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Reference values for collective tactical behaviours based on positional data in professional football matches: a systematic review

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ABSTRACT: Match collective tactical behaviours can be used as a reference to design and select training strategies to improve individual and team performance in professional football. The aim of the systematic review was to cluster the collective tactical variables used to highlight and compare male soccer teams' collective behaviour during professional official matches, providing reference values for each of them. A systematic review of relevant articles was carried out using three electronic databases (PubMed, SPORTdiscus and Web of Science). From a total of 1,187 studies initially found, 13 original articles were included in the qualitative synthesis. The articles found concerned studies carried out on the Spanish, Portuguese, English and Brazilian 1st divisions and during the European UEFA Champions League. The team length and width ranged from 31 to 46 m and from 35 to 48 m, respectively. The distance from a defending team's goalkeeper to the nearest teammate ranged from 9 ± 6 to 30 ± 7 m, the goal line-recovery location from 27 to 37 m, and the opponent's goal line from 42 to 50 m. The stretch index ranged from 7 to 16 m. Mean team area was ~900 m^2 and the area of the pitch which included all outfield players divided by the 20 outfield players ranged from 79 ± 15 to 94 ± 16 m^2. All studies provided greater distance and area values during the team-possession phase in comparison to the non-possession one. The ball location on the pitch determined the collective tactical behaviour of the teams. The differences between halves in the distance and area values were contradictory. Further studies should assess the effect of the interaction between the contextual factors on the collective tactical behaviour to obtain more accurate references. This could help football coaches in the design of suitable training tasks to optimize tactical performance.

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INTRODUCTION

As with other team sports, soccer is a collective duel (i.e. team vs team), that is, two teams playing against each other [1, 2]. The players of the same team collaborate (i.e. communication, or positive interaction) to oppose (i.e. counter-communication or negative interaction) the players of the other team [2, 3]. Soccer players need to respond to the uncertainty produced by the presence of opponents and teammates [4–7]. This "social" uncertainty means that soccer is a complex synergistic relationship [3], in which players should adapt to contingencies [8]. Despite the unpredictability and non-linearity of behaviours [9], the specific structural traits (or constraints) of soccer guide the motor behaviours of the players beforehand [10, 11], and the regularity of several tactical behaviours can be identified at individual, subgroup and team levels [12]. Despite interest in the assessment of individual behaviours [13, 14], the observable manifestations at the collective level acquire greater relevance in team sports [15–17] because the players in a team behave as a superorganism or superplayer [11, 18] that should be assessed as a whole or partially (e.g. team lines) and with respect to the opponents. This allows for the identification of different properties of tactical behaviour that cannot be observed individually [19] and its regularities and reference values can be used to optimize the training process and improve the performance of teams in competition [20, 21].

In order to assess tactical behaviour from positional data, i.e. the actions performed by players when adapting to the dynamically chang-

ing match situations [19], three types of tactical variables have been suggested (i.e. *geometrical centre* (*GC*), *distance*, and *area* related variables) based on geometrical primitives (node, line and surface) [22]. *GC* (i.e. node) is the mean position of several or all players of a team [23] and *distance* (i.e. line) variables refer to the relation between two points inside the field (i.e. player-player, player-ball, player-space, GC-player, GC-GC, GC-ball, GC-space, GC-GC) [24]. The *area* (i.e. surface) variables refer to those spaces used by a player or several players, and have been divided into three main types: occupied space (e.g. surface area, effective playing space), exploration space (e.g. major ranges of GC) and dominant area (e.g. Voronoi diagrams) [25]. The measurement of these variables is possible thanks to electronic performance and tracking systems (EPTS). Until a few years ago, athletes' movement patterns were assessed through notational motion analysis. Moreover, the time taken to complete the analyses, the classification of movement categories, the parallax error or lack of reliability due to the impossibility of eliminating subjective analysis [26] are some problems that are alleviated using player tracking technologies, which are based on positional data. These data are recorded with global positioning systems and represented in geographical coordinates (i.e. latitude and longitude), or with semi-automatic camera systems and/or local positioning systems and represented by a time series of cartesian coordinates (i.e. x- and y-axes) [27, 28].

Previous works have highlighted the importance of the future collaboration between sports science and computer science regarding the application of complex approaches in the analysis of the tactical behaviour in soccer using position-tracking data [29, 30]. Sports scientists identify problems and test theoretical hypotheses, computer science develops robust techniques to allow this type of analysis, and sports scientists in turn adjust theories and derive practical implications from data by implementing them [29]. On the other hand, several systematic reviews have identified and examined the variables and methods for analysing tactical behaviour in soccer [19, 23, 24, 31, 32]. A summary of empirical research on collective tactical behaviours in soccer was provided (Low et al., 2020) and the impact of the manipulation of constraints on the tactical behaviours during soccer small-sided games (SSGs) was assessed [33]. In addition, Sarmento et al. [32] conducted a systematic review of match analysis in adult male soccer, assessing set plays, activity profile and also tactical behaviour. They specifically summarized results about Team Centre, Dispersion, and Interaction/Coordination Networks in amateur and professional adult male soccer during SSGs, and simulated and official matches [32]. However, to our knowledge, no study has systematically reviewed tactical behaviour in soccer in relation to male professional soccer teams and official matches using the three types of tactical behaviour variables (i.e., *GC*, *distance* and *area*). At present, the same type of work in relation to female soccer must wait due to the low number of articles published to date [19].

Therefore, the aim of this systematic review was to cluster the collective tactical variables used to highlight and compare the collective behaviour of male soccer teams during professional official matches, providing reference values for each of them.

MATERIALS AND METHODS

Design

The systematic review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [34]. The protocol was not registered prior to the initiation of the project and did not require the Institutional Review Board's approval. A systematic search was performed by three authors (MR, ALA and JPO) to identify articles published before 7th November of 2019 in three electronic databases (i.e. PubMed, SPORTdiscus and Web of Science) before 9:00 a.m. The authors were not blinded to journal names or manuscript authors. The search was carried out using two filters where the database allowed this: journal article and title (TI)/abstract. This was possible in all databases except for WoS (Web of Science), which was searched throughout the text. In addition, in the final database the search was filtered by the subject of sports science. The search strategy combined terms covering the topics of (1) *sport*: soccer, football, (2) outcomes: "tactical behavio*", "tactical performance*", "tactical-derived variables", "tactical analysis", "tactical ability", "team tactic*" "positioning performance*", "collective variable*", "collective behavio*", "collective tactical movement*", "positional data", "teamwork analysis", "dynamic positioning", synchronization, "interpersonal coordination", "team* organisation", "coordination pattern*". The keywords were connected with AND to combine the two groups and using OR to link the words of each group.

Screening strategy and study selection

When the aforementioned authors had completed the search, they compared their results to ensure that the same number of articles had been found. Then, one of the authors (MR) downloaded the main data from the articles (title, authors, date, and database) to an Excel spread sheet (Microsoft Excel, Microsoft, Redmond, USA) and removed duplicate records. Subsequently, the same authors screened the remaining records to verify the inclusion-exclusion criteria using a hierarchical approach in two phases. The papers were included when they were original and descriptive or observational studies which assessed collective tactical behaviours from positional data and met the following inclusion/exclusion criteria: *phase 1 (criterion 1):* (1) original studies which assess tactical behaviours from positional data in male football matches; *phase two (criteria 1 and 2):* (2) the studies measure tactical behaviours during professional football matches by using positional data; (3) the studies that reported absolute values of, about at least, one tactical behaviour variable during professional football matches. In addition, a filter for 'English' was applied, but no additional restrictions about publication data were considered. The agreement

of the raters was optimal. Any disagreements (5% of the total) on the final inclusion-exclusion status were resolved through discussion in both the screening and excluding phases and a final decision was agreed upon.

Data analysis and extraction

The values of the match collective behaviour references were reported in Tables 1, 2, 3, 4, 5 and 6 in two ways: (1) mean and standard deviation (± SD) when the studies provided the data exactly, and (2) the approximate mean ± SD when the data were extracted from the plots of the studies. In addition, the range was provided when the data of several studies were provided in the discussion and conclusions. In order to provide the results from the contexts in which the original study was done, the following information was extracted and detailed in the tables: league (country), number of teams involved in the analysis, level of the teams, level of the rivals, sample, pitch size (if available), time of the game to which the data belong, value of the collective variables, and other contextual information.

RESULTS

Identification and selection of studies

A total of 1,187 documents were initially retrieved from the aforementioned databases, of which 233 were duplicated. Thus, a total of 954 articles were downloaded. After screening the titles and abstract against *criterion 1* where applicable, and the full text of the remaining papers against *criterion 1*, 72 studies met the inclusion criteria. In addition, reviewing the references of the included articles, the authors found and added 25 articles that met the first inclusion criterion. From the 97 articles, which assessed tactical behaviours from positional data, 51 were ruled out because the studies were not carried out during professional football matches (*criterion 2*). Finally, 46 articles were analysed and 33 of them did not fulfil inclusion *criterion 3*. So finally, 13 studies were included in the qualitative analysis (Figure 1).

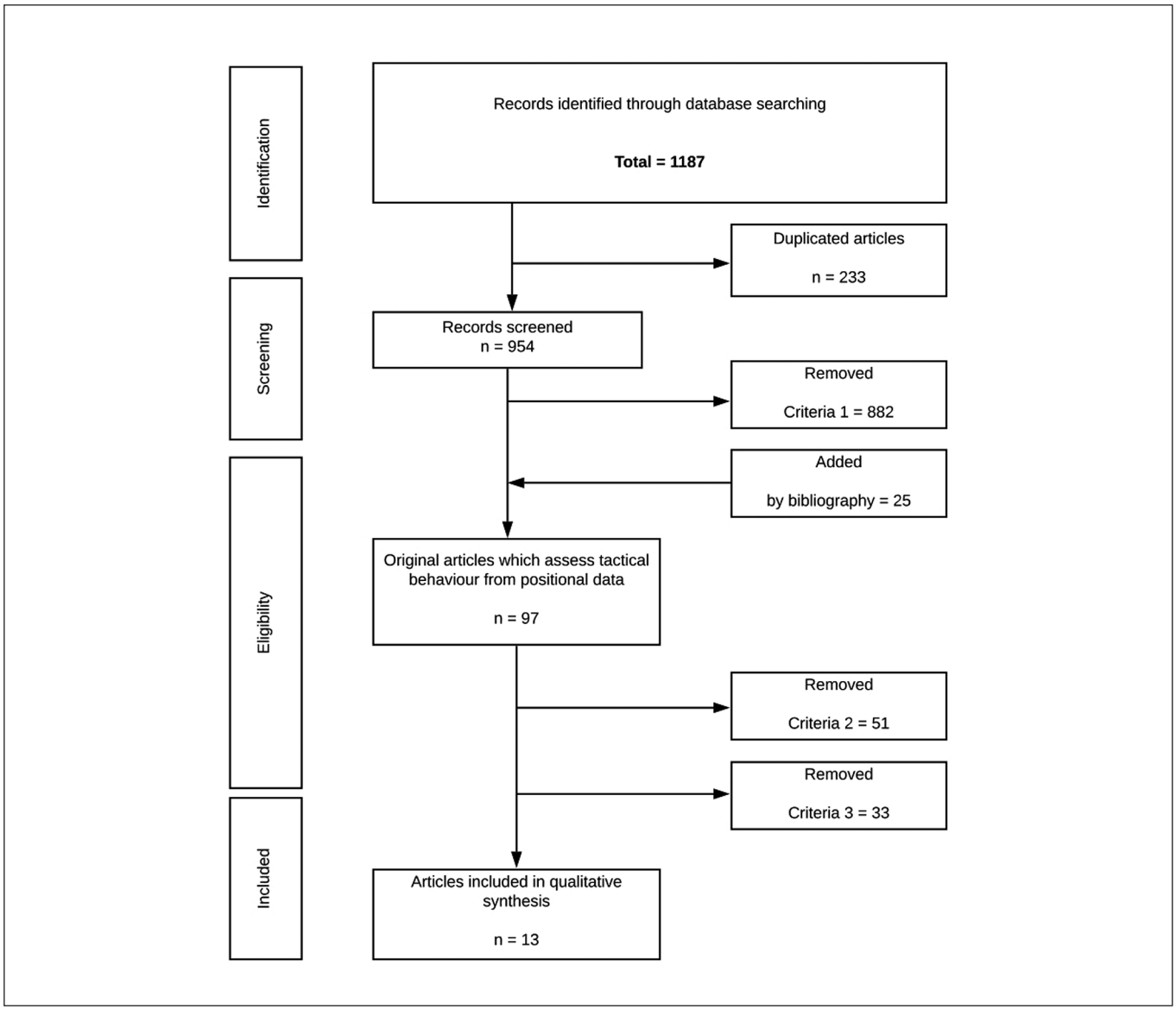

FIG. 1. Flow diagram of the study.

TABLE 1. Reference values of the *player-player distance* (m) variables during professional soccer matches.

Ref.	League	Teams	Level of the teams	Level of the rivals	Sample (Matches included)	Other conditions	Full games or halves	Effective time or full match	Pitch size	Length Mean (sd) [min-max]	Width Mean (sd) [min-max]	Df. Gk – nearest Teammate Mean (sd) [min-max]	Attack. Gk – nearest Teammate Mean (sd) [min-max]	Spread Mean (sd) [min-max]	Q
Tenga et al., [40]	Spanish La Liga.	5	1º div.	-	8	Zone 1	Full game	Full match	105 × 68	42 ± 6	41 ± 7				93
						Zone 2				39 ± 5	44 ± 8				
						Zone 3				37 ± 4	45 ± 10				
						Zone 4				36 ± 5	45 ± 8				
						Zone 5				39 ± 5	42 ± 8				
						Zone 6				46 ± 4	41 ± 6				
Castellano et al., [35]	Spanish La Liga	1	1º div.	Strong	6	Attacking	Full game	Full match		37 ± 7	41 ± 10				87
				Weak						37 ± 7	41 ± 10				
				Strong		Defending				36 ± 7	37 ± 7				
				Weak						34 ± 8	36 ± 7				
Castellano and Álvarez-Pastor, [36]	Spanish La Liga	7	1º div. Reference team among weak 7 teams	3 teams among top 6 and other 3 among weak 7	6	Attacking	Full game	Possessions	~105 × 68	36 ± 7	41 ± 10				87
						Attacking zone 1				38 ± 10	34 ± 9				
						Attacking zone 2				37 ± 6	42 ± 10				
						Attacking zone 3				34 ± 5	44 ± 9				
						Attacking zone 4				36 ± 5	42 ± 8				
						Attacking zone 5				44 ± 7	37 ± 9				
						Defending				34 ± 7	37 ± 7				
						Defending zone 1				41 ± 8	36 ± 7				
						Defending zone 2				34 ± 6	38 ± 6				
						Defending zone 3				31 ± 6	38 ± 6				
						Defending zone 4				33 ± 8	35 ± 7				
						Defending zone 5				37 ± 13	30 ± 10				
Duarte et al. [44]	English Premier League	2	1º div.	-	1	Home team	1st half	0´–15´	-	~32 ± 8	~40 ± 8				80
								15´–30´		~35 ± 10	~39 ± 8				
								30´–45´		~34 ± 8	~38 ± 9				
							2nd half	45´–60´		~34 ± 7	~42 ± 10				
								60´–75´		~34 ± 7	~39 ± 8				
								75´–90´		~34 ± 10	~37 ± 7				
						Visiting team	1st half	0´–15´		~31 ± 9	~41 ± 10				
								15´–30´		~33 ± 12	~41 ± 8				
								30´–45´		~30 ± 10	~38 ± 10				
							2ndhalf	45´–60´		~31 ± 11	~43 ± 10				
								60´–75´		~31 ± 8	~38 ± 8				
								75´–90´		~37 ± 10	~39 ± 6				
Fradua et al., [38]	Spanish La Liga	5	1º div.	-	4	-			-	~38 ± 8 [37 ± 6 – 39 ± 5]	~ 45 ± 8 [43 ± 9 – 47 ± 8]	~23 ± 8 [21 ± 8 – 24 ± 8]	~24 ± 8 [22 ± 8 – 26 ± 8]		
						Zone 1	Full game	Full match		42 ± 6	41 ± 6	30 ± 6	12 ± 8		93
						Zone 2				39 ± 5	45 ± 8	29 ± 5	16 ± 6		
						Zone 3				35 ± 4	47 ± 9	26 ± 4	23 ± 5		
						Zone 4				34 ± 4	46 ± 7	22 ± 5	27 ± 5		
						Zone 5				39 ± 17	43 ± 8	16 ± 4	31 ± 5		
						Zone 6				46 ± 4	41 ± 6	9 ± 5	33 ± 7		

TABLE 1. Continue.

Ref.	League	Teams	Level of the teams	Level of the rivals	Sample (Matches included)	Other conditions	Full games or halves	Effective time or full match	Pitch size	Length Mean (sd) [min-max]	Width Mean (sd) [min-max]	Df. Gk – nearest Teammate Mean (sd) [min-max]	Attack. Gk – nearest Teammate Mean (sd) [min-max]	Spread Mean (sd) [min-max]	Q
Castellano & Casamicha-na [37]	Spanish La Liga	20	1º div.	Top 10 Botton 10	320	-	Full game	Full match	-	~37 ± 9	~43 ± 7				93
	Adelante League	22	2º div.	Top 10 Botton 12	335	-				~36 ± 5	~44 ± 7				
Palucci Vieira et al.,[43]	Brazilian prof. League	5	-		2	-	Full game	Full match	100 × 70					~ 172 ± 15	93
							1st half							168 ± 9	
							2nd half							177 ± 18	
Moura et al., [42]	Brazilian prof. League	16	1º div.	-	8	Attacking	Full games	Full match						~348 [323 – 387]	87
								Suffer tackle						350 ± 3	
								Shot						277 ± 7	
						Defending		Full match						~305 [283 – 326]	
								Tackle						305 ± 2	
								Suffer shot						394 ± 5	

TABLE 2. Reference values of the *player-space distance* (in m) variables during professional soccer matches.

Ref.	League	Teams	Level of the teams	Level of the rivals	Sample (Matches included)	Other conditions	Full games or halves	Effective time or full match	Pitch size	Own goal line-ball recovery location Mean (sd) [min-max]	Own goal line-closest defender Mean (sd) [min-max]	Own goal line-closest attacker Mean (sd) [min-max]	Height of defense Mean (sd) [min-max]	Q
Santos, Lago-Peñas, and García-García, [39]	Spanish La Liga	1	1º div.	Top	13	Losing at home	Full games	510 ball recoveries	-	32	25	42		93
						Losing away				27	22	46		
						Drawing at home				27	22	46		
						Drawing away				22	19	49		
						Winning at home				28	22	46		
						Winning away				24	18	50		
				Similar		Losing at home				37	29	40		
						Losing away				32	25	44		
						Drawing at home				32	26	44		
						Drawing away				27	22	47		
						Winning at home				34	25	44		
						Winning away				29	22	48		
Castellano and Casamicha-na [37]	Spanish La Liga	20	1º div.	Top 10 Botton 10	320	.	-	Full game	Full match				~37 ± 10	93
	Adelante League	22	2º div.	Top 10 Botton 12	335	-	-						~38 ± 8	
Castellano and Álvarez-Pas-tor [36]	Spanish La Liga	1 team (n = 6) 6 teams (n = 1)	1º div. Reference team among weak 7 teams	3 teams among top 6 and other 3 among weak 7	6793 individual possessions from 6 games	Attacking zone 1	Full game	Possessions	~105 × 68				~10 ± 25	87
						Attacking zone 2							~25 ± 20	
						Attacking zone 3							~38 ± 20	
						Attacking zone 4							~45 ± 15	
						Attacking zone 5							~50 ± 12	
						Defending zone 1							~45 ± 20	
						Defending zone 2							~40 ± 20	
						Defending zone 3							~30 ± 12	
						Defending zone 4							~20 ± 20	
						Defending zone 5							~6 ± 10	

TABLE 3. Reference values of the *GC-GC* and *GC-player* (stretch index) *distance* (m) variables during professional soccer matches.

Ref.	League	Teams	Level of the teams	Level of the rivals	Sample (Matches included)	Other conditions	Full games or halves	Effective time or full match	Pitch size	GC-GC Mean (sd) [min-max]	Stretch index Mean (sd) [min-max]	Weighted stretch index Mean (sd) [min-max]	Q
Frencken et al. [45]	UEFA Championship	2	1º div.	-	1	-	1st half	Full match	105 × 68	Longitudinal axe = 7 ± 2 Lateral axe = 0 ± 2			87
							2nd half			Longitudinal axe = 6 ± 4 Lateral axe = 1 ± 4			
Duarte et al., [44]	English Premier League	2	1º div.	-	2	Home team	1st half	0´ – 15´	-		~15 ± 2		80
								15´–30´			~15 ± 3		
								30´–45´			~15 ± 4		
							2nd half	45´–60´			~17 ± 3		
								60´-75´			~15 ± 4		
								75´–90´			~14 ± 4		
						Visiting team	1st half	0´–15´			~15 ± 3		
								15´–30´			~15 ± 4		
								30´–45´			~13 ± 4		
							2nd half	45´–60´			~14 ± 3		
								60´-75´			~13 ± 3		
								75´–90´			~16 ± 3		
Bartlett et al., [46]	-	5	1º div.	-	10	Defending	Situations in stable state and goal situations due to stable state is broken	Stable state	-		[~9 – 10]		87
								Goal situation			[~7 – 10]		
						Attacking		Stable state			[~12 – 13]		
								Goal situation			[~12 – 16]		
Clemente et al. [41]	Portuguese premier League	1	1º div.	-	3	-	Full match	-	-			16 ± 4 [**3** – 35]	60
							1st half					17 ± 3 [**3** – 26]	
							2nd half					16 ± 4 [**5** – 35]	
						Attacking	Full match					17 ± 4 [**6** – 35]	
							1st half					18 ± 3 [**6** – 26]	
							2nd half					17 ± 4 [**6** – 35]	
						Defending	Full match					15 ± 3 [**3** – 31]	
							1st half					15 ± 3 [**3** – 25]	
							2nd half					15 ± 3 [**5** – 31]	

TABLE 4. Reference values of the team´s area (m^2) measured by several computation methods during professional soccer matches.

Ref.	League	Teams	Level of the teams	Level of the rivals	Sample (Matches included)	Other conditions	Full games or halves	Effective time or full match	Pitch size	Surface area Mean (sd) [min-max]	Sum of triangulations Mean (sd) [min-max]	Length x width Mean (sd) [min-max]	Q
Palucci Vieira et al., [43]	Brazilian prof. League	5	-	-	2	-	Full game	Full match	100 × 70	914 ± 163			93
							1st half			884 ± 100			
							2nd half			944 ± 206			
Moura et al., [42]	Brazilian prof. League	16	1º div.	-	8	Attacking	Full games	Attacking	-	~1082 [968–1408]			87
								Suffer tackle		1060 ± 15			
								Shot		899 ± 44			
						Defending		Full match		~914 [805–1158]			
								Tackle		921 ± 13			
								Suffer shot		1110 ± 42			
Clemente et al. [41]	Portuguese premier League	1	1º div.	-	3	-	Full match	-	-		1535 ± 539 [93–3790]		60
							1st half				1608 ± 467 [142–3082]		
							2nd half				1462 ± 593 [92–3790]		
						Attacking	Full match				1735 ± 564 [152–3790]		
							1st half				1831 ± 452 [260–3082]		
							2nd half				1628 ± 644 [152–3790]		
						Defending	Full match				1323 ± 416 [92–3432]		
							1st half				1370 ± 349 [143–2660]		
							2nd half				1277 ± 469 [92–3432]		
Duarte et al., [44]	English Premier League	2	1º div.	-	2	Home team	1st half	0´–15´	-	~900 ± 300			87
								15´–30´		~850 ± 300			
								30´–45´		~900 ± 400			
							2nd half	45´–60´		~1000 ± 200			
								60´-75´		~850 ± 250			
								75´–90´		~800 ± 350			
						Visiting team	1st half	0´–15´		~800 ± 300			
								15´–30´		~900 ± 400			
								30´–45´		~750 ± 400			
							2nd half	45´–60´		~800 ± 300			
								60´–75´		~750 ± 250			
								75´–90´		~950 ± 300			
Castellano et al., [35]	Spanish La Liga	1	1º div.	Strong	6	Attacking	Full game	Full match	-			1527+518	80
				Weak								1486+456	
				Strong		Defending						1205+395	
				Weak								1227+362	
Castellano and Álvarez-Pastor [36]	Spanish La Liga	7	1º div. Reference team among weak 7 teams	3 teams among top 6 and other 3 among weak 7	6	Attacking	Full game	Possessions	~105 × 68			~1511 ± 475	87
						Attacking zone 1						~1347 ± 547	
						Attacking zone 2						~1563 ± 526	
						Attacking zone 3						~1494 ± 426	
						Attacking zone 4						~1527 ± 359	
						Attacking zone 5						~1618 ± 501	
						Defending						~1250 ± 376	
						Defending zone 1						~1485 ± 447	
						Defending zone 2						~1321 ± 331	
						Defending zone 3						~1169 ± 308	
						Defending zone 4						~1165 ± 355	
						Defending zone 5						~1148 ± 557	

TABLE 5. Reference values of the area regions (m^2) during professional soccer matches.

Ref.	League	Teams	Level of the teams	Level of the rivals	Sample (Mat. incl.)	Other conditions	Full games or halves	Effective time or full match	Pitch size	Defensive backward region Mean (sd) [min-max]	Defensive 1st half of the middle region Mean (sd) [min-max]	Defensive 2nd half of the middle region Mean (sd) [min-max]	Defensive forward region Mean (sd)[min-max]	Q
Clemente et al., [47]	Portuguese Premier League	1	1st div.	-	3	-	1st half	Full match	104 × 68	2213	2816	3335	1400	87
							2nd half			1946	2549	3058	1268	
						Final score: loss	Full game			1744	2669	3001	1333	
						Final score: draw				1499	1668	2237	1649	
						Final score: win				2038	2523	2931	1085	

Defensive backward region = space between the defensive players and the goalkeeper; Defensive 1st half of the middle region = region between the defender and the midfielder; Defensive 2nd half of the middle region = region between two midfielders and one attacking player; Defensive forward region = region between attacking players and one midfielder; Mat. Incl.: Matches included.

TABLE 6. Reference values of individual playing area (m^2) during professional soccer matches.

Ref.	League	Teams	Level of the teams	Level of the rivals	Sample (Matches included)	Other conditions	Full games or halves	Effective time or full match	Pitch size	Individual playing area Mean (sd) [min-max]	Q
Fradua et al., [38]	Spanish La Liga	5	1º div.	-	4	-	Full game	Full match	-	~84 ± 19 [**81** ± 17 – 87 ± 23]	93
						Zone 1				88 ± 19	
						Zone 2				89 ± 20	
						Zone 3				82 ± 18	
						Zone 4				79 ± 15	
						Zone 5				84 ± 38	
						Zone 6				94 ± 16	

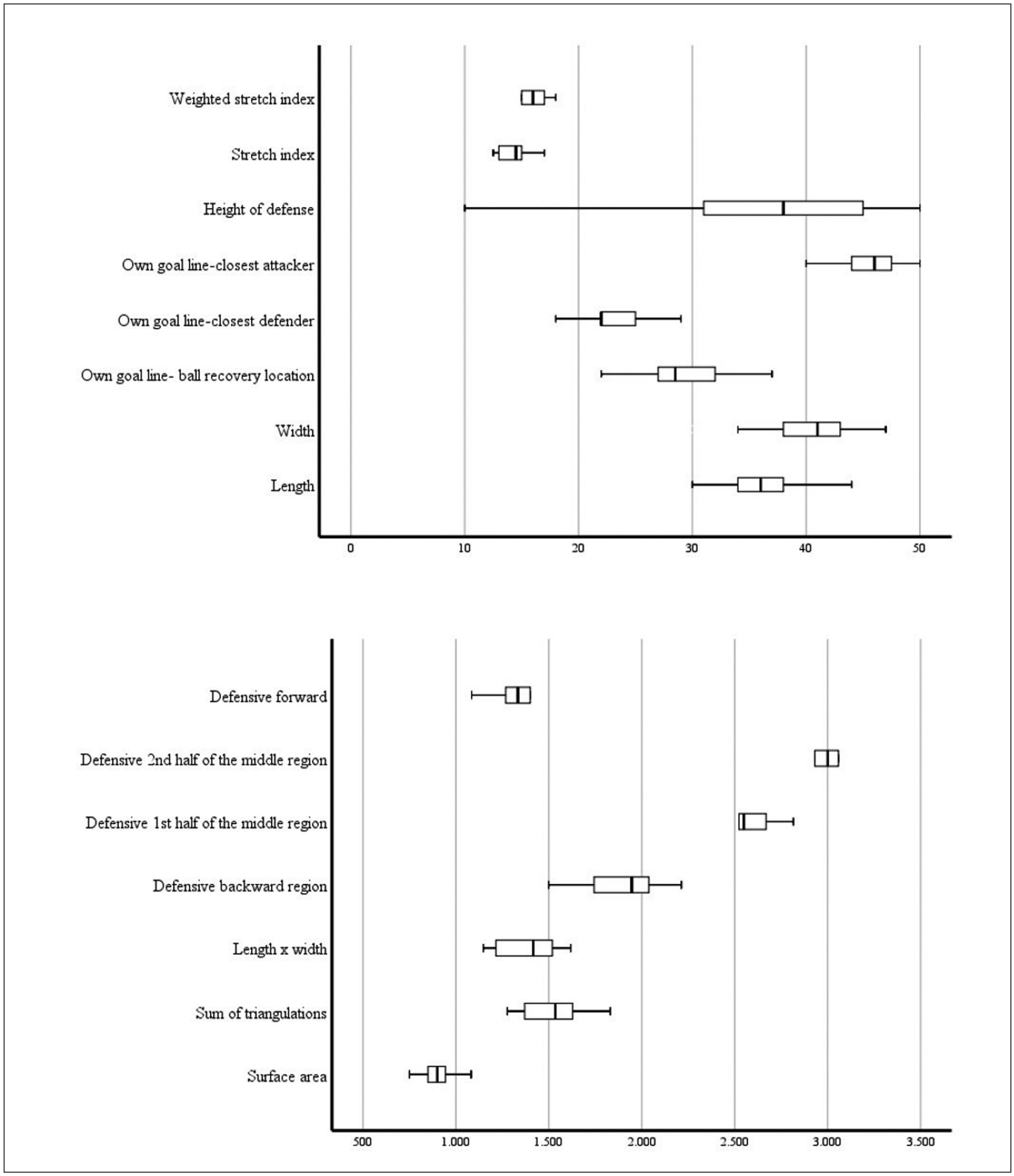

FIG. 2. *Distance* (upper) and *area* (lower) variables' reference values in official professional soccer matches.

Assessment of methodological quality

The quality of included studies was individually assessed using a modified assessment scale of Downs and Black by Sarmento et al. [32]. Among the articles included in this systematic review (n = 13), five were rated as having a quality of 93%, six of 87%, one of 80% and one of 62%. No studies were left out due to poor quality (Tables 1, 2, 3, 4, 5 and 6).

Study characteristics

Twelve articles reported absolute values based on the *distance* variables (Table 1, 2 and 3). Among them, six studies were carried out during official matches of the Spanish 1st Division [6, 9, 28–31], one in the Portuguese 1st Division [41], two in the Brazilian 1st Division [42, 43], one in the English Premier League [44], one during the European UEFA Champions League [45] and one did not specify in which European League it was carried out (Tables 1, 2 and 3). These studies provided information about distance between players (i.e. player-teammate). Overall, team length ranged from 31 to 46 m; team width ranged from 35 to 48 m; the distance from the defender's goalkeeper to the nearest teammate ranged from 9 ± 6 to 30 ± 7 m; the distance from the attacker's goalkeeper to the nearest teammate ranged from 13 ± 8 to 33 ± 8 m; goal line-recovery location ranged from 27 to 37 m; opponent goal line-own team's offense line ranged from 22 to 28 m; and, opponent goal line-own offense line ranged from 42 to 50 m (Figure 2). In addition, the aforementioned studies provide data about distance values as follows: GC-player (i.e. stretch index) ranged from 7 to 16 m, GC-GC ranged from 1 to 7 m, player-space (i.e. goal line-recovery location) ranged from 27 to 37 m, goal line-offense line ranged from 42 to 50 m, and goal line-defence line ranged from 22 to 28 m. Specifically, three studies reported values about spread [42, 43], three about the stretch index [41, 44, 46], six about length and width [35–38, 40, 44], one about GC-GC [45], one about player-player [38] and three about player-space [36, 37, 39] distances (Table 1, Table 2 and Table 3).

Area variables were divided into three levels: a) each team individually (i.e. surface area), b) several players of a team and c) individual space per player. Surface area values were reported five times and ranged from 750 to 1,831 m [36, 41–44]: two in the Brazilian league [42, 43], one in the Portuguese league [41], one in the English Premier League [44] and one in the Spanish league [36] (Tables 4, 5 and 6). Space between several player was measured in the Portuguese 1st Division [47]. Finally, individual area per player was reported in two articles and ranged from 79 to 94 m: in the Spanish 1st Division [38] and the other in the Portuguese one [41] (Tables 4, 5 and 6).

DISCUSSION

The aim of this systematic review was to cluster the collective tactical variables used to highlight and compare the collective behaviour of male soccer teams during official professional matches, providing reference values for each of them. The main contribution of the revision was to obtain match-value references about collective tactical behaviours with respect to the three types of variables (i.e., dot, distance and area). All the studies provided greater distance and area values during the team's possession phase in comparison to non-possession. The ball's location on the pitch determined the collective team's tactical behaviours.

Distance variables

Player-teammate

In a match the whole team's length ranged from 27 to 48 m [36, 38, 40]. Similarly, the team length ranged from 24 to 42 m in the English Premier League [44] and from 26 to 46 m, in the Spanish 1st Division [37]. The area of the pitch where the ball was determined considerably the team length [36], being higher in near-the-goal areas where the finishing phase of play takes place in comparison to midfield areas (Table 1). On the other hand, the team width values, from 41 ± 6 m to 47 ± 9 m, remained more stable than the team length in different areas in the Spanish 1st Division [38, 40]. This suggests that technical staff should design training tasks that force players to use similar distances during training sessions. The training tasks that aim at improving the finalization phase (i.e. near to the official goal) could include targets behind (i.e. near to the centre line of the pitch) the attacking players to force them to play "longer" during the attack. In order for the team length to be "shorter" in the middle zone of the pitch, a smaller playing space and interaction zones could be used in which the players must dribble or receive the ball because this could force them to be near to the interaction zone line. Both the team length and width were lower during the defending phase in comparison to the attacking one [35, 36]. Thus, the assessment of the team length and width during training and matches should be carried out differentiating between both playing phases, especially during critical situations, for example, shots on goal and tackling (i.e. attacking-defending transition) [42].

The suitability of defending-training tasks near to one's own goal and attacking-training tasks far from one's own goal could be assessed by comparing training-distance values with the reference values provided by the studies (i.e. goalkeeper-nearest teammate (attacking): ranged from 12 ± 8 to 33 ± 8 m; goalkeeper-nearest teammate (defending): ranged from 30 ± 7 to 9 ± 6 m). This comparison should be carried out during training tasks performed in a similar playing area applying match conditions and using the offside rule. These reference values suggest that the off-side rule should be applied during the training tasks oriented by official targets (i.e. goalkeepers) to allow players to be similar distances away as in the match. As has been found with respect to the match physical-physiological load [48, 49], playing phase (i.e. ball possession vs. ball non-possession) and halves (i.e. 1st vs 2nd) also determined the collective tactical behaviours, having a lower spread of values during the defending phase (i.e. 323 to 388 m) and in the 1st half in comparison to the attacking phase (i.e. 283–388) and the 2nd half [42, 43]. Thus, the assessment of the *player-teammate* match distances should

be carried out differentiating between both playing phases and halves [41, 42, 50]. If the aim of the training task is to force teammates to play closer together during non-possession but farther apart during possession phases, it could be interesting to divide the playing space into several zones that should be occupied by the teams or not, according to the playing phase. That is, fewer zones should be occupied during the non-possession phase in comparison to the possession phase.

Player-space

As for the match physical-physiological load [51], contextual factors also determined *space-player* distance. The goal line-recovery location, the opponent's goal line-own offense line and opponent goal line-own offense line *distances* were greater at home than away; the team was closer to its own goal and further away from the opponent's goal when the team was winning or drawing than when it was losing; and playing against top-level opponents decreased the distance between their own goal line and the ball recovery location and the position of the defensive line compared with playing against similar skilled opponents [39]. But, the results of the interaction between the contextual factors altered the general differences provided after analysing each of them independently. Thus, the use of multi-level analysis to identify the impact of each contextual factor on the collective tactical behaviours is suggested. At a practical level, the impact of both contextual factors should be considered in the design of training strategies in order to prepare the player response to different match scenarios. Despite the fact that teams can be classified in several styles of team play in high-level football, the strategic proposal of teams varied during matches [52, 53].

Football technicians could consider the distance between the deepest defender and own goal match reference values (i.e. attacking 38 ± 8 m and, defending: ~6 to ~45 m) [36] to design the initial situation of the training tasks in which the aim is to optimize positional defending and the attacking phases. This type of training task should involve a high number of players and be played in a large pitch with the offside rule. Again, teams' styles of play determine the use of the provided references [52, 53].

GC-GC and GC-player

The values of the 'pressure' indicator *GC-GC distance* [16] varied between halves (longitudinal axis, $1^{st} > 2^{nd}$ half; lateral axis, $1^{st} < 2^{nd}$ half) [45] and according to defending strategy (deep-defending, 9 ± 2 m; high press 7 ± 1 m) [54]. As for the player-space distance, training strategies should help players to manage different distances during training tasks to optimize the adaptability to match variations. Thus, it would be interesting to vary the dimensions and the type of targets during the training week and the season. The stretch index and weighted stretch index approximately ranged from 10 to 19 m [46] and 16 ± 4 [41], respectively. In addition, these varied according to the playing phase for professional football players [41, 46], being lower during the defending phase (ranging from ~7 to 10 m) in comparison to the attacking phase (ranging from ~12 to 16 m) [46]. This could be due to the defending team reducing inter-player distances in order to decrease the occupied space, while the attacking team's players remain further apart to provoke the defending team's dispersion, and subsequently, greater spaces free of opponents [15, 42]. Thus, the design of training strategies, that is, the combination of structural traits, should allow players to explore different spaces during ball possession and, in contrast, be closer when not in possession, for example, tasks with and without lines which limit pitch space [55] and the use of different pitch dimensions [56].

Area variables

Team area

The mean team area during official professional soccer matches was calculated using the convex hull (900 m^2) [42, 44] and through the sum of the area of each possible triangulation among 11 teammates (1500 m^2) [41]. These references can be used to assess the area occupied by the players during the training tasks that involve a high number of players and are played on a large pitch, with a goalkeeper, and with the offside rule. The entire playing space of the training tasks should allow outfield players to occupy the space similarly to in the official match, suggesting the use of match derived relative area in training session design [56].

The surface area was also affected by playing phases (i.e., possession vs non-possession), with area values being greater when the team was in the possession phase during professional official soccer matches [35, 36, 41, 42]. Technical staff could divide the playing space in several zones, in both longitudinal and transversal axes, and penalise with a score the team that occupies too many sub-zones when the opposing team has possession of the ball to "force" players to play "together" during the non-possession phase. On the other hand, the team that has possession could be penalised if it occupies few sub-spaces. The decrease in the occupied area during the 2^{nd} half in comparison to the 1^{st} half [41] could be due to accumulated fatigue [57] or strategical behaviour according to the score, but it should be assessed in further studies.

Space between several players

Considering that the *defensive play area* between players of the different lines was greater when the final result was a loss or a win, while when the final score was a draw these spaces were lower [47], and that the ball recovery location was further from a team's own goal when the teams were losing or winning (Santos et al. [39]), it seems that when the result was a draw the teams were more compact and played closer to goal.

However, these conclusions should be taken with caution because the score during the game and the impact it has during the match were not considered. At a practical level, the use of different mechanism interruptions is suggested (i.e. *time limit* [e.g. the team that scores more goals after five minutes of play wins], *score limit* [e.g. the team that scores three goals wins], or mixed score [e.g. 5 minutes

or 3 goals to win]) during training tasks to make players "play" depending on the current score. This will mean variation in the collective-tactical behaviours during training as occurs during a match.

Effective playing area per player

Fradua et al. [38] computed *individual playing area* by dividing the area of a rectangle including all outfield players (goalkeepers excluded) by 20 (the total number of outfield players) during full-sized matches. Match *individual playing area* ranged from 79 ± 15 to 94 ± 16 m^2, being greater when the ball was placed near the goals in comparison to the rest of the spaces of the pitch. This variable has been suggested when designing training tasks [38], but several considerations are necessary. *Individual playing area* values are conditioned by the total playing space that can be played; that is, match *individual playing area* ranges from 79 ± 15 to 94 ± 16 m^2 because all the playing space can be used (i.e. length [105 m] * width [70 m] = 7350 m^2). The players use the space considering that it is possible to play to their "backs" and the off-side rule is applied. Actually, the *hypothetical interaction individual space* is approximately 320 m^2 (i.e. [length*width] / number of players [56]) according to the dimensions of each pitch. Thus, the use of the *hypothetical interaction individual space* as reference (around 320 m^2 per player) is suggested to limit the playing space, together with the relative length/width value (or ratio) in the design of training tasks played on a large pitch, with targets and with off-side. As for length and width values (Table 1), when the ball was placed near the goal, the team area was greater in comparison to the rest of the spaces on the pitch. Thus, the assessment of the use of the space during training should be carried out according to the place in relation to the goal. As we have suggested, technical staff could include targets behind (i.e. near to the centre line of the pitch) the players that attack the official goal to encourage "more length" and "width" during the attack. In order for the team's length to be "shorter" in the middle zone of the pitch, a smaller playing space and interaction zones could be used, in which the players should dribble or receive the ball.

Study limitations

Only distance and area values have been provided from Brazilian, Portuguese, and Spanish high-level football and a European Champions League quarterfinal match. Due to the selected leagues and teams included in the considered articles, the generalization of the results should be done with caution. Hence, the particularity of the culture of play and playing styles could add some bias in the team behaviour reference values. In addition, the number of matches analysed in the studies was low and the impact of the contextual factors was assessed independently. Further studies should assess more matches in different leagues and competition levels, taking into account the interaction between the contextual factors. In this way, references values would be more accurate and would help football coaches in the design of suitable training tasks to optimize the collective tactical behaviours.

CONCLUSIONS

The analysis of collective tactical behaviours during football matches should differentiate both playing phases and the location of the ball. The reference values of the team behaviours could help staff to optimize the performance of the teams. The results relating to the comparison between match halves (i.e. 1st vs. 2nd) were contradictory, and the impact of the final match result was not clear. Future studies should analyse whether the regularities provided during official matches are performed during training tasks.

Practical applications

Reference values can help coaches in the assessment of collective tactical behaviours during matches, and at the same time, these variables could be used to design suitable training tasks in order to optimize the collective performance of the team. It would allow a guarantee of the representativeness of the tasks where players could replicate match constraints, usually training tasks designed with a large number of players and playing space including the offside rule.

As examples, there follows a brief description of some training scenarios (e.g. tasks), taking into consideration the results of the current study. Firstly, the training tasks that seek to improve the finalization phase (i.e. near to the goal) should be "longer" during the attacking phase near to the opposing team's goal but "shorter" in the middle zone of the pitch. Secondly, technical staff should design tasks in which players are "forced" to play "together" during the non-possession phase (e.g. marking a sub-space on the field which the team in the defence phase must occupy) but "bigger" during possession phases. Finally, the use of different mechanism interruptions is suggested (i.e. *time limit* [e.g. the team that scores more goals after five minutes of play wins] or *score limit* [e.g. the team that scores three goals wins]). This constraint could be applied during training tasks to make players "play" depending on the current score, that is, to develop different collective-tactical behaviours according to whether they are winning, drawing or losing, considering the time remaining to finish the task or the goals needed to finish the task.

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