 DOI: https://doi.org/10.5114/biolsport.2020.97067

Worst case scenario match analysis and contextual variables in professional soccer players: a longitudinal study

AUTHORS: José M. Oliva-Lozano[1], Daniel Rojas-Valverde[2,3], Carlos D. Gómez-Carmona[4], Víctor Fortes[5], José Pino-Ortega[6]

[1] 1Health Research Centre. University of Almería. Almería, Spain
[2] Centro de Investigación y Diagnóstico en Salud y Deporte, Escuela Ciencias del Movimiento Humano y Calidad de Vida, Universidad Nacional, Heredia, Costa Rica
[3] Grupo de Avances en Entrenamiento Deportivo y Acondicionamiento Físico (GAEDAF), Deporte Faculty of Sports Science. University of Extremadura, Cáceres, Spain
[4] Optimization of Training and Sports Performance Research Group (GOERD). Didactics of Music, Plastic and Body Expression Department. Faculty of Sports Science. University of Extremadura, Cáceres, Spain
[5] Unión Deportiva Almería, Almería, Spain
[6] Physical Activity and Sports Department. Faculty of Sports Science. University of Murcia, San Javier, Murcia, Spain

Corresponding author:
Carlos D. Gómez Carmona
Training Optimization and Sport Performance Research Group (GOERD). Department of Didactics of Music, Plastic and Body Expression, Sport Science Faculty.
Avenida de la Universidad s/n
10071 Caceres (Spain)
Phone: +34 664233394
E-mail: cgomezcu@alumnos.unex.es

ABSTRACT: This study aimed to describe the worst-case scenarios (WCS) of professional soccer players by playing position in different durations and analyse WCS considering different contextual variables (match half, match location and match outcome). A longitudinal study was conducted in a professional soccer team. Data were collected from different WCS durations in the total distance (TD), high-speed running distance (HSRD), and sprinting distance (SPD). A mixed analysis of variance was performed to compare different WCS durations between playing positions and contextual variables, making pairwise comparisons by Bonferroni post hoc test. Positional differences were found for TD ($p < 0.01$, $\omega_p^2 = 0.02$), HSRD ($p < 0.01$, $\omega_p^2 = 0.01$) and SPD ($p < 0.01$, $\omega_p^2 = 0.02$). There was a significant interaction when comparing WCS by match half in TD ($F = 6.1$, $p < 0.01$, $\omega_p^2 = 0.07$) but no significant differences in HSRD ($p = 0.403$, $\omega_p^2 = 0$) or SPD ($p = 0.376$, $\omega_p^2 = 0$). A significant interaction was identified when comparing WCS by match location in TD ($F = 51.5$, $p < 0.01$, $\omega_p^2 = 0.14$), HSRD ($F = 19.15$, $p < 0.01$, $\omega_p^2 = 0.05$) and SPD ($F = 8.95$, $p < 0.01$, $\omega_p^2 = 0.01$) as well as WCS by match outcome in TD ($F = 36.4$, $p < 0.01$, $\omega_p^2 = 0.08$), HSRD ($F = 13.6$, $p < 0.01$, $\omega_p^2 = 0.04$) and SPD ($F = 7.4$, $p < 0.01$, $\omega_p^2 = 0.02$). Positional differences exist in TD, HSRD, and SPD in match-play WCS, and contextual variables such as match half, match location and match outcome have a significant impact on the WCS of professional soccer players.

CITATION: Oliva-Lozano JM, Rojas-Valverde D, Gómez-Carmona CD et al. Worst case scenario match analysis and contextual variables in professional soccer players: a longitudinal study. Biol Sport. 2020;37(4):429–436.

Received: 2020-03-03; Reviewed: 2020-06-23; Re-submitted: 2020-06-29; Accepted: 2020-06-30; Published: 2020-07-10.

Key words:
External load
Competition demands
Most demanding passage
GPS
Playing positions
Match outcome
Match periods
Match location

INTRODUCTION

Recently, several studies have analysed competitive demands in professional soccer [1–3]. These investigations aimed to provide scientifically based data to coaches, which may help to understand match-play workload [4]. Players train to be prepared for the demands of the match, and that involves training peak demand periods [2]. Thus, new methods have been applied to detect the worst-case scenarios (WCS) of professional soccer players since the use of averages likely underestimates peak demands [5].

The WCS is defined as the most intense period (e.g. 1 minute) of a match or training [4, 6]. These WCS may be studied using several methods (static or rolling method) [2]. Nevertheless, the application of the rolling method has been reported as a more accurate approach to the most intense periods [2]. For example, midfielders (MF) and wide-midfielders (WMF) frequently cover a greater total distance but a smaller sprint distance (above 25.2 km/h) than the rest of playing positions in match-play WCS. Consequently, match-play WCS are position-dependent [2, 4].

Previous studies have analysed average external load demands taking into consideration different contextual variables such as match location [7–9], match half [10–14], and match outcome [7, 9, 15]. However, there is a lack of research related to match-play WCS taking into account the contextual variables mentioned above, which could have significant practical application for coaches [16].

Therefore, the aims of this study were to 1) describe the WCS of Spanish professional soccer players by playing position in four different durations; 2) compare the WCS in relation to half of the match (first or second half), match location (home vs away) and match outcome (win vs draw vs loss).

MATERIALS AND METHODS

Design

A longitudinal study over 13 microcycles was carried out during the 2018–2019 season in LaLiga 123, which consisted of one match per microcycle. Every week had a different structure depending on the day of the match (Friday, Saturday, or Sunday). In addition, the study was designed and conducted following the Ethical Standards in Sports and Exercise Science Research [17].

Participants

A total of 23 professional soccer players (age: 26.78 ± 3.77 years old; height: 180.83 ± 6.18 cm; weight: 75.69 ± 6.87 kg) were included in the study. Goalkeepers were excluded from the analysis due to the different nature of their activity-demands profile. The team systematically played in 4-4-2 formation.

Procedures

Global Positioning System (GPS) derived data was collected at 10 Hz using WIMU Pro (RealTrack Systems, Almeria, Spain), which is considered a valid and reliable device for measuring GPS-derived positioning metrics [18] and is a frequently used device in soccer research [19–22]. The units were calibrated according to the manufacturer's instructions, which consisted of placing the device on a flat surface, turning the units on without surrounding magnetic devices, and finally, waiting for 60 seconds. Then, the units were placed in the back of a specific chest vest. After the match, the data were transferred to SPRO software to analyse the WCS (RealTrack Systems, Almeria, Spain) for four different periods (1', 3', 5', 10') using a rolling technique. Players were included in the analysis only if they played the whole match.

Variables

External load: total distance (TD, distance covered in meters) per minute, high-speed running distance (HSRD, distance covered in meters above 19.8 km/h) per minute, and sprinting distance (SPD, distance covered in meters above 25.2 km/h) per minute. Each speed threshold was set according to previous research on the analysis of WCS [2].

Playing position: to explore possible differences by playing positions the total sample was grouped in five regular soccer roles: central defender (CD, n = 4), forward (FW, n = 5), full-back (FB, n = 6), midfielder (MF, n = 4) and wide midfielder (WMF, n = 4). If classified in total cases analysed there were 210 cases for CD, 283 for FW, 235 for FB, 243 for MF, and 234 for WMF, for a total of 1205 cases in each WCS duration.

Match half: data from each match were divided into two official periods according to official soccer rules: the first half (n = 127 cases) and the second half (n = 148 cases).

Match location: home (n = 6) or away (n = 7). Total cases per match location were 206 for home matches and 229 for away matches.

Match outcome: match outcome games: win (n = 3), draw (n = 5) or loss (n = 5). Total cases per match outcome were 164 for a win, 165 for a draw, and 99 for a loss.

Statistical analysis

Descriptive statistics were implemented through the mean (M) and their respective standard deviations (± SD). The Kolmogorov-Smirnov test was used to confirm the data normality of each of the data sets. Data of TD, HSRD, and SPD were analysed using a mixed analysis of variance to compare WCS duration vs playing position, match period, match location, and match outcome. If statistically significant differences were found, the respective post hoc analysis was done using the Bonferroni method. The magnitudes of the differences for all variables were analysed using partial omega squared (ω_p^2). The ω_p^2 values were qualitatively interpreted using the following thresholds: < 0.01 small; < 0.06 medium and < 0.14 large [23]. Alpha was set at $p < 0.05$. The data analysis was performed using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp, Armonk, NY, USA).

RESULTS

Figure 1 shows descriptive statistics and a comparative analysis between playing positions in TD, HSRD and SPD at 1-minute, 3-minute, 5-minute and 10-minute WCS. A significant interaction was found when comparing WCS duration by playing position in TD ($F = 7.714$, $p < 0.01$, $\omega_p^2 = 0.02$), HSRD ($F = 4.68$, $p < 0.01$, $\omega_p^2 = 0.01$) and SPD ($F = 6.37$, $p < 0.01$, $\omega_p^2 = 0.02$).

Regarding the impact that contextual variables such as match half or match location may have on the external load profile, a descriptive and comparative analysis between match half (Figure 2a, 2b and 2c) and between match outcome (Figure 2d, 2e and 2f) in TD, HSRD and SPD at 1-minute, 3-minute, 5-minute and 10-minute WCS was carried out. There was a significant interaction when comparing WCS by match half in TD ($F = 6.1$, $p < 0.01$, $\omega_p^2 = 0.07$) but no significant difference in HSRD ($F = 1.01$, $p = 0.403$, $\omega_p^2 = 0$) or SPD ($F = 1.06$, $p = 0.376$, $\omega_p^2 = 0$). However, a significant interaction was identified when comparing WCS by match location in TD ($F = 51.5$, $p < 0.01$, $\omega_p^2 = 0.14$), HSRD ($F = 19.15$, $p < 0.01$, $\omega_p^2 = 0.05$) and SPD ($F = 8.95$, $p < 0.01$, $\omega_p^2 = 0.01$).

In addition, Figure 3 shows descriptive statistics and a comparative analysis between match outcome in TD (Figure 3a), HSRD (Figure 3b) and SPD (Figure 3c) at 1-minute, 3-minute, 5-minute and 10-minute WCS. There was a significant interaction when comparing WCS by match outcome in TD ($F = 36.4$, $p < 0.01$, $\omega_p^2 = 0.08$), HSRD ($F = 13.6$, $p < 0.01$, $\omega_p^2 = 0.04$) and SPD ($F = 7.4$, $p < 0.01$, $\omega_p^2 = 0.02$). However, no significant differences were observed in 3-minute and 5-minute WCS.

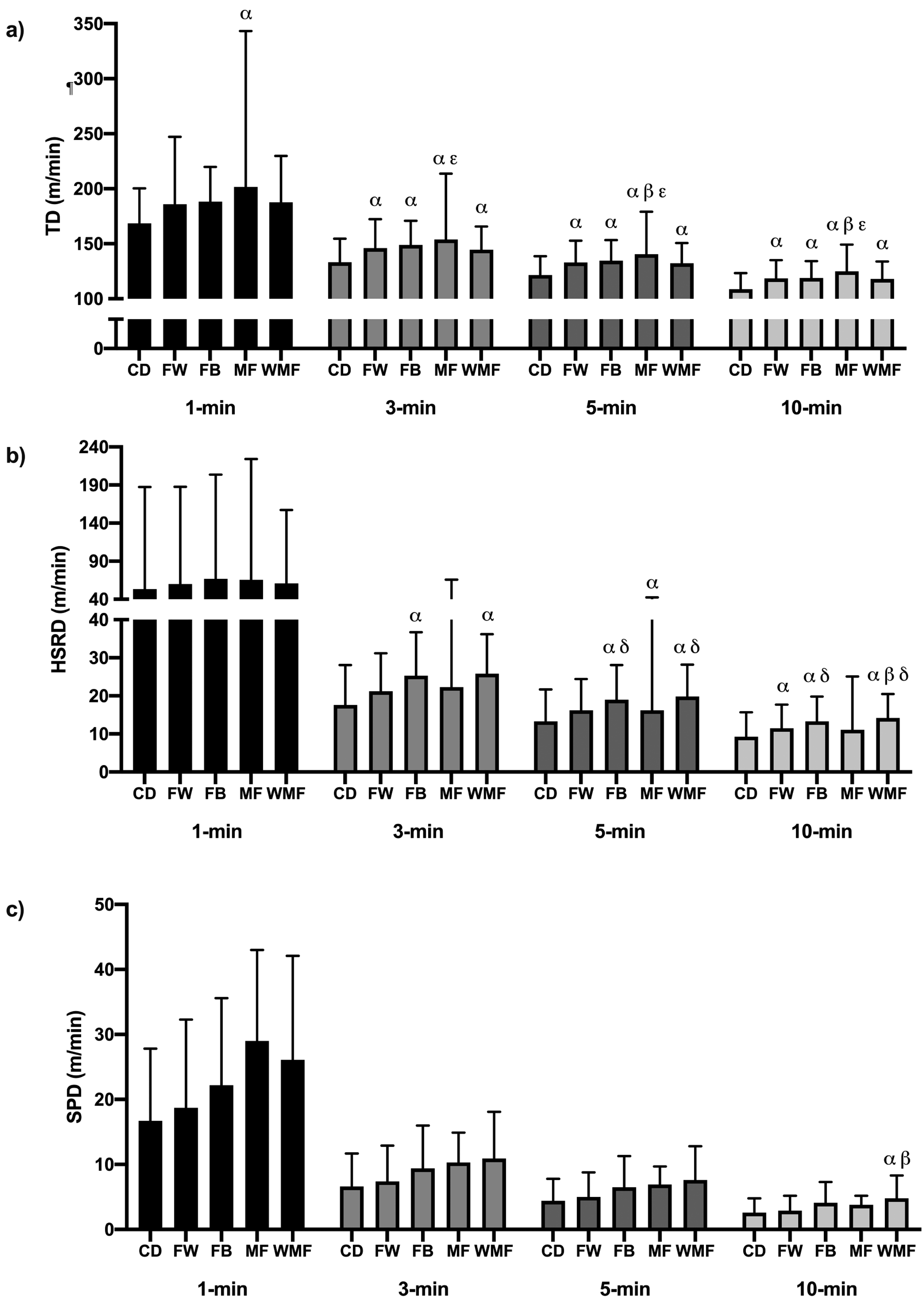

FIG. 1. Comparative analysis between playing positions in the external load variables TD, HSRD and SPD at 1-min, 3-min, 5-min, and 10-min WCS. $^{\alpha}$Significant differences with central defenders (CD) ($p < 0.05$); $^{\beta}$Significant differences with central forwards (FW) ($p < 0.05$); $^{\chi}$Significant differences with full backs (FB) ($p < 0.05$); $^{\delta}$Significant differences with midfielders (MF) ($p < 0.05$); $^{\varepsilon}$Significant differences with wide midfielders (WMF) ($p < 0.05$).

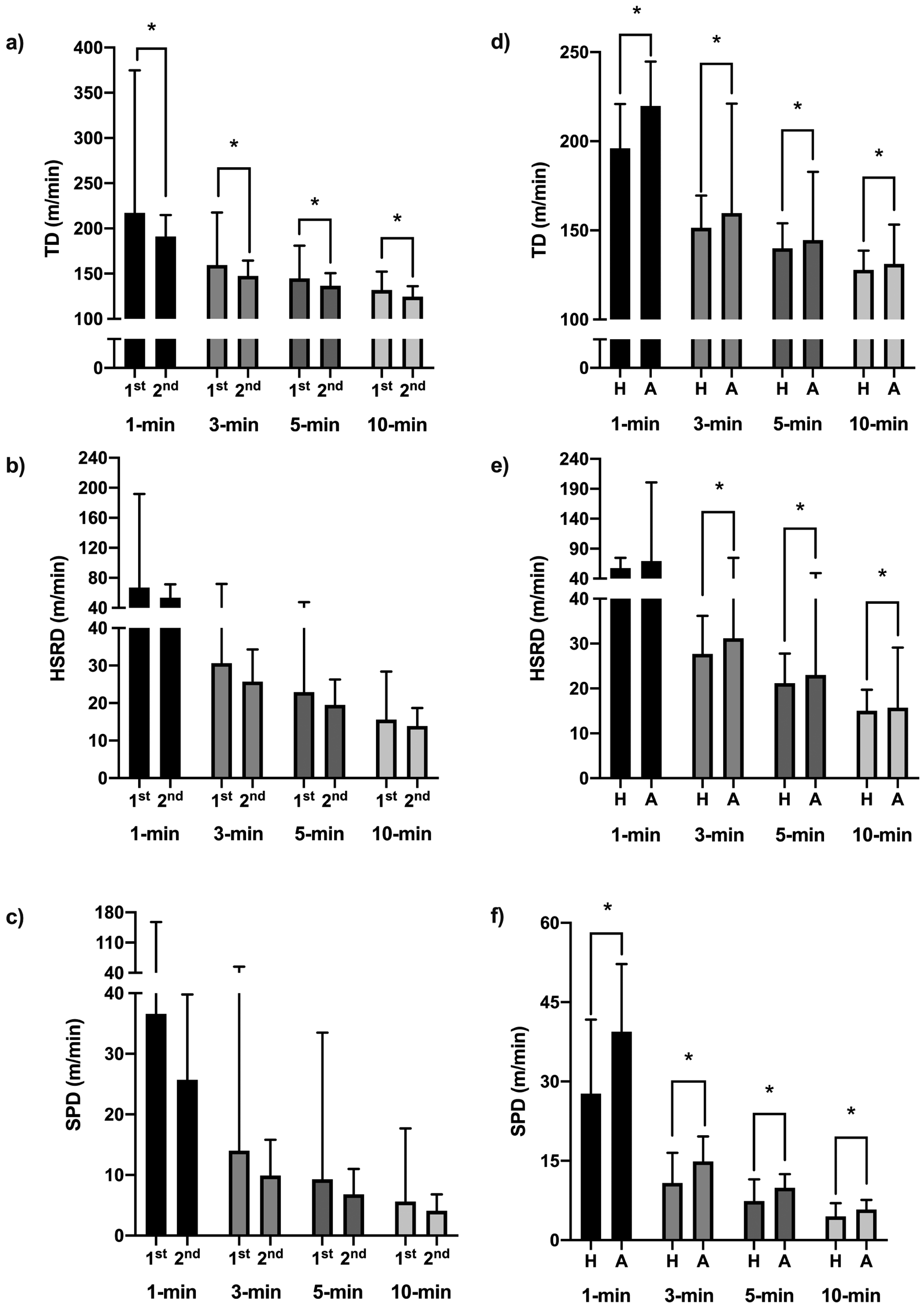

FIG. 2. Comparative analysis between match half and between match outcome in the external load variables TD, HSRD, and SPD at 1-min, 3-min, 5-min, and 10-min WCS. *Significant differences between groups.

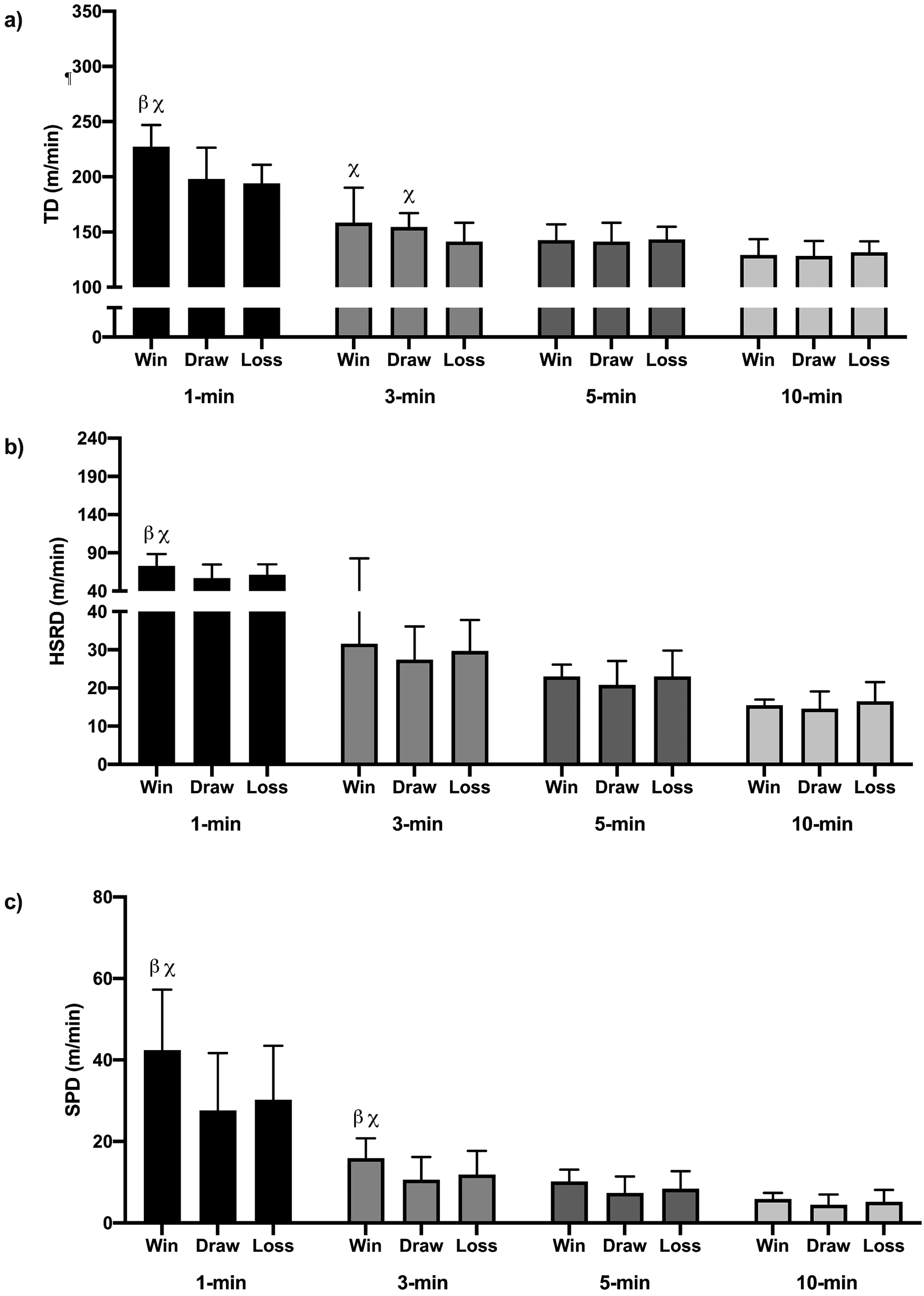

FIG. 3. Comparative analysis between match outcome in the external load variables TD, HSRD, and SPD at 1-min, 3-min, 5-min, and 10-min WCS. [α]Significant differences with win ($p < 0.05$); [β]Significant differences with draw ($p < 0.05$); [χ]Significant differences with loss ($p < 0.05$).

DISCUSSION

The main purpose of this study was to describe the WCS of Spanish professional soccer players by playing position in four different durations and analyse the impact that different contextual variables (match half, match location and match outcome) had on match-play WCS. The main findings were that positional differences existed in TD, HSRD, and SPD in match-play WCS, and significant impacts of match half, match location and match outcome on match-play WCS of different durations were observed.

Positional differences were found in TD, HSRD, and SPD, with CD being the position with the lowest demands in all the WCS (Figure 1). These results are in line with a previous study which found that CD was the position with the shortest TD in all WCS [4]. However, a similar study concluded that not only that CD covered less TD than the rest of the positions but also that FW could cover the least TD in 1-minute (FW: 160.0 ± 26.3 m; CD: 163.6 ± 24.9 m), 3-minute (FW: 128.3 ± 17.2 m; CD: 131.9 ± 16.2 m), 5-minute (FW: 118.2 ± 14.9 m; CD: 123.2 ± 12.8 m) and 10-minute (FW: 110.5 ± 14.3; CD: 115.6 ± 11.9 m) WCS [2]. Since FW is the most offensive position and CD the most defensive position, the positional differences could be explained by the tactical roles of these positions in the team [24, 25]. Although there were significant differences in TD and HSRD between playing positions in 3-minute, 5-minute, and 10-minute WCS of our study, no significant differences were found in 1-minute WCS for any of the external load variables. Regarding this conclusion, it could be noted that such a short WCS duration may not lead to differences occurring between playing positions. Also, there were no differences between playing positions in SPD for any WCS duration (Figure 1c). A recent investigation also showed that there were no positional differences in HSRD ($p = 0.07$) or SPD of 1-minute WCS ($p = 0.09$) [2], so these results suggest that the higher the speed threshold, the more difficult it is to achieve positional differences in the WCS of competitive match play.

Regarding the impact that match half had on WCS performance, it is important to highlight that first halves required a higher external load in all the WCS durations (Figure 2a, 2b, 2c), but it was only significantly different for TD (Figure 2a). Previous investigations have examined the differences between match halves in terms of absolute demands [10–14]. The results lead to similar conclusions since, for example, greater TD (262 ± 25 m; $p < 0.001$; ES = 1.1), HSRD (131 ± 35 m; $p < 0.001$; ES = 0.6) [12] and SPD (9 ± 5 m; $p < 0.05$; ES = 0.13) [13] covered were found in the first halves compared to second halves of the matches. However, to the best of our knowledge, only one study has investigated the impact that this contextual variable had on WCS of professional soccer players, which reported that the players decreased the intensity (e.g., distance covered per minute) during the second half of the match as well [16]. Therefore, the decrease in performance between halves not only in absolute match demands but also in WCS may have a close relationship with the development of fatigue [11].

Regarding the match location, the WCS was always more demanding in all the external load variables when playing away matches (Figure 2d, 2e, 2f). Since this is the first study to analyse the impact that match location has on WCS in professional soccer match play, only previous research on absolute match demands is comparable [7, 9, 13, 26]. However, the results are controversial because previous studies reported that TD covered was greater at home than away matches (262–383 m) [7, 9, 26], whereas others observed no significant differences for distances covered at different intensities [13]. Our study suggested that match location has a significant impact on WCS performance in all the external load variables, so the effect of "home advantage" [27] may lead to the opponent team having higher physical demands in match-play WCS. Nonetheless, future studies are necessary to examine additional contextual variables (e.g., level of the opponent, total number of fans at the match) which may explain this effect on match-play WCS.

Also, the match outcome was a contextual variable that had a significant impact on 1-minute and 3-minute WCS, but no effect was observed on 5-minute or 10-minute WCS (Figure 3). These results imply that WCS duration has an interaction since shorter WCS (i.e., 1 or 3 minutes) have significantly different demands for winning, drawing, or losing. For example, winning the match resulted in greater TD, HSRD, and SPD compared to drawing or losing the match. This could be related to the motivational influence that winning has on physical performance, since players might tend to maximize their physical output in WCS when achieving a positive goal (i.e., winning) and particularly when trying to achieve a come-back [15]. However, this physical output in WCS may be limited to one's own WCS duration since the intensity decreases with longer WCS (e.g., 5 or 10 minutes) [1, 4]. This is the first research analysing the impact of match outcome on WCS, and the discussion of this variable is limited to previous research on absolute match demands [13, 15]. By comparing the results from different studies [7, 9, 13, 28], it could be concluded that the impact of this variable on match demands is unclear. Perhaps this contextual variable is highly dependent on match situational variables such as team style of play [7], effective playing time [13], or opponent level [7, 13].

However, this study has some limitations. Given the difficulties to collect data from professional soccer teams, only one team was analysed. Additional contextual variables such as effective playing time [13], ball possession [8], or match status [29] were not examined. Also, only positioning-derived parameters (i.e., TD, HSRD, and SPD) were included and the analysis of additional variables such as accelerations, decelerations, or player load [14] could be of interest for future investigations. Given the limited amount of investigations on the WCS of professional soccer players, more research is necessary for both training and match situations. Moreover, it may be of interest for future investigations to analyse the effect that match-related contextual variables may have not only on the weekly training load but also on the WCS from training sessions [22].

To the best of the authors' knowledge, this is the first study on the relationship between contextual variables and performance in the WCS of HSRD and SPD. Also, although the impact of match half on TD covered in WCS was analysed in a previous study [16], the impact of match location and match outcome on this variable had not been investigated before. The results from this novel study may help coaches to design training drills that are individualized by playing position and based on the WCS from the match. For example, if the TD covered by CD during the WCS is significantly shorter than the TD covered by the rest of the playing positions, coaches may add drills for CD, which may require less TD but more specific actions related to their defensive tactical role (e.g., body impacts, high-intensity accelerations). In addition, these drills should prepare the players not only for absolute match demands but also for the WCS. For instance, although the TD covered in official matches is about 110 meters per minute [30], the results from this study suggest that training drills, which are designed to adapt the player to 1-minute WCS, may need to involve 170 meters per minute at least. Moreover, these training drills should be designed considering the effect of match-related contextual variables. For example, it is suggested that professional soccer players train the WCS as fatigue increases since a decline in the intensity (i.e., TD, HSRD, and SPD covered per minute) was observed during second halves. However, the practical applications of this study are limited to the context and characteristics of the sample team that was analysed, and future research is necessary to further investigate the impact that contextual variables may have on the WCS of professional soccer players.

CONCLUSIONS

Positional differences exist in TD, HSRD, and SPD in match-play WCS, and contextual variables such as match half, match location and match outcome have a significant impact on the WCS of professional soccer players. Regarding the impact of match half on WCS performance, first halves required greater demands than second halves in all the WCS durations, but it was only significantly different for TD. Regarding the match location, the WCS was always more demanding when playing away matches. However, match outcome was a contextual variable that had a significant impact on 1-minute and 3-minute WCS, but no effect was observed on 5-minute or 10-minute WCS. For example, winning the match resulted in greater TD, HSRD, and SPD in 1-minute and 3-minute WCS compared to drawing or losing the match.

Funding

The authors Carlos D. Gómez Carmona and José M. Oliva Lozano were supported by a grant from the Spanish Ministry of Innovation, Science and Universities (FPU17/00407 and FPU18/04434).

Conflict of Interest Disclosure

None of the authors has a conflict of interest to declare, and all authors were involved in the study design, data collection and interpretation, and contributed to the writing of the manuscript.

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