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 ± 50 m. The stretch index ranged from 7 to 16 m. Mean team area was ~900 m². 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 ± 50 m. The stretch index ranged from 7 to 16 m. Mean team area was ~900 m². 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 ± 50 m. The stretch index ranged from 7 to 16 m. Mean team area was ~900 m². 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 ± 50 m. The stretch index ranged from 7 to 16 m. Mean team area was ~900 m². 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 ± 50 m. The stretch index ranged from 7 to 16 m. Mean team area was ~900 m².

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 regularity 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 behaviour”, “tactical performance”, “tactical-derived variables”, “tactical analysis”, “tactical ability”, “team tactic” “positioning performance”, “collective variable”, “collective behaviour”, “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 (criterion 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 | Other conditions | Full games or halves | Other distances          | Notes |
|--------------|-----------------------------|-------|--------------------|---------------------|--------|------------------|----------------------|-------------------------|-------|
| Tenga et al., [40] | Spanish La Liga.       | 5     | 1º div.            | -                   | 8      | Full game        | Full match           | 42 ± 6                  | 93    |
|              | Zone 1                      |       |                    |                     |        |                  |                      | 39 ± 5                  |       |
|              | Zone 2                      |       |                    |                     |        |                  |                      | 37 ± 4                  |       |
|              | Zone 3                      |       |                    |                     |        |                  |                      | 36 ± 5                  |       |
|              | Zone 4                      |       |                    |                     |        |                  |                      | 39 ± 5                  |       |
|              | Zone 5                      |       |                    |                     |        |                  |                      | 46 ± 4                  |       |
|              | Zone 6                      |       |                    |                     |        |                  |                      | 41 ± 6                  |       |
| Castellano et al., [35] | Spanish La Liga.      | 1     | 1º div.            | Strong             | 6      | Attacking        | Full game            | 37 ± 7                  | 87    |
|              | Zone 2                      |       |                    |                     |        |                  |                      | 37 ± 7                  |       |
|              | Zone 3                      |       |                    |                     |        |                  |                      | 36 ± 7                  |       |
|              | Zone 4                      |       |                    |                     |        |                  |                      | 34 ± 8                  |       |
|              | Zone 5                      |       |                    |                     |        |                  |                      | 36 ± 7                  |       |
|              | Zone 6                      |       |                    |                     |        |                  |                      | 37 ± 7                  |       |
| Castellano and Álvarez-Pastor, [36] | Spanish La Liga. | 7     | 1º div.            | Reference team among top 6 and other 3 among weak 7 | 6      | Full game        | Full match           | 44 ± 7                  | 87    |
|              | Zone 2                      |       |                    |                     |        |                  |                      | 34 ± 7                  |       |
|              | Zone 3                      |       |                    |                     |        |                  |                      | 34 ± 8                  |       |
|              | Zone 4                      |       |                    |                     |        |                  |                      | 33 ± 8                  |       |
|              | Zone 5                      |       |                    |                     |        |                  |                      | 37 ± 13                 |       |
|              | Zone 6                      |       |                    |                     |        |                  |                      | 30 ± 10                 |       |
| Duarte et al. [44] | English Premier League. | 2     | 1º div.            | -                   | 1      | Home team        |                       | 0–15’                  | 80    |
|              | Zone 1                      |       |                    |                     |        |                  |                      | 15–30’                  |       |
|              | Zone 2                      |       |                    |                     |        |                  |                      | 30–45’                  |       |
|              | Zone 3                      |       |                    |                     |        |                  |                      | 45–60’                  |       |
|              | Zone 4                      |       |                    |                     |        |                  |                      | 60–75’                  |       |
|              | Zone 5                      |       |                    |                     |        |                  |                      | 75–90’                  |       |
|              | Zone 6                      |       |                    |                     |        |                  |                      | 90–105’                 |       |
|              | Zone 1                      |       |                    |                     |        | Visiting team    |                       | 0–15’                  | 80    |
|              | Zone 2                      |       |                    |                     |        |                  |                      | 15–30’                  |       |
|              | Zone 3                      |       |                    |                     |        |                  |                      | 30–45’                  |       |
|              | Zone 4                      |       |                    |                     |        |                  |                      | 45–60’                  |       |
|              | Zone 5                      |       |                    |                     |        |                  |                      | 60–75’                  |       |
|              | Zone 6                      |       |                    |                     |        |                  |                      | 75–90’                  |       |
| Fradua et al., [38] | Spanish La Liga.   | 5     | 1º div.            | -                   | 4      | Full game        | Full match           | 42 ± 6                  | 93    |
|              | Zone 1                      |       |                    |                     |        |                  |                      | 41 ± 7                  |       |
|              | Zone 2                      |       |                    |                     |        |                  |                      | 44 ± 8                  |       |
|              | Zone 3                      |       |                    |                     |        |                  |                      | 45 ± 10                 |       |
|              | Zone 4                      |       |                    |                     |        |                  |                      | 45 ± 10                 |       |
|              | Zone 5                      |       |                    |                     |        |                  |                      | 48 ± 10                 |       |
|              | Zone 6                      |       |                    |                     |        |                  |                      | 51 ± 10                 |       |

References:

1. Castellano and Álvarez-Pastor, [36]
2. Duarte et al. [44]
3. Fradua et al., [38]
TABLE 1. Continue.

| Ref.          | League               | Teams | Level of the teams | Level of the rivals | Sample | Other conditions | Full games or halves | Effective time or full match | Pitch size | Other | Mean (sd) | Mean (sd) | Mean (sd) | Mean (sd) | Mean (sd) | Mean (sd) | Mean (sd) | Mean (sd) |
|---------------|-----------------------|-------|--------------------|---------------------|--------|------------------|----------------------|--------------------------|------------|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Castellano & Casamicha-na (37) | Spanish La Liga | 20 | 1º div. | Top 10 | Battalion 10 | 320 | - | Full | 36 ± 2 | - | 36 ± 2 | 105 | 105 | 105 | 105 |
| | Adelante League | 22 | 2º div. | Battalion 12 | 335 | - | Full | 36 ± 2 | - | 36 ± 2 | 105 | 105 | 105 | 105 |

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 | Other conditions | Full games or halves | Effective time or full match | Pitch size | Other | Mean (sd) | Mean (sd) | Mean (sd) | Mean (sd) | Mean (sd) | Mean (sd) | Mean (sd) | Mean (sd) |
|---------------|-----------------------|-------|--------------------|---------------------|--------|------------------|----------------------|--------------------------|------------|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Santos, Lago-Peñas, and García-García, (39) | Spanish La Liga | 1 | 1º div. | - | 13 | Top | Losing at home | 32 25 42 | 27 22 46 | 22 29 40 | 23 22 46 | 37 25 44 | 32 24 44 | 29 22 48 |
| | | | | Similar | - | - | Draw at home | 32 25 42 | 27 22 46 | 22 29 40 | 23 22 46 | 37 25 44 | 32 24 44 | 29 22 48 |
| Castellano and Casamicha-na (37) | Spanish La Liga | 20 | 1º div. | Top 10 | Battalion 10 | 320 | - | Full | 37 ± 5 | - | 44 ± 7 | 105 | 105 | 105 | 105 |
| | Adelante League | 22 | 2º div. | Battalion 12 | 335 | - | Full | 37 ± 5 | - | 44 ± 7 | 105 | 105 | 105 | 105 |
| Castellano and Álvarez-Pastor (36) | Spanish La Liga | 1 team | 6 teams | Reference team among top 6 and other 7 | 6973 | - | Full | 40 ± 20 | - | 40 ± 20 | 105 | 105 | 105 | 105 |
| | | | | - | 7 teams | Individual possessions from 6 games | 40 ± 20 | - | 40 ± 20 | 105 | 105 | 105 | 105 |
### 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 | Stretch index | Weighted stretch index | Q     |
|-------------|-------------------------------|-------|-------------------|---------------------|--------------------------|---------------------------------|---------------------|--------------------------------|------------|-------|---------------|------------------------|-------|
| Frencken et al. [45] | UEFA Championship            | 2     | 1º div.           | 1                   | Full games or halves     | Longitudinal axe = 7 ± 2       | 1ª half             | Full match                      | 105 × 68   | GC-GC | Mean (sd) [min-max] | Mean (sd) [min-max] | Lateral axe = 0 ± 2 | Lateral axe = 6 ± 4 | 87     |
| Duarte et al., [44]  | English Premier League       | 2     | 1º div.           | 2                   | 1ª half                  | 0′ – 15′                       | 45′ – 60′           | 60′ – 75′                      | 75′ – 90′   | 30′ – 45′ | Mean (sd) [min-max] | Mean (sd) [min-max] | 0′ – 15′ | 45′ – 60′ | 60′ – 75′ | 75′ – 90′ | 80     |
| Bartlett et al., [46] | 5º div. – 10                 | 5     | 1º div.           | 10                  | 1ª half                  | 2ª half                        | 0′ – 15′            | 15′ – 30′                      | 0′ – 15′   | 30′ – 45′ | Mean (sd) [min-max] | Mean (sd) [min-max] | 0′ – 15′ | 30′ – 45′ | 15′ – 30′ | 0′ – 15′ | 87     |
| Clemente et al. [41] | Portuguese premier League    | 1     | 1º div.           | 3                   | 1ª half                  | 1ª half                        | Full match           | 2ª half                        | 1ª half    | 2ª half | 16 ± 4 [3 – 35] | 17 ± 3 [3 – 26] | 16 ± 4 [5 – 35] | 17 ± 4 [6 – 35] | 18 ± 3 [6 – 26] | 17 ± 4 [6 – 35] | 60     |
## Reference values for positioning in professional soccer

**TABLE 4.** Reference values of the team’s area (m²) 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 (m) | Surface area (m²) | Sum of triangulations (mean (sd) [min-max]) | Length × width (mean (sd) [min-max]) | Q |
|------|--------|-------|--------------------|--------------------|--------------------------|---------------------|---------------------|------------------------|----------------|----------------|---------------------------------------------|-------------------------------------|---|
| Palucci Vieira et al., [43] | Brazilian prof. League | 5 | - | 2 | Full game | 1st half | Full match | 914 ± 163 | 914 – 1082 (968–1408) | 93 |
| Moura et al., [42] | Brazilian prof. League | 16 | 1st div. | 8 | Attacking | Full games | 1st half | 93 |
| Clemente et al. [41] | Portuguese premier League | 1 | 1st div. | 3 | Attacking | Full games | 1st half | 60 |
| Duarte et al., [44] | English Premier League | 2 | 1st div. | 2 | Home team | 1st half | 0-15’ | 1527+518 |
| Castellano and Álvarez-Pastor [36] | Spanish La Liga | 7 | 1st div. | 6 | Reference team among weak 7 teams | 1st half | Full game | 87 |

### Other conditions:
- Full game
- 1st half
- 2nd half
- Effective time or full match
- Pitch size
- Surface area
- Sum of triangulations
- Length × width
TABLE 5. Reference values of the area regions (m²) 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] |
|---------------|---------------------|-------|--------------------|---------------------|---------------------|-------------------|---------------------|---------------------------|-----------|-----------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| Clemente et al., [47] | Portuguese Premier League | 1 1st div. - 3 | -                  | -                   | 100x68              |                   | -                   | 1st half 2nd half         |           | 2213 2816 3335 1400                     | 1946 2549 3058 1268                                 | 1744 2669 3001 1333                               | 87                                             |
|               |                     |       |                    |                     |                     |                   | Full match          | Full match               |           | 1499 1668 2237 1649                     | 1499 1668 2237 1649                                 | 1499 1668 2237 1649                               | 87                                             |

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 (m²) 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 1st div. - 4 | -                  | -                   | -                        |                   | -                    | Full game Full match          | -         | ~84 ± 19 [81 ± 17 – 87 ± 23]                  | 93 |
|               |                     |       |                    |                     |                          |                   |                      |                           |           | 88 ± 19                                      |     |
|               |                     |       |                    |                     |                          |                   |                      |                           |           | 89 ± 20                                      |     |
|               |                     |       |                    |                     |                          |                   |                      |                           |           | 82 ± 18                                      |     |
|               |                     |       |                    |                     |                          |                   |                      |                           |           | 79 ± 15                                      |     |
|               |                     |       |                    |                     |                          |                   |                      |                           |           | 84 ± 38                                      |     |
|               |                     |       |                    |                     |                          |                   |                      |                           |           | 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 attacking 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-name own team’s offensive line ranged from 22 to 28 m; and, opponent goal line-name own 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 m² [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 players was measured in the Portuguese 1st Division [47]. Finally, individual area per player was reported in two articles and ranged from 79 to 94 m² 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 team-
mates to play closer together during non-possession but farther apart
during possession phases, it could be interesting to divide the play-
ing 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 loca-
tion, 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 be-
tween 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 col-
lective 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 dif-
f erent 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. attack-
ning 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, 1st > 2nd half; lateral axis, 1st < 2nd
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 defend-
ing team’s dispersion, and subsequently, greater spaces free of op-
opponents [15, 42]. Thus, the design of training strategies, that is, the
combination of structural traits, should allow players to explore dif-
f erent 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 m²) [42, 44] and through the
sum of the area of each possible triangulation among 11 teammates
(1500 m²) [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 goal-
keeper, 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., pos-
session 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 2nd
half in comparison to the 1st 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 com-
 pact 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 mech-
anism 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 m², 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 m² because all the playing space can be used (i.e. length [105 m] * width [70 m] = 7350 m²). 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 m² (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 m² 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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