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Do contextual factors influence running and accelerometry GPS based variables in professional women soccer players? A case study about the effect of match location and result

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Abstract

The aims of this study were to compare external match load between home and away matches as well as the result of the match (win, draw, and loss). The secondary aim was to quantify external training load that preceded the next match taking into account both match location and result. Ten elite women soccer players participated in the study (age 24.6 ± 2.3 years). Seven home and seven away matches in which four wins, three draws, and seven losses occurred. The following global positioning system (GPS) metrics were analyzed: duration, total distance, high-speed running distance (HSR, $\geqslant$ 15 km h^{-1}), number of accelerations (ACC) and decelerations (DEC), average speed, and player load. There were no significant differences between match results and match locations. Regarding comparisons of training data preceding different match results, only duration and player load did not differ while HSR, number of ACC and DEC showed to be higher when the next match was a loss ($p < 0.05$, moderate to very large effect). Regarding comparisons of training data preceding different match locations, only duration, total distance, and player load did not differ while HSR, average speed, number of ACC and DEC in all zones were higher when the next match was at home ($p < 0.05$, moderate to very large effect). In conclusion, this study showed that match result and location did not have a significant effect on GPS metrics exhibited during match-day. However, training data influenced the contextual factors of the next match which should be considered when planning training sessions.

Keywords

Acceleration, away games, deceleration, football, high-speed running, home games, load, match outcome, situational variables, win, BPI league, Female soccer players, women athletes, professional soccer

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Introduction

In women's soccer, players have shown a tendency to cover between ~5.5 to 11 km in total distance per match. Within those distances, around ~450 to 3000 m are covered at high-speed (> 12.5 km h^{-1}), while ~74 to 423 accelerations and ~78 to 430 decelerations can occur.[1,2] Regarding training characteristics, some ranges were given point values for total distance (2347–6646 m) and distance > 19.4 km h^{-1} (9–543 m). Furthermore, range values for additional metrics have also been reported, namely, distance $\geqslant$ 14 km·h^{-1} (543–2520 m), $\geqslant$ 18 km·h^{-1} (96–1680 m), number of accelerations (49–240) and deceleration (21–85), and player load (848–1096 AU).[2]

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Usually, such variables are part of the external load dimension that is associated with the physical exercise and respectively the demand placed on players during a training session or match.[3] Nonetheless, there are factors that can influence the previously documented distance or accelerometry-based variables such as the level of competition, playing position, age, status, the period of the season and physical fitness[4,5] as well as other contextual factors or situational variables such as match result/outcome, match location, and quality of opponents.[6,7]

With respect to contextual factors such as match result (win, draw, and loss), a systematic review stated that these factors only provide trivial changes in the male and female match-running demands, although only two studies in female athletes were included.[7] Even so, a further study[8] examining female soccer players showed that in drawn matches a moderate increase in high-speed running was contributed, with small to moderate decreases in total distance in matches lost or won. Moreover, in matches won a moderately higher total distance was produced than in matches drawn. In addition, the number of accelerations were higher in a drawn match compared to a win and/or a loss.[8] Furthermore, Vescovi et al.[6] also found that sprint distance was higher in lost versus drawn matches in female professional soccer players. In contrast with previous studies, Nobari et al.[9] reported higher accelerations and decelerations in matches with positive results (win and draw) compared with negative results (lost). Notably, this notion was supported by a supplementary study by Nobari et al.[10] who stated higher total distance, sprint distance, and player load in matches won or drawn. However, both of these studies were developed with professional male Iranian players.[9,10]

When investigating contextual factors, Vescovi et al.[6] stated that match location does not affect the running demands of professional female soccer players. Recently, this finding was also supported in a study conducted with male semi-professional soccer players.[11] Indeed, it was also partially supported by data from professional Iranian male soccer players that found slightly higher values in running (18–23 and >23 $km \cdot h^{-1}$) and accelerating-based variables in home versus away matches. Although, there was an exception of high-speed running, which was higher in the last training session that preceded away matches.[12] Moreover, a study with professional female soccer players that compared the total distance, running distances between 15 to 17.9 $km \cdot h^{-1}$; $\geqslant 18$ to 20.9 $km \cdot h^{-1}$ and >21 $km \cdot h^{-1}$, player load accelerations and deceleration using worst-case scenario method, according to different rolling average found that match location had no effect in the previous metrics.[13]

Considering training data that preceded home and away matches, European male professional players produced higher values of total distance and high-speed running when playing away in the next matched in opposition to playing at home matches.[14] Intrinsically, training data that preceded won, drawn or lost matches showed that European male professional players produced slightly higher values of total distance and high-speed running when the next match result was a loss.[15]

Thus, the aims of this study were to compare external match load between home and away matches (location) as well as the result of the match (win, draw and loss). The secondary aim was to quantify external training load that preceded the next match taking into account both match location and result. On the basis of previous research findings, we hypothesized that match location and match result can influence the preceding training sessions of the next match.[14,15] Moreover, we hypothesized that external match load may be similar regardless of the match location[11] with a tendency to be higher with a positive result (win and draw).[9,10,12]

Materials and methods

Design

This study is the second part of previously published research[16] in which the observational period was September 2019 to March 2020. The season was not completed due to the COVID-19 pandemic, which provoked the disruption of training sessions and matches. This situation did not allow a final classification to be made. Consequently, the quality of opponents that would usually be based on the final classification[17,18] of the season was not employed in the present study. Nonetheless, data was drawn from a total of 23 weeks, 14 weeks of which included matches. From those, seven home and seven away matches occurred including four wins, three draws, and seven losses.

All players were recruited from the same women's BPI League team in Portugal where they usually performed three training sessions and one match per week.

Participants

The sample included 10 elite women soccer players: professional experience 4.9 ± 2.1 years, age 24.6 ± 2.3 years, height 165 ± 6.0 cm (Seca 220, Hamburg, Germany), body mass 58.5 ± 9.3 kg (Seca 220, Hamburg, Germany), and body mass index 22.3 ± 3.8 kg m^{-2}.

Similar to previous studies with small sample sizes,[19–21] the power of the sample size was estimated through G-Power.[22] Two analyses were conducted considering both contextual factors. Thus, when comparing home and away conditions, a *T*-test with a total of 10 participants with a $p < 0.05$ and effect-size of 1.2, 96.7% of actual power was achieved. Moreover, considering a *F*-test, with a total of 10 participants with a $p < 0.05$ and effect-size of 1.2 and three conditions (win, draw, and loss), 97.5% of actual power was achieved.

The inclusion criterion from our previous study[16] was used, namely, minimum of 80% participation in training sessions and an average of 75 minutes playing time in all matches, while the exclusion criteria was based on injury status, illness and sickness for two consecutive weeks. Only defenders (n = 3), midfielders (n = 4), and strikers (n = 3) were included for analysis. Goalkeepers due to low number of participants, and the specific demands of the playing position were not considered for analysis.

The same ethical procedures were applied[16] which included a full study design explanation, the collection of a written informed consent and approval from the Ethics Committee of the Polytechnic Institute of Santarém, Santarém, Portugal (252020 Desporto). The study was developed according to the requirements of the Declaration of Helsinki.

Moreover, outside factors that could influence the load over the analyzed period were considered. Specifically, all participants were asked to maintain their normal diet throughout the study period. To confirm habits, a nutritional questionnaire was used to record intake over seven days. This procedure was applied in the first and last week of the analyzed period following the procedures of our previous studies.[16,23]

External intensity quantification

The same equipment and procedures regarding data collection of external intensity were used according to our previous study.[16] Specifically, a portable 10 Hz GPS device was used to collect external data (PlayerTek, Catapult Innovations, Melbourne, Australia), which utilizes a tri-axial 100 Hz accelerometer. This type of device has previously been proven to be the most valid and reliable in team sports.[24]

PlayerTek devices were turned on 10 min prior to each session and placed in a specific customized vest pocket located on the posterior side of the upper torso fitted tightly to the body. The devices were distributed to players daily by the same coach, and the players consistently wore the same device to ensure intra-reliability.[25]

Previously examined measures were collated in this study and considered for analysis: total distance (meters, m), high-speed running distance (HSR, $\geqslant 15\,\text{km h}^{-1}$ in m),[26] number of accelerations (ACC, >1–$2\,\text{m s}^{-2}$ (ACC1); >2–$3\,\text{m s}^{-2}$ (ACC2); >3–$4\,\text{m s}^{-2}$ (ACC3); $>4\,\text{m s}^{-2}$ (ACC4)) and decelerations (DEC, <-1 to $2\,\text{m s}^{-2}$ (DEC1); <-2 to $3\,\text{m s}^{-2}$ (DEC2); <-3 to $4\,\text{m s}^{-2}$ (DEC3); $<-4\,\text{m s}^{-2}$ (DEC4)), average speed (km·h^{-1}) and player load (in arbitrary units, AU and directly collected from the GPS).

Statistical procedures

Descriptive statistics (mean ± standard deviation, SD, as well as confidence intervals at 95%, [CI, 95%]) were performed for all measures. All the variables were checked for normality and homoscedasticity, respectively, using the Shapiro–Wilk and Levene tests. Then, repeated measures ANOVA with the Bonferroni correction post hoc test were calculated to compare the training and match data considering the two contextual factors (match location and results). The p-value $\leqslant 0.05$ was used as significant and all the data were analyzed using SPSS version 23.0 (IBM Corp., Armonk, NY, USA) for the Windows statistical software package.

Finally, the Cohen's D effect-size (ES) was performed to determine the effect magnitude through the difference of two means divided by the standard deviation from the data and the following criteria were used: <0.2 = trivial, 0.2–0.6 = small effect, 0.6–1.2 = moderate effect, 1.2–2.0 = large effect, and >2.0 = very large.[27]

Table 1. Characterization of the weeks and matches included for analysis.

Weeks	Match result	Match location
1	Loss	Home
2	Draw	Home
3–6	Not included	
7	Win	Away
8	Draw	Home
9	Not included	
10	Loss	Home
11	Win	Away
12	Win	Home
13	Loss	Away
14	Loss	Home
15	Loss	Away
16–17	Not included	
18	Draw	Away
19	Win	Away
20	Not included	
21	Loss	Home
22	Not included	
23	Loss	Away

There were no matches in the weeks not included.

Results

Table 1 shows the distribution of match result and location.

Table 2 describes the comparison of match data between different results (win, draw, and loss). There were no significant differences between match results.

Table 3 describes comparisons of training data preceding different match results (win, draw, loss). Only training duration and player load did not differ in preceding different match results ($p > 0.05$). Thus, pairwise comparisons and effect sizes (for those with significant differences) are also described in Table 3.

Table 4 describes the comparison of match data considering different match location (home or away). There were no significant differences between locations.

Table 5 describes the comparison of training data preceding different match locations. Only training

Table 2. Comparison of match-day data between wins, draws, and losses, mean ± SD (CI, 95%).

Full match	Win	Draw	Loss	p-Value
Duration (min)	87.4 ± 9.5 (80.6–94.2)	86.5 ± 16.9 (74.4–98.6)	84.7 ± 11.8 (76.3–93.2)	0.904
Total distance (m)	8341.6 ± 1122.0 (7538.9–9144.2)	7876.0 ± 2026.6 (6426.3–9325.7)	7478.7 ± 1715.1 (6251.7–8707.6)	0.436
HSR (m)	459.5 ± 232.6 (293.1–625.9)	400.8 ± 254.0 (219.1–582.5)	393.5 ± 195.9 (253.4–533.7)	0.336
Average speed (m min^{-1})	91.8 ± 5.9 (87.6–96.0)	83.2 ± 20.6 (68.5–97.9)	97.7 ± 25.5 (79.4–115.9)	0.085
ACC1 (nr)	189.7 ± 27.2 (170.3–209.1)	173.8 ± 46.0 (140.9–206.7)	177.3 ± 40.6 (148.2–206.3	0.603
ACC2 (nr)	112.2 ± 21.8 (96.6–127.8)	112.2 ± 30.3 (90.5–133.9)	110.7 ± 25.2 (111.4–114.7)	0.985
ACC3 (nr)	39.1 ± 11.5 (30.9–47.4)	37.3 ± 17.4 (24.–49.7)	35.9 ± 11.0 (28.0–43.7)	0.729
ACC4 (nr)	10.4 ± 5.7 (6.2–14.5)	10.4 ± 7.7 (4.9–15.9)	9.8 ± 5.8 (5.7–14.0)	0.847
DEC1 (nr)	185.7 ± 43.0 (154.9–216.4)	168.4 ± 39.3 (140.3–196.5)	167.0 ± 27.8 (147.1–186.9)	0.547
DEC2 (nr)	101.4 ± 20.2 (87.0–115.9)	100.5 ± 30.9 (78.4–122.3)	98.2 ± 20.6 (83.5–113.0)	0.918
DEC3 (nr)	40.4 ± 14.1 (30.3–50.4)	39.5 ± 16.0 (28.1–51.0)	36.4 ± 12.8 (27.2–45.5)	0.415
DEC4 (nr)	18.3 ± 8.7 (12.0–24.5)	20.5 ± 13.3 (11.0–30.0)	19.0 ± 9.3 (12.3–25.6)	0.579
Player load (AU)	346.9 ± 54.6 (307.8–386.0)	325.7 ± 81.4 (267.5–383.9)	313.3 ± 56.9 (272.6–354.0)	0.468

HSR: high-speed running; ACC1: accelerations > 1–2 m·s^{-2}; ACC2: accelerations of 2–3 m·s^{-2}; ACC3: accelerations of 3–4 m·s^{-2}; ACC4: accelerations > 4 m·s^{-2}; DEC1: decelerations < 1–2 m·s^{-2}; DEC2: decelerations of 2 to 3 m·s^{-2}; DEC3: decelerations of 3–4 m·s^{-2}; DEC4: decelerations < 4 m·s^{-2}.

Table 3. Comparison of accumulated training data that preceded matches with wins, draws, and losses, mean ± SD (CI, 95%).

Full match	Win	Draw	Loss	Overall p-value	p-Value; ES win versus draw	p-Value; ES win versus loss	p-Value; ES draw versus loss
Duration (min)	162.4 ± 35.9 (136.7–188.1)	137.8 ± 28.3 (117.5–158.1)	122.5 ± 31.5 (99.3–145.0)	0.055	NA	NA	NA
Total distance (m)	10,407.2 ± 2803.1 (8401.9–2412.4)	13,818.8 ± 1123.8 (13,014.8–14,622.7)	10,879.2 ± 2017.8 (9435.8–12,322.6)	0.001	0.008; 3.3	> 0.999; NA	0.001; 2.61
HSR (m)	245.4 ± 128.8 (153.3–337.5)	152.7 ± 84.1 (92.5–212.9)	324.5 ± 147.7 (218.8–430.2)	< 0.001	0.008; 0.73	0.023; 0.54	0.001; 1.19
Average speed (m min^{-1})	136.1 ± 44.2 (104.5–167.7)	159.5 ± 16.5 (147.7–171.3)	124.2 ± 23.5 (10.3–141.0)	0.021	0.272; NA	> 0.999; NA	0.001; 2.22
ACC1 (nr)	205.4 ± 45.6 (172.8–238.0)	135.9 ± 29.2 (15.0–156.7)	274.3 ± 62.0 (229.9–318.6)	< 0.001	0.002; 1.55	0.053; NA	< 0.001; 2.29
ACC2 (nr)	123.1 ± 34.6 (98.4–147.9)	78.8 ± 19.8 (64.7–93.0)	152.8 ± 37.8 (125.8–179.8)	< 0.001	0.001; 1.33	0.114; NA	< 0.001; 2.04
ACC3 (nr)	45.3 ± 17.8 (32.5–58.0)	29.5 ± 9.4 (22.7–36.2)	54.9 ± 17.2 (42.6–67.2)	< 0.001	0.004; 0.98	0.087; NA	< 0.001; 1.62
ACC4 (nr)	15.4 ± 8.6 (9.–21.6)	11.6 ± 5.2 (7.9–15.5)	18.5 ± 8.7 (12.3–24.7)	0.001	0.141; NA	0.273; NA	0.002; 0.94
DEC1 (nr)	187.6 ± 44.7 (15.6–219.6)	123.2 ± 25.9 (104.6–141.7)	248.1 ± 55.9 (208.1–288.1)	< 0.001	0.002; 1.47	0.043; NA	< 0.001; 2.30
DEC2 (nr)	119.5 ± 33.1 (95.8–143.2)	78.0 ± 17.5 (65.5–90.5)	153.6 ± 32.8 (130.1–177.1)	< 0.001	0.002; 1.30	0.086; NA	< 0.001; 2.40
DEC3 (nr)	43.4 ± 14.4 (33.2–53.7)	29.6 ± 10.0 (22.4–36.8)	64.3 ± 20.9 (49.4–792)	< 0.001	0.003; 1.02	0.011; 1.05	< 0.001; 1.84
DEC4 (nr)	18.8 ± 10.5 (11.3–26.3)	11.3 ± 5.6 (7.3–15.3)	23.2 ± 8.9 (16.8–29.6)	< 0.001	0.009; 0.88	0.235; NA	0.001; 1.58
Player load (AU)	628.8 ± 174.8 (503.7–753.8)	889.4 ± 79.8 (632.3–746.4)	619.7 ± 149.4 (512.8–726.6)	0.438	NA	NA	NA

NA: non-applicable; HSR: high-speed running; ACC1: accelerations > 1–2 m·s^{-2}; ACC2: accelerations of 2–3 m·s^{-2}; ACC3: accelerations of 3–4 m·s^{-2}; ACC4: accelerations > 4 m·s^{-2}; DEC1: decelerations < 1–2 m·s^{-2}; DEC2: decelerations of 2–3 m·s^{-2}; DEC3: decelerations of 3–4 m·s^{-2}; DEC4: decelerations < 4 m·s^{-2}.

Table 4. Comparison of data between home and away matches, mean ± mean ± SD (CI, 95%).

Full match	Home	Away	*p*-Value
Duration (min)	88.6 ± 9.0 (82.2 ± 95.0)	83.8 ± 12.0 (75.2–92.3)	0.380
Total distance (m)	7967.5 ± 1668.4 (6764.0 ± 9160.9)	7632.0 ± 1536.1 (6533.1 ± 8730.9)	0.602
HSR (m)	417.2 ± 249.0 (239.0 ± 595.3)	411.5 ± 194.8 (272.2 ± 550.9)	0.923
Average speed (m min^{-1})	94.7 ± 24.2 (77.4 ± 112.0)	90.1 ± 11.0 (82.2 ± 98.0)	0.365
ACC1 (nr)	186.5 ± 32.4 (163.3 ± 209.7)	172.4 ± 35.3 (147.2 ± 197.7)	0.302
ACC2 (nr)	116.4 ± 24.1 (99.1 ± 133.7)	106.9 ± 22.6 (90.7 ± 123.0)	0.312
ACC3 (nr)	39.1 ± 12. (30.1 ± 48.1)	35.2 ± 11.4 (27.1 ± 43.4)	0.206
ACC4 (nr)	11.0 ± 6.3 (6.5 ± 15.5)	9.0 ± 6.2 (4.6 ± 13.5)	0.123
DEC1 (nr)	178.6 ± 20.2 (164.1 ± 13.0)	165.9 ± 36.0 (140.2 ± 191.7)	0.438
DEC2 (nr)	103.3 ± 22.1 (87.5 ± 119.1)	95.9 ± 21.4 (80.6 ± 111.2)	0.303
DEC3 (nr)	38.9 ± 12.6 (29.9 ± 47.9)	37.3 ± 15.4 (26.3 ± 48.3)	0.597
DEC4 (nr)	20.4 ± 10.6 (12.9 ± 28.0)	18.0 ± 8.9 (11.7 ± 24.3)	0.151
Player load (AU)	332.8 ± 55.9 (292.8 ± 372.8)	318.2 ± 60.5 (275.0 ± 361.5)	0.563

HSR: high-speed running; ACC1: accelerations $>$ 1–2 m·s^{-2}; ACC2: accelerations of 2–3 m·s^{-2}; ACC3: accelerations of 3–4 m·s^{-2}; ACC4: accelerations $>$4 m·s^{-2}; DEC1: decelerations $<$1–2 m·s^{-2}; DEC2: decelerations of 2–3 m·s^{-2}; DEC3: decelerations of 3–4 m·s^{-2}; DEC4: decelerations $<$4 m·s^{-2}.

Table 5. Comparison of accumulated training data that preceded home and away matches, mean ± SD (CI, 95%).

Full match	Home	Away	*p*-Value; ES
Duration (min)	231.4 ± 36.3 (205.5–257.4)	204.6 ± 40.8 (175.4–233.8)	0.065; NA
Total distance (m)	11,919.0 ± 1535.2 (10,820.8–13,017.2)	11,498.2 ± 1818.6 (10,197.3–12,799.1)	0.331; NA
HSR (m)	301.5 ± 137.0 (203.5–399.5)	203.1 ± 103.2 (129.3–276.9)	0.003; 0.72
Average speed (m/min)	136.1 ± 18.9 (122.6–149.6)	117.4 ± 21.3 (102.2–132.6)	<0.001; 0.98
ACC1 (nr)	235.4 ± 43.9 (204.0–266.8)	189.2 ± 40.3 (160.4–21.0)	0.004; 1.06
ACC2 (nr)	137.3 ± 25.9 (118.7–15.8)	105.8 ± 30.9 (83.7–127.9)	0.001; 1.20
ACC3 (nr)	50.1 ± 14.7 (39.6–60.6)	38.3 ± 13.8 (28.4–48.2)	<0.001; 0.81
ACC4 (nr)	19.0 ± 8.3 (13.1–25.0)	11.8 ± 6.3 (7.3–16.3)	<0.001; 0.97
DEC1 (nr)	214.2 ± 37.2 (187.6–240.8)	170.9 ± 39.8 (142.4–199.4)	0.002; 1.16
DEC2 (nr)	133.5 ± 24.9 (115.7–151.3)	107.5 ± 24.8 (89.7–125.2)	0.003; 1.04
DEC3 (nr)	52.9 ± 15.0 (42.2–63.7)	43.2 ± 15.9 (31.8–54.6)	0.019; 0.64
DEC4 (nr)	20.7 ± 7.5 (15.3–26.0)	16.0 ± 7.9 (10.4–21.7)	0.002; 0.61
Player load (AU)	643.7 ± 103.4 (569.7–717.6)	630.8 ± 17.2 (546.9–714.7)	0.605; NA

NA: non-applicable; HSR: high-speed running; ACC1: accelerations $>$ 1–2 m·s^{-2}; ACC2: accelerations of 2–3 m·s^{-2}; ACC3: accelerations of 3–4 m·s^{-2}; ACC4: accelerations $>$4 m·s^{-2}; DEC1: decelerations $<$1–2 m·s^{-2}; DEC2: decelerations of 2–3 m·s^{-2}; DEC3: decelerations of 3–4 m·s^{-2}; DEC4: decelerations $<$4 m·s^{-2}.

duration, total distance, and player load did not differ in sessions that preceded home versus away matches.

Discussion

The aims of this study were to compare the external match load between home and away fixtures (location) and the match result (win, draw, and loss). The secondary aim was to quantify the external training load that preceded the next match considering both contextual factors of match location and result. Regarding the match-day data, the present study revealed that contextual factors such as match location and match result did not have a statistically significant effect on running (total distance, HSR, average speed) and accelerometer-based variables (accelerations, decelerations, and player load) in professional female soccer players. However, in the present study, it was observed that the load distribution in running and accelerometer-based variables during the training sessions/days during the week before the match was different according to the factors of the match context (match location and match outcome).

The present study revealed that there was no significant difference in external match load between home and away matches (match location). However, there are conflicting results in the existing literature. A recent study that supported the present results, detected no differences between home and away matches in terms of external load measures (moderate and high-intensity running distance, metabolic power, and sprint distance) in professional female soccer players.[6] Accordingly, in a study of elite futsal players, it was reported that external load metrics related to match data, such as player load, high-intensity accelerations and decelerations, explosive movements, did not statistically change compared to match location (home and away).[28] The present results are also in line with previous studies on professional soccer players that emphasized no significant differences in total distance covered, HSR, sprint distance, accelerations, decelerations, and player load when a match is played away compared to a home match.[29,30] As in our study, Vescovi et al.[6] alleged that the similarity observed in physical match demands between home and away fixtures in professional women's soccer might be due to similar crowd sizes, familiarity with other players, and minimal travel time (i.e., no change of time zone and no transmeridian travel).

Although, contrary to our findings, a previous study pointed out that when playing home matches compared to away matches, professional soccer players covered greater high-intensity running distances, performed a higher number of accelerations/decelerations, and achieved higher peak speeds.[31] Another study performed by Nobari et al.[12] noted that professional soccer players displayed significantly higher values in external load variables (sprint distance, maximal speed, body load, metabolic power, accelerations, and decelerations), except high-intensity running distance, in home matches compared to away matches. Lastly, Aquino et al.[32] and Diez et al.[33] showed that greater running outputs (e.g., total distance, high-intensity distance, deceleration) were detected in home compared with away matches in professional soccer players. Considering the above studies showing the external load measures as home versus away, a possible explanation for this difference may be related to the home advantage. For instance, Aquino et al.[32] observed that the number of passes that players received and successfully completed (ball possession rate) was higher in home matches. While in another study, it was reported that teams exhibited high-level technical performance and tactical behaviors, including more offensive strategies by making more offensive actions, in home matches compared to away matches.[34] In addition, previous studies have shown that factors related to home advantage may have a positive effect on performance, namely crowd size and support, travel fatigue for away matches, familiarity with local conditions or with other players, and psychological factors.[32,35,36] Such factors were not controlled in the present study which is recommended for future studies.

Regarding match-day data, the present study demonstrated that match result (win, draw, and loss) had no significant effect on running and accelerometry-based variables in the professional female soccer players examined. Consistent with the results of the present study, Trewin et al.[7] reported that contextual factors related to match status (win, draw, loss) caused insignificant or trivial changes on the match running demands in soccer players. Similarly, a recent study expressed that the distance and accelerometry-based measures exhibited during match-play were not affected by the match outcome (win or lose) in professional soccer players,[30] and in elite futsal players.[28] Contrary to our findings, in a study of professional female soccer players, the contextual factor related to match outcome only significantly affected relative sprint distance, which was found to be greater during losing compared to drawing.[6]

Considering accumulated training data associated with external load before home and away matches, HSR, average speed, accelerometer-based variables such as acceleration (ACC1,2,3,4) and deceleration (DEC1,2,3,4), the values were found to be higher before home matches than away matches. In contrast to our results, Chena et al.[37] noted that external load measures such as total distance covered, total number of high acceleration and deceleration, and high-intensity running distance were similar in weekly training sessions before home and away matches. Furthermore, Oliveira et al.[14] observed that male professional soccer players exhibited greater external load during training performed on match-day minus 5 days (MD-5, total distance, HSR, and muscle soreness), match-day minus 4 days (MD-4, total distance, HSR and average speed), and match-day minus 3 days (MD-3, total distance, HSR and average speed), and match-day minus 2 days (MD-2, total distance, HSR, average speed) prior to away matches compared to home matches. Subsequently, the same authors noted that the duration of the training sessions and the total distance covered were higher in training sessions before home matches than in sessions prior to away matches.[14] Additionally, Nobari et al.[12] reported that there were greater values of accumulated HSR that preceded away matches.

Although our results are inconsistent with the literature mentioned above, our results are in line with the studies of Brito et al.[38] in elite youth soccer players, and Gonçalves et al.[30] in professional male soccer players. For instance, Gonçalves et al.[30] showed that players exhibited higher values of total distance, low to moderate-intensity running distance, high-intensity running distance, acceleration, deceleration, and player load in the training sessions (on MD-5 and MD-4) during the week before playing at home compared to away matches. Similarly, another study investigating a semi-professional soccer team conducted by Hernandez et al.,[39] stated that during the middle sessions of the microcycle (weekly training load) (MD-4: total distance, sprint distance, and high-speed distance; MD-3: total distance, sprint distance, and medium-speed distance; MD-2: total distance, medium-speed distance, and low-speed distance), the external load variables were higher when the team played at home than when playing away. Additionally, a recent study indicated that a higher volume of intense mechanical work (number of ACC3 and DEC3) was found in the week before playing a home match compared to an away match. Also, it was affirmed a decreased number of accelerations and decelerations preceding away matches, probably due to the coaches' prescribed workload or players' pacing strategy influenced by the upcoming travel was reported.[40] In another study, Oliveira et al.[14]

claimed that this finding may be related to the travel (as in an away match). Consequently, coaches may apply more training load before home matches as they know the players will have greater time to recover. Lastly, Costa et al.[41] asserted that the match location, specifically away matches, may cause deterioration in sleep patterns and/or autonomic heart activity in female soccer players. Therefore, Rago et al.[40] further suggested that the neuromuscular load might be lower in microcycles prior to away matches to off-set the fatigue caused by travel and disrupted sleep routines (impaired recovery) for away fixtures. Nonetheless, the literature is not conclusive and further investigation of female soccer players is required. A recommendation for future research is to include the distance and travel time for away matches, establishing which type of distance and methods of travel (e.g., plane, bus) may impact load intensity prescriptions.

The present study revealed greater values of HSR distance, accelerations (except ACC4) and decelerations during the training sessions before winning and losing match results compared to a drawing result. In a study conducted in professional soccer players, which supports the findings of our study, it was shown that accumulated decelerations during the microcycles prior to a loss were significantly greater than matches with a draw.[37] Additionally, in a study of a top-level male soccer team, Rago et al.[40] found that total distance and the percentage of HSR covered within the preceding training sessions were moderately higher before losing a match compared to drawing a match. Furthermore, when the external load measures are compared in the training sessions before matches that resulted in winning and drawing results, Oliveira et al.[15] reported that the weekly training load related to HSR distance and average speed was higher prior to the winning matches. Another study conducted by Rago et al.[40] found that high-speed running was moderately greater in the week before winning a match compared to a draw in a top-level male soccer team. Subsequently, Gonçalves et al.[30] specified that distance-based volume measures such as total distance covered, high-intensity running distance, and mechanical work variables such as accelerations and decelerations were higher during the training session before (i.e., MD-1) winning matches compared to a draw or loss. In the literature, when the above-mentioned studies are taken into account, it was observed that external load measurements associated with a high-intensity activity profile were higher in the training sessions (a typical microcycle) before winning or losing matches than prior to drawing matches. However, it is difficult to draw conclusions regarding the cause and effect between the match result and the changes in the weekly load distribution. Therefore, this study highlights important contextual variables such as match result and match location for coaches and practitioners to consider when organizing weekly session distribution and workload responses in trainings.[30]

Limitations and future directions

The present study contains some limitations. Firstly, although sample power analysis was performed in the method section of our study, the sample size was small (10 elite professional female soccer players) from one team with a specific playing style. The sample size in the present study makes it difficult to generalize the results to other teams, leagues or male soccer players in different countries. Secondly, the distribution of running and accelerometry-based variables evaluated in our study may differ according to the playing positions both in the weekly training sessions before the matches and on match day,[32,33] which was not analyzed due to the small sample size. Thirdly, the contextual factor of opponent level (high, medium, low)[30,37,40,42] was not analyzed as the data collection period belonged to a competitive season that was cancelled due to the COVID-19 pandemic. Another contextual factor not taken into consideration was the competitive period of analysis, because only data from September to March was collected which could be considered the first half of the season[43] or the early-season period.[44] Thus, it is recommended to analyze this contextual factor in future studies. Finally, by increasing the sample size, comprehensive studies can be conducted to analyze the interaction between opponent level or other contextual factors and weekly training load (cause-effect relationship) in professional adult or young female soccer players competing in varying leagues in different countries.

Therefore, the following suggestions are recommended for future studies:

- to include larger sample sizes to analyze playing positions;
- to analyze more teams from different leagues/countries;
- to include the contextual factor of the opponent level (high, medium, low) and period analysis;
- to include the distance and travel time and the type of travel (e.g., plane, bus) for always matches to define if there are a cause-effect on the subsequent load imposed by coaches;
- to include wellness variables such as sleep quality, stress, mood, fatigue, and muscle soreness for a further analysis of the relationship between those with the training load imposed by coaches.

Conclusion

The present study showed that contextual factors such as match result and location did not have a significant effect on running and accelerometry GPS based variables exhibited during match-day in professional female soccer players. However, HSR, average speed, accelerometer-based variables such as acceleration (ACC1,2,3,4) and deceleration (DEC1,2,3,4) were found to be higher during training sessions before home matches compared to away matches. Moreover, it was observed that external load metrics such as HSR distance, acceleration (ACC1,2,3,4) and deceleration (DEC1,2,3,4) presented higher values in training sessions before winning and losing match results compared to drawing.

Considering all results, our study highlights the importance of appropriate planning of external load during training sessions rather than the external load exhibited in match-play according to contextual factors such as match result and match location. Consequently, the information of the present study may help coaches to adjust their prescription decisions considering that higher external load was noticed before home matches than away.

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