), 9.5	149.7 (31.1),[a] 15.1*	149.3 (33.2), 13.7*	144.9 (27.1), 11	144.3 (30), 134.6**	.03*,-
	HSR	41.4 (16.7)	53.9 (21.2),[a] 12.8*	50.1 (16.9), 9.3	56.4 (20.4),[a] 14.4*	49.9 (17.7), 9.9	49.8 (19.2), 40.7**	.07*,**
	MAS	49.4 (19.3)	64.3 (25.9),[a] 14.9**	59.1 (19.9), 10	65.7 (23.6),[a] 17**	60.3 (21.4), 11.8*	59.1 (22.8), 48.8**	.04**,-
	Sprint	29.3 (14.4)	39.9 (15.6),[a] 10.7*	34.6 (12.7), 5.5	41 (14.8), 10.1*	36.4 (13.2), 8.3	35.7 (14.8), 29**	.1*,**
	ASR30	40.7 (16.5)	51.6 (19.8),[a] 11.2*	47.6 (16.1), 7.5	52.5 (18.6),[a] 11.6*	47.3 (16.1), 7.7	47.5 (18), 40**	.05*,*
3 min	Distance	114.4 (16)	119.9 (21), 4.9	132.1 (22.8),[a,b] 18.1**	127.1 (19.5),[a] 12.8*	124.3 (19), 10.8*	123.3 (20.9), 114.3**	.04**,-
	HSR	18.3 (7.8)	26.7 (9.8),[a] 8.6**	23.9 (7.9), 6*	27.2 (9.7),[a] 8.9**	26 (8.3),[a] 9.1**	24 (9.3), 17.7**	.11**,**
	MAS	25.3 (9.1)	35.7 (12),[a] 10**	33.2 (10.5),[a] 7.9*	34.8 (12),[a] 9.8**	37.4 (10.9),[a] 13**	32.7 (11.7), 25**	.08**,**
	Sprint	10.9 (5.6)	15.6 (5.8),[a] 4.8*	12.8 (4.9), 2	16 (5.8), 4.7*	15.4 (5.7),[a] 5.5*	13.8 (5.9), 10.6**	.14*,**
	ASR30	17.8 (7.6)	24.5 (8.7),[a] 6.9**	21.5 (7.1), 4.3	24.1 (8.5),[a] 6.8**	23.9 (7.5),[a] 7.2**	22 (8.3), 17.2**	.07**,*
5 min	Distance	109 (13)	113.6 (17.6), 4.5	130 (19.1),[a,b] 22.2**	125.6 (15.9),[a,b] 17.1**	119.2 (17.7),[a] 11.6*	119 (18.6), 108.5**	.07**,**
	HSR	13.1 (5.5)	20.1 (7.1),[a] 7.1**	19 (6.8),[a] 6.1**	22 (6.7),[a] 8.7**	19.9 (5.8),[a] 7.7**	18.4 (7.1), 12.8**	.09**,**
	MAS	19.7 (6.9)	28.5 (8.4),[a] 8.7**	28.6 (8.8),[a] 9**	30.1 (8.7),[a] 10.5**	30.7 (7.8),[a] 11.8**	27 (9.1), 19.5**	.1**,**
	Sprint	7 (3.7)	10.7 (4.2),[a] 3.8*	8.5 (3.6), 1.6	10.9 (4),[a] 3.8*	10.2 (3.7),[a] 3.8*	9.2 (4.1), 6.8**	.14**,**
	ASR30	12.6 (5.3)	18 (6.2),[a] 5.4**	16.6 (6.2),[a] 4.2*	18.4 (5.8),[a] 6.1**	18 (5.4),[a] 5.8**	16.4 (6.2), 12.3**	.04**,-
10 min	Distance	105.3 (10.3)	109.1 (13.2), 3.6	127.3 (13.7),[a,b] 22.6**	119.5 (13.8),[a,b] 15.5**	119.5 (12.7),[a,b] 14.4**	115.6 (15.3), 104.9**	.15**,**
	HSR	9.5 (3.5)	15.5 (5.1),[a] 5.9**	15.6 (4.9),[a] 6.1**	17.3 (4.9),[a] 8.1**	15.8 (4.2),[a] 6.7**	14.4 (5.3), 9.4**	.15**,**
	MAS	16.1 (5.2)	23.7 (6.1),[a] 7.1**	24.8 (6.4),[a] 8.5**	25.2 (6.5),[a] 10.4**	27.2 (5.5),[a] 11**	22.9 (7.1), 16.1**	.14**,**
	Sprint	4 (2.2)	6.8 (2.7),[a] 2.7**	5.2 (2.4), 1.1	7 (2.7),[a] 3**	6.4 (2.4),[a] 2.7*	5.7 (2.7), 4**	.15**,**
	ASR30	9 (3.4)	13.6 (4.4),[a] 4.6**	13.1 (4.2),[a] 4.3**	14 (4.4),[a] 5.6**	13.7 (4),[a] 4.9**	12.5 (4.5), 8.8**	.07**,*

Abbreviations: ASR30, >30% anaerobic speed reserve; CD, central defenders; F, forwards; FB, fullbacks; ICC, interclass correlation coefficients; HSR, high-speed running; M, midfielders; MAS, maximal aerobic speed; WM, wide midfielders. Note: Data are presented as mean (SD) with significance differences below (a–e) followed by estimates of fixed effects and significance of the fixed effects (<.01**, <.05*). All columns show fixed intercept effect, and the ICC column shows ICC value followed by the significance level of fixed position effects and the significance of random player effects (<.01**, <.05*) for the model. - indicates no significant difference.

Significant differences: [a]higher than the CD value, [b]higher than the FB value, [c]higher than the M value, [d]higher than the WM value, and [e]higher than the F value.

Table 5 Activity Measures (in Meters per Minute) for Each Position for the Most Demanding Phases of a Match for Maximum ASR30 Distance for the Durations of 1, 3, 5, and 10 Minutes

	Metric	CD	FB	M	WM	F	All players	ICC
1 min	Distance	151.1 (22.4)	166.7 (26.5),[a] 15.8*	173.2 (30.5),[a] (23.3)**	176.5 (26.1),[a,e] 28.7**	161.9 (24.4), 11.7	165.3 (27.7), 149.9**	.04**,-
	HSR	56 (14.3)	71.5 (19.6,[a] (16.3**)	70.6 (15.4,[a] (15.7*)	74.6 (19,[a] (20.9**)	64.1 (15.2 (10.6)	67 (18 (54.2**)	.1**,**
	MAS	66.5 (15.3	87.1 (23.4),[a] 21**	84.5 (19.5),[a] 19.2*	88 (23.6),[a] 26.1**	77.9 (18.2), 13.8	80.4 (21.7), 64.4**	.11**,**
	Sprint	22.5 (18.8)	29.9 (21.2), 7.4	24.5 (18.6), 1.9	30.1 (20.7), 6.4	28.1 (18.5), 6.7	26.6 (19.7), 22.4**	.08-,**
	ASR30	55 (14.6)	66.2 (18),[a] 12*	64.9 (14.5),[a] 11.4*	66.3 (17),[a] 13.6*	59.7 (14.6), 6.5	62.3 (16.4), 53.2**	.07**,-
3 min	Distance	118 (16.3)	131.4 (17.8),[a] 13.7**	145.5 (18.2),[a,b] 28.7**	139.2 (16.6),[a] 21.4**	138.7 (15.8),[a] 21.6**	133.8 (19.8), 117.2**	.06**,-
	HSR	24.5 (6.7)	33.5 (8.6),[a] 9.1**	34.4 (7.3),[a] 10.3**	36.2 (8),[a] 11.9**	32.5 (7.2),[a] 9.1**	31.8 (8.7), 23.9**	.09**,**
	MAS	32.3 (8.6)	45.1 (11.1),[a] 12.3**	46.4 (10.4),[a] 14.3**	45.9 (9.8),[a] 15**	46.4 (9),[a] 14.5**	42.7 (11.4), 31.8**	.09**,**
	Sprint	8.5 (7.1)	12.2 (7.3), 4	8.6 (6.2), 0.3	11.7 (7.8), 2.7	11.4 (7.3), 4.4	10.3 (7.3), 8.1**	.12-,**
	ASR30	23.8 (6.8)	30.3 (7.8),[a] 6.7**	30.3 (6.8),[a] 7.3**	30.8 (7.4),[a] 8**	29.3 (6.7),[a] 6.5**	28.7 (7.6), 23**	.08**,**
5 min	Distance	114.1 (13.1)	121.8 (15.1), 7.5	138.1 (15),[a,b] 24.9**	134 (14.9),[a,b] 22.2**	128.3 (13.3),[a] 14.5*	126.6 (16.9), 113.6**	.12**,**
	HSR	17.6 (4.7)	25.3 (6.4),[a] 7.6**	25.9 (5.3),[a] 8.5**	28 (6.2),[a] 11**	25 (5.5),[a] 8.1**	24 (6.7), 17.2**	.12**,**
	MAS	25.5 (6.4)	35.8 (8.4),[a] 9.9**	37.2 (7.1),[a] 11.8**	38 (8.5),[a] 14.7**	37.7 (7.1),[a] 12.3**	34.3 (9), 25.2**	.13**,**
	Sprint	5.4 (4.4)	8.7 (5), 3.4*	6.2 (4.6), 0.8	8.6 (5), 2.9	7.8 (4.6), 3.3	7.2 (4.9), 5.2**	.14-,**
	ASR30	16.9 (4.8)	22.5 (5.8),[a] 5.8**	22.4 (4.9),[a] 6.2**	23.2 (5.4),[a] 7.5**	22 (5.1),[a] 5.8**	21.2 (5.7), 16.2**	.12**,**
10 min	Distance	107.9 (9.5)	113.4 (11.4), 5.8	131.9 (12.6),[a,b] 25.8**	126.3 (10.7),[a,b] 20.1**	123.3 (12.7),[a,b] 16.4**	119.8 (14.7), 106.9**	.15**,**
	HSR	12.1 (2.9)	18.3 (4.4),[a] 6**	19 (3.8),[a] 6.9**	20.5 (4.2),[a] 8.4**	18.7 (3.9),[a] 6.9**	17.4 (4.9), 12**	.13**,**
	MAS	19.4 (4.5)	27.6 (5.8),[a] 7.6**	29.3 (5),[a] 9.9**	29.8 (5.8),[a] 11.8**	30.7 (5.8),[a] 11.1**	26.8 (6.8), 19.3**	.17**,**
	Sprint	3.2 (2.5)	5.9 (3.1),[a] 2.7*	4.1 (2.9), 0.8	5.8 (3.3),[a] 2.7*	5.2 (2.8), 2.4*	4.7 (3.1), 3.1**	.14*,**
	ASR30	11.5 (3)	16 (4),[a] 4.4**	16 (3.5),[a] 4.8**	16.4 (3.6),[a] 5.6**	16 (3.7),[a] 4.8**	15 (4.1), 11.2**	.11**,**

Abbreviations: ASR30, >30% anaerobic speed reserve; CD, central defenders; F, forwards; FB, fullbacks; ICC, interclass correlation coefficients; HSR, high-speed running; M, midfielders; MAS, maximal aerobic speed; WM, wide midfielders. Note: Data are presented as mean (SD) with significance differences below (a–e) followed by estimates of fixed effects and significance of the fixed effects (<.01**, <.05*). All columns show fixed intercept effect, and the ICC column shows ICC value followed by the significance level of fixed position effects and the significance of random player effects (<.01**, <.05*) for the model. - indicates no significant difference.

Significant differences: [a]higher than the CD value, [b]higher than the FB value, [c]higher than the M value, [d]higher than the WM value, and [e]higher than the F value.

Table 6 Number of Values by Player and Position for Distance Covered Over a 1-Minute Period

		Distance		HSR		MAS		Sprint		ASR30	
Player	Count	Mean (SD), CV	Random effect	Mean (SD), CV	Random effect	Mean (SD), CV	Random effect	Mean (SD), CV	Random effect	Mean (SD), CV	Random effect
CD1	74	185.5 (10.9), 5.9%	2	37.2 (22.7), 61.2%	4.3	55.5 (22.3), 40.2%	–0.2	10.8 (15.9), 147.5%	1.7	32.9 (22.5), 68.3%	2
CD2	13	175.8 (11.3), 6.4%	–5.2	20.5 (17.6), 85.8%	–3.8	38.2 (17.8), 46.6%	–9.9	4.8 (8.2), 170.7%	–1.2	15.9 (16.6), 104.2%	–3.6
CD3	62	186.7 (11.9), 6.4%	3.2	30.8 (19.1), 62.1%	–0.5	67.5 (21.7), 32.1%	10.1	7.6 (12.3), 162.1%	–0.6	32.5 (19.1), 58.7%	1.6
CD	149	185.2 (11.7), 6.3%		33 (21.3), 64.5%		59 (23.2), 39.3%		8.9 (14), 157.3%		31.2 (21.1), 67.6%	
FB1	24	189.4 (13.1), 6.9%	–9.7	46.1 (26.4), 57.2%	–4.5	77.9 (26.1), 33.5%	–6.4	15 (20.5), 136.2%	–1.8	41.5 (26.3), 63.5%	–2.2
FB2	29	206.6 (13.6), 6.6%	4.4	56.7 (24.8), 43.8%	0.8	78.2 (27.2), 34.8%	–6.6	18.8 (20.7), 110.2%	0	42.6 (23.9), 56.2%	–2
FB3	51	198.4 (14.4), 7.3%	–2.6	50.4 (23), 45.7%	–3.3	91.2 (24.1), 26.4%	3.4	14 (14.9), 106.3%	–3.2	47.8 (22.8), 47.7%	0.4
FB4	45	210.2 (18.2), 8.7%	7.9	66.1 (30.5), 46.1%	7	98.8 (30.6), 31%	9.6	26.9 (25.2), 93.6%	5	54.2 (29.2), 53.8%	3.8
FB	149	202.1 (16.9), 8.4%		55.7 (27.2), 48.8%		88.8 (28.2), 31.8%		19 (21), 110.5%		47.7 (25.9), 54.3%	
M1	42	221.7 (10.4), 4.7%	0.4	47.9 (22.5), 47%	0.5	82.4 (24.1), 29.2%	1	4.8 (7.9), 164.5%	–2	42.8 (21.6), 50.6%	2.8
M2	73	220.6 (11.5), 5.2%	–0.6	48 (23.5), 48.9%	0.7	82.1 (25.7), 31.3%	0.8	10.1 (14.6), 145.4%	1.4	36.4 (20.9), 57.5%	–0.7
M3	39	221.5 (11.6), 5.2%	0.2	45 (22.4), 49.8%	–1.3	79 (24.9), 31.5%	–1.8	9 (12.5), 138.3%	0.6	33.3 (21.3), 63.9%	–2.1
M	154	221.1 (11.2), 5.1%		47.2 (22.9), 48.5%		81.4 (24.9), 30.6%		8.4 (12.7), 151.2%		37.3 (21.4), 57.4%	
WM1	12	216 (16.4), 7.6%	1.4	61.9 (28.5), 46%	1.8	100.8 (30.8), 30.6%	5.7	10.1 (13.3), 132.3%	–0.8	51.4 (25.1), 48.8%	2.1
WM2	8	210.5 (13.2), 6.3%	–2	47.1 (19.2), 40.7%	–2.2	88.5 (27.3), 30.9%	–0.8	12.5 (9.7), 77.4%	0	38.6 (16.6), 42.9%	–0.7
WM3	69	214.5 (15.4), 7.2%	0.6	56.8 (25.9), 45.7%	0.4	84.7 (24.8), 29.3%	–4.9	14 (16.4), 117.6%	0.9	40.8 (23.7), 58%	–1.3
WM	89	214.3 (15.3), 7.1%		56.6 (25.7), 45.4%		87.2 (26.1), 29.9%		13.3 (15.5), 116.5%		42 (23.4), 55.7%	
F1	26	212.2 (13.6), 6.4%	5.3	49.2 (20.8), 42.3%	1.4	78.9 (23.6), 29.9%	–4.1	10.9 (13.4), 122.6%	–0.4	33.4 (19.2), 57.6%	–1.3
F2	49	201.4 (11.3), 5.6%	–3.9	43 (21.3), 49.6%	–2.4	84.9 (21.6), 25.4%	0.3	11.7 (13.1), 112.2%	0	38.1 (21.3), 55.9%	0.9
F3	14	203.6 (14.2), 7%	–1.5	49.5 (16.3), 32.9%	1.1	91.2 (17.1), 18.8%	3.9	12.6 (13.6), 108%	0.3	37.8 (15.7), 41.4%	0.4
F	89	204.9 (13.2), 6.4%		45.8 (20.5), 44.8%		84.1 (21.7), 25.8%		11.6 (13.1), 112.9%		36.7 (19.8), 54%	
All	630	204.9 (18.9), 9.2%		47 (25.2), 53.6%		79.1 (27.5), 34.8%		12.2 (16.2), 132.8%		38.9 (23.2), 59.6%	

Abbreviations: CD, central defenders; CV, coefficient of variation; F, forwards; FB, fullbacks; HSR, high-speed running; M, midfielders; MAS, maximal aerobic speed; WM, wide midfielders.

kind. The results of this study provide the first indication that individualized thresholds for external workload may provide a more robust and comparable measure between playing positions within the most demanding phases of play. The current study findings appear to be consistent across playing positions except CD. This may allow practitioners to employ MAS and/or ASR30 to directly compare the intensity of activity between playing positions during short periods in training and match play.

Our main findings reported that positional differences in the key generic metrics of total distance, HSR, and sprint distance are in support of existing literature.[30,31] Specifically, similar to Oliva-Lozano et al,[6] CD produced the lowest physical output for all examined variables across the most demanding phases of match play. However, although Martín-García et al[5] reported higher values for FB, CM, and WM, values for F and CD were similar to our findings. This may be related to differences between the physical profile of the 2 teams under investigation and in any tactical variations identified between the 2 playing systems/styles examined in this paper and in the work by Martín-García et al.[5] The tactical roles and style of play of each position and player may also have an impact on these values.[7] Furthermore, the drop-off in meters per minute across various periods is consistent with a negative power curve.[30] Overall, the values for the generic metrics of total distance, HSR, and sprint distance are consistent with the findings of a previous systematic review.[1]

MAS and HSR distances for F were found to be lower than CM, WM, and FB for the 1-minute periods, but evidently, there is a trend toward other positions over different periods suggesting that MAS for F during 10-minute periods may exceed the average for CM, WM, and FB positions (see Table 3). This highlights that positional differences are influenced by metrics and by the period. It is important to note that when HSR is used to quantify the most demanding phases (see Table 2), F produces consistently lower HSR than all other non-CD positions. This may be due to FB and WM having more opportunities to perform HSR during games due to the positional demands.[32] The maximum ES difference between the CM, WM, and FB positions for the HSR and MAS measures are 0.28 and 0.18 for the 1-minute period, 0.36 and 0.19 for the 3-minute period, 0.46 and 0.31 for the 5-minute period, and 0.49 and 0.315 for the 10-minute period. This indicates that, in using the MAS measure, there may be less difference between the CM, WM, and FB positions compared with the HSR measure. This may allow practitioners to compare the physical outputs of players during the most demanding phases of play regardless of the players' positional group. Indeed, practitioners frequently need to manipulate and periodize drill duration based on player position to ensure each positional group is prepared for the most demanding phases of play. This process may be simplified by using the MAS measure as opposed to the generic threshold of HSR. This could provide practitioners with a performance benchmark for the most demanding phases of play which could be used across all non-CD playing positions.

Despite the previous strengths of this study, there are some limitations to list (1) the study was conducted using only one team, and thus a limited sample of players was examined, which consequently may restrict a generalization of the results; (2) the metrics chosen for this study did not account for the transition between the different speed and intensity zones, usually expressed by accelerometry-based variables. The addition of acceleration and metabolic measures may provide practitioners with additional loading information, not provided by high-intensity distance metrics. (3) Contextual factors such as match location, score status, and team formation were not considered in this study; this would potentially influence positional demands over the course of the game.[1] Future research should also examine the most demanding phases within training and additional leagues to ensure players are prepared for the most intense periods of the game.

Practical Applications

Similar to Martín-García et al,[5] a key finding of this research was that while high-intensity periods are quantified using a single variable, significant differences still exist between positions for other variables. This is important information for practitioners to understand that high-intensity periods differ hugely based on the metric examined, duration, and playing position. As a result, isolated conditioning may not be the optimal modality for preparing players for those high-intensity periods. Practitioners should look to develop and monitor short-duration high-intensity match-based training activities using targets for non-CD positions based on distances covered above MAS and ASR30. This would help practitioners compare the physical outputs of positional groups within the most demanding phases of play. This in turn could have implications for drill design, recovery modalities, return to play, and training prescription.

Conclusion

The results of this study indicate that individualized speed thresholds may provide practitioners with a more robust and comparable measure between playing positions than generic thresholds within the most demanding phases of play. Failure to monitor the relative intensity placed on the individual athlete may result in the intensity of the most demanding phases being substantially underestimated, thus resulting in the player being undertrained/overtrained or increasing their injury risk. This research provides practitioners with individualized positional demands for the most demanding phases of play. With distance above maximal aerobic speed indicating a greater similarity between non-central-defender positions than the generic high-speed-running measure. Future research should examine high-intensity periods within training to ensure players are prepared for the demands of the game in their respective leagues.

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