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The Quantification of Absolute and Relative Training and Match Data Across a Typical Microcycle Utilizing a Match Day Minus Approach—A Case Study Examining Female Professional Soccer Players

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Abstract

This study aimed to quantify the absolute and relative data across a typical microcycle (MC) in female professional soccer players utilizing a match day minus (MD-) approach. Ten players (24.7 ± 2.6 years) from an elite female Portuguese team participated in this case study. Data was analyzed in absolute or relativized values (per minute) and included the following metrics: duration, total distance, high-speed running distance (HSR, >15 km/h), number of accelerations (ACC, >1–2 m.s^{-2} [ACC1]; >2–3 m.s^{-2} [ACC2]; >3–4 m.s^{-2} [ACC3]; >4 m.s^{-2} [ACC4]) and decelerations (DEC, <1–2 m.s^{-2} [DEC1]; <2–3 m.s^{-2} [DEC2]; <3–4 m.s^{-2} [DEC3]; <4 m.s^{-2} [DEC4]). Total distance showed a significant difference between MD-4 and MD-2 (p = 0.047, moderate effect), which presented the lowest value of all MC days, while MD presented the highest value of HSR compared to all training days (p < 0.001, large to very large effect) for both absolute and relativized data. Relative data showed higher values for MD-5 with significant differences during MD-2 for ACC1, ACC2, DEC1, and DEC2 (p < 0.01, large to very large effect), while absolute data showed higher values during MD-4 for ACC2, DEC1, and DEC2 (p < 0.01, large to very large effect). Absolute ACC3 was higher during MD-3, denoting significant differences from MD-2 (p = 0.002, large effect). This study highlighted that it is possible to train, in specific sessions, with identical loading patterns of match play, specifically for ACC and DEC metrics. However, HSR distance was found to be higher during MD, while training values were significantly lower.

Keywords: women; football; game; global positioning system; performance; training

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1. Introduction

Monitoring load in professional soccer is an integral aspect of player development [1–4]. Load has been classified as external, which can be quantified by the physical/locomotor/mechanical demands, and internal as the physiological stress response to training and/or match play. Load analysis often consists of objective measures, typically collected by global positioning system (GPS) metrics such as running volumes at various velocity thresholds and explosive mechanical work quantified as accelerations (ACC) and decelerations (DEC) [2,5].

Recently, the organization of the training week leading into match day has gained attention [6–11]. Briefly, the recovery and training cycle is periodized considering the previous match and the next competition. Training sessions can be categorized utilizing a "match day minus" (MD-) structure, and load periodization is predominantly determined by the number of days between matches [6]; for example, MD-1, the day before match play or MD-5, five days prior to the next competition. Furthermore, based on this categorization, it has been suggested that recovery strategies during the microcycle (MC) are days following competition (MD+) aimed at regeneration (MD+1) and resting (MD+2) [7]. Additionally, training content should be based on the number of days of the MC [7], where coaches can consider specific objectives (technical, tactical, physical) [8], ensuring appropriate training load distribution [9], to achieve optimal player match play performance [10,11].

In soccer, tactical periodization is a model that has gained relevance among coaches, where training factors emerge and contribute to the tactical supra-dimension [12]. In this model, the principle of specific horizontal alternation to integrate the physical demands through tactical game situations promotes an alternation of load and recovery [13]. According to tactical periodization, the composition of an MC is two days of recovery, three acquisition days (strength, endurance, and speed), and one taper day [13,14].

More specifically, Fernandes et al. [15] analyzed the MC structure of a female elite soccer team from the Portuguese League (League BPI, *Banco Português de Investimento*), which consisted of three training sessions (MD-5, MD-4, and MD-2) and one match. Interestingly, greater total distances were covered during MD-5 with high values of player load (PL), ACC, and DEC were also reported, while the highest average speed, maximal speed, and high-speed running (HSR) were performed during MD-4 [15]. Low values of external load were reported during MD-2 training sessions. This study highlighted that the total distance, average speed, maximal speed, and number of ACC and DEC decreased as MD approached.

More recently, a study analyzed the MC structure of five training sessions and one competition in professional female soccer players from the second Spanish division [7]. Notably, the authors observed that during MD-4, MD-3, and MD-2, the highest total distance and high-intensity running were covered, and the greatest number of ACC and DEC. Additionally, MD-2 presented the highest value of maximal speed, and MD-1 and MD+1 had shorter durations than all other training sessions [7]. Another study investigated the variations in loading patterns of differing MC structures of seven, six, or five days between matches of a female soccer team competing in the Norwegian first division [13]. MD-4 (SSG 1 × 1, 4 × 4, and 5 × 5) showed higher values in ACC and DEC, MD-3 (11 × 11 game) reported higher values in distance covered, HSR, and sprint distance, while MD-1 presented the lowest values of all external load variables [13]. An earlier study examining the Spanish first division female soccer players supported more recent findings [13] reporting higher values of ACC and DEC during MD-4, greater values for total distance and HSR during MD-3, and lower external load values during MD-2.

Previous studies [13,15] utilized absolute values, while others presented relative metrics (per minute) [7,16]. Furthermore, a systematic review in 2022 also revealed that at the time, there was a limited number of studies (#2) that applied the MD- approach [17]. Considering the limited research quantifying the external load of female professional soccer players, the current research can offer real-world practical applications aimed at quantifying a typical MC structure. Thus, the aim was to quantify the absolute and relative data across a typical MC in female professional soccer players utilizing an MD- approach during the 2020–2021 season. The study hypothesis was that the external load of professional female soccer players during MD-2 training sessions would be lower than all other training sessions and that MD would present the highest values of the MC.

2. Materials and Methods

2.1. Design

During the 2020–2021 season, a retrospective observational case study was conducted analyzing training and match play data of 10 female professional soccer players from a Portuguese club (the BPI League, the women's top-tier League) across a 20-week period. Due to a change in the head coach, only data from September to January were included in the analysis, resulting in 100 training sessions and 10 competitive league matches utilized in the analysis.

The typical MC included four training sessions (MD-5, MD-4, MD-3, and MD-2) and one match per week. MD-1 and MD+1 were not included, as both were scheduled as a team day off. Typically, the pitch-based training sessions were: MD-5, active recovery with ball-possession games and team/opponent games (medium-sized dimensions); MD-4, ball-possession games and team/opponent tactical preparation (small- and medium-sided games); MD-3, ball-possession games and team/opponent tactical preparation (large-sided games); MD-2, speed endurance sessions (e.g., long sprints, repeated sprints), ball-possession games and team/opponent tactical sessions.

A non-probabilistic sampling protocol was employed to recruit participants. The research focused on monitoring player total distance, HSR distance, number of ACC and decelerations during training and competitive BPI match play. Player monitoring protocols were standardized and fulfilled during the observational season (2020–2021) without intervention from the researchers.

2.2. Participants

Identical to previous studies [15,18,19], a sample of 10 female professional outfield soccer players from a Portuguese club was recruited for the study (age 24.7 $\pm$ 2.6 years, weight 57.3 $\pm$ 8.2 kg, height 1.63 $\pm$ 1.0 m, body mass index 21.3 $\pm$ 2.2). The power of the sample size was estimated through G-Power [20], which showed that a post hoc analysis for repeated measures, with an effect size of 0.6, $p < 0.05$, one group and four measurements would feature 89.8% of actual power [15]. The inclusion criteria were adopted from previous research [15,18,19] and included (1) completion of a minimum of 80% of training sessions, and (2) a minimum of 45 min of each match play. While the exclusion criteria have also been previously applied [21,22] and included (1) two or more consecutive weeks of recorded injury or illness, (2) joining the team late in the study season, (3) incomplete training or match play data, and (4) goalkeepers, due to the significantly reduced external load during training and match play.

Considering previous research [15,18,19], the players' position was classified at the start of the season and remained consistent throughout the study period: defenders (n = 3), midfielders (n = 4), and strikers (n = 3).

The examined data was produced from regular monitoring methods across the competitive season. The study was fully explained to the club, coaches, and participants and written informed consent was provided. The requirements of the Declaration of Helsinki were adhered to and the study was approved by the local Research Ethics Committee of the Polytechnic Institute of Santarém, Santarém, Portugal (No. 252020Desporto) and the Portuguese club from which the participants volunteered [23]. To ensure confidentiality, all data were anonymized before analysis.

2.3. Data Collection

A portable 10 Hz and tri-axial 100 Hz accelerometer GPS device collected external data (PlayerTek, Catapult Innovations, Melbourne, Australia). This system previously reported valid and reliable values in team sports [24]. Prior (ten minutes) to all training sessions and match play, PlayerTek devices were turned on and inserted into a custom-made pocket located on the posterior part of the upper torso, closely fixed to the body. To standardize data collection, the same practitioner managed the PlayerTek devices, and the same device was consistently worn by players [25].

Previously employed [16] measures were included in the analysis: total distance, HSR distance (>15 km/h), number of ACC (>1–2 m.s^{-2} [ACC1]; >2–3 m.s^{-2} [ACC2]; >3–4 m.s^{-2} [ACC3]; >4 m.s^{-2} [ACC4]) and DEC (<1–2 m.s^{-2} [DEC1]; <2–3 m.s^{-2} [DEC2]; <3–4 m.s^{-2} [DEC3]; <4 m.s^{-2} [DEC4]). Absolute (total amount) and relativized (per minute) data were utilized.

2.4. Statistical Analysis

The statistical analysis procedures have been previously implemented [18]. Specifically, the IBM SPSS Statistics for Windows (version 27.0, IBM Corp., Armonk, NY, USA) was used for all descriptive and inferential statistics. Mean ± standard deviation was used for descriptive statistics. Shapiro–Wilk and Levene tests analyzed normality and homogeneity for all measures, respectively. Normal distribution was not confirmed, and thus, a non-parametric test of ANOVA Friedman (to compare all training and match days) and Mann–Whitney U test was utilized for the comparisons with the Bonferroni correction (for pairwise comparisons). Statistical significance was set at $p < 0.05$. Furthermore, the magnitude of the Hedges effect-size (ES) was determined and interpreted as follows: <0.2 = trivial, 0.2 to 0.59 = small, 0.6 to 1.1 = moderate effect, 1.2 to 2.0 = large effect, >2.0 = very large [26].

3. Results

Table 1 reports the differences in duration, total distance, and HSR across the various training sessions and MD using the Friedman test. With the exception of duration, where no differences were found, total distance showed a significant difference between MD-4 and MD-2 ($p = 0.047$, ES = 1.07), which presented the lowest value of all MC days. While HSR showed a significant difference between MD-5 and MD ($p = 0.030$, ES = 1.90), MD-4 and MD ($p = 0.047$, ES = 1.49), and MD-2 and MD ($p < 0.001$, ES = 2.57). Match day presented the highest HSR value in comparison to all training days.

Table 1. Squad averages (mean ± SD) for duration (min), total distance (m/min), and high-speed running (m/min) across all training sessions and matches.

Day	Duration (min)	Total Distance (m/min)	HSR (m/min)
MD-5	84.0 ± 25.3	43.7 ± 26.7	6.6 ± 3.6 $^{c,\#}$
MD-4	96.5 ± 4.5	41.2 ± 18.7 ^{b,*}	7.2 ± 4.9 $^{c,\#}$
MD-3	94.3 ± 20.1	34.1 ± 12.8	6.5 ± 2.8
MD-2	87.3 ± 29.9	23.6 ± 12.2	4.9 ± 2.7 $^{c,\&}$
MD	86.2 ± 15.9	39.5 ± 16.6	14.7 ± 4.8
p-value	0.188	0.027	<0.001

MD, match day; MD-, match day minus (-5, -4, -3, -2); min, minutes; m, meters; HSR, high-speed running; ^{b} denotes difference from MD-2; ^{c} denotes difference from MD; all $p \leq 0.05$; * suggests a moderate effect size; # suggests a large effect size; & suggests a very large effect size.

Table 2 highlights the ACC and DEC differences between training sessions and MD using the Friedman test.

Table 2. Squad average (mean ± SD) for accelerations and decelerations across all training sessions and matches.

MD	ACC1	ACC2	ACC3	ACC4	DEC1	DEC2	DEC3	DEC4
MD-5	1.9 ± 0.6 $^{b,\&}$	1.2 ± 0.4	0.3 ± 0.1 ^{a,*}	0.1 ± 0.1	1.7 ± 0.5 $^{b,\&}$	1.1 ± 0.5	0.4 ± 0.2	0.2 ± 0.1
MD-4	1.7 ± 0.3	1.1 ± 0.2 $^{b,\#}$	0.4 ± 0.1	0.1 ± 0.1	1.5 ± 0.3 $^{b,\&}$	1.0 ± 0.2 $^{b,\#}$	0.4 ± 0.2 $^{b,\$}$	0.2 ± 0.2 ^{b,§}
MD-3	1.5 ± 0.3	1.0 ± 0.2	0.4 ± 0.1 ^{c,*}	0.1 ± 0.1	1.4 ± 0.3	0.9 ± 0.2	0.4 ± 0.1 $^{b,*,\$}$	0.2 ± 0.2
MD-2	1.1 ± 0.3 $^{c,\&}$	0.7 ± 0.2 $^{c,\#}$	0.3 ± 0.1	0.1 ± 0.1	1.0 ± 0.2 $^{c,\&}$	0.7 ± 0.2	0.3 ± 0.2	0.2 ± 0.2
MD	1.8 ± 0.3	1.1 ± 0.2	0.3 ± 0.1	0.1 ± 0.0	1.7 ± 0.3	0.9 ± 0.2	0.4 ± 0.1	0.2 ± 0.1
p-value	0.001	0.001	0.016	0.703	<0.001	0.003	0.005	0.015

MD, match day; MD- = match day minus (-5, -4, -3, -2); ACC1, number of accelerations >1–2 m.s^{-2}; ACC2 number of accelerations >2–3 m.s^{-2}; ACC3 number of accelerations >3–4 m.s^{-2}; ACC4, number of accelerations >4 m.s^{-2}; DEC1, number of decelerations <1–2 m.s^{-2}; DEC2, number of decelerations <2–3 m.s^{-2}; DEC3, number of decelerations <3–4 m.s^{-2}; DEC4, number of decelerations <4 m.s^{-2}; ^{a} denotes difference from MD-3; ^{b} denotes difference from MD-2; ^{c} denotes difference from MD; all $p \leq 0.05$; § suggests a trivial effect size; $^{\$}$ suggests a small effect size; * suggests a moderate effect size; # suggests a large effect size; & suggests a very large effect size.

ACC1 showed significantly higher values for MD-5 than MD-2 ($p = 0.011$, ES = 2.40) and for MD than MD-2 ($p = 0.002$, ES = 2.13). ACC2 reported significantly higher values for MD-4 than MD-2 ($p = 0.002$, ES = 1.81) and for MD than MD-2 ($p = 0.003$, ES = 1.83). ACC3 showed significantly higher values for MD-5 than MD-3 ($p = 0.037$, ES = 0.90) and for MD than MD-3 ($p = 0.047$, ES = 0.90).

DEC1 reported significantly lower values during MD-2 compared to MD-5 ($p = 0.002$, ES = 3.20), MD-4 ($p = 0.015$, ES = 2.21) and MD ($p < 0.001$, ES = 2.18). DEC2 showed significantly higher values during MD-4 compared to MD-2 ($p = 0.001$, ES = 1.50). DEC3 showed significantly lower values for MD-2 compared to MD-4 ($p = 0.024$, ES = 0.45) and MD ($p = 0.009$, ES = 0.48). Significantly lower DEC4 values during MD-2 compared to MD-4 ($p = 0.007$, ES = 0.0) were found.

Figure 1 demonstrates daily comparisons of absolute data for total distance and HSR, Figure 2 presents all ACC metrics, while Figure 3 reports all DEC metrics across training and MD using Mann–Whitney U test with the Bonferroni correction.

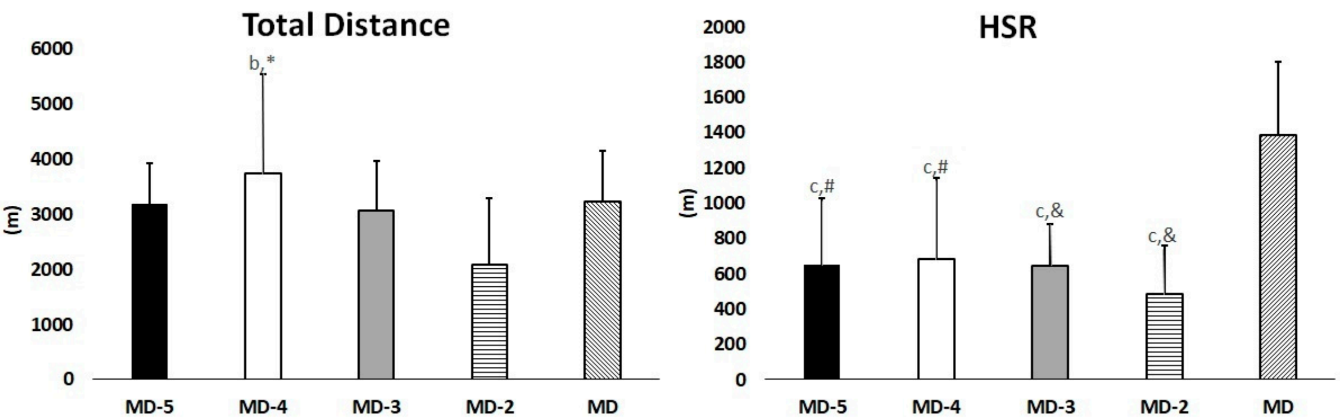

Figure 1. Daily comparisons of total distance and high-speed running (HSR) across each MD- during training and match play. MD, match day; MD- = match day minus (-5, -4, -3, -2); Total distance in meters; HSR, high-speed running >15 km/h in meters, ^{b} denotes difference from MD-2; ^{c} denotes difference from MD; all $p \leq 0.05$; * suggests a moderate effect size; # suggests a large effect size; & suggests a very large effect size.

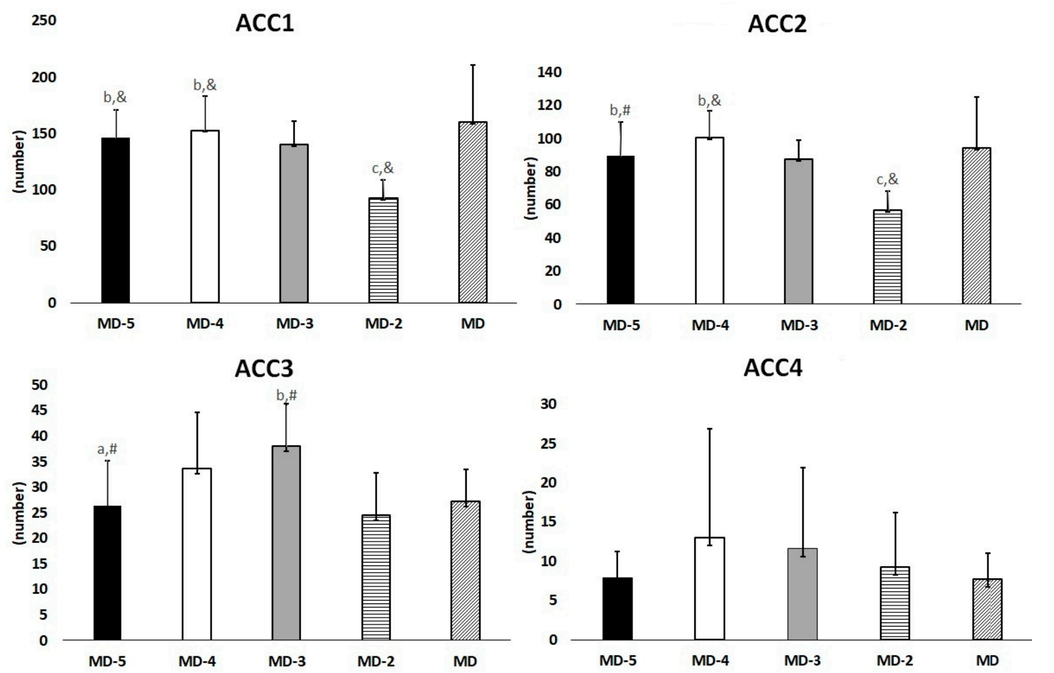

Figure 2. Daily comparisons of all acceleration metrics across each MD- during training and match play. MD, match day; MD- = match day minus (-5, -4, -3, -2); ACC1, number of accelerations >1–2 m.s^{-2}; ACC2 number of accelerations >2–3 m.s^{-2}; ACC3 number of accelerations >3–4 m.s^{-2}; ACC4, number of accelerations >4 m.s^{-2}; [a] denotes difference from MD-3; [b] denotes difference from MD-2; [c] denotes difference from MD; all $p \leq 0.05$; # suggests a large effect size; & suggests a very large effect size.

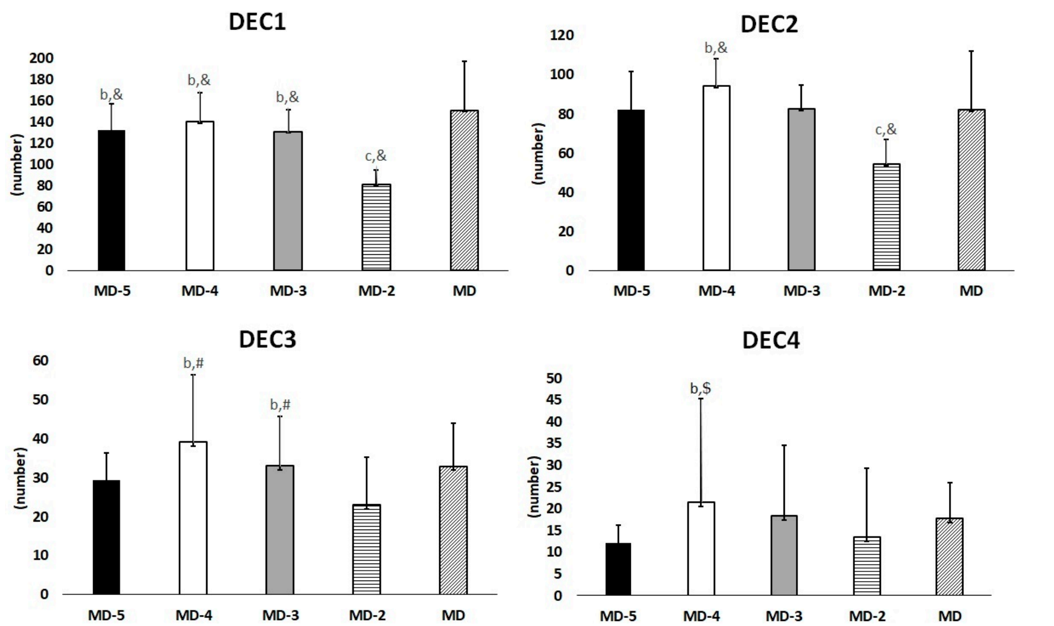

Figure 3. Daily comparisons of all deceleration metrics across each MD- during training and match play. MD, match day; MD- = match day minus (-5, -4, -3, -2); DEC1, number of decelerations <1–2 m.s^{-2}; DEC2, number of decelerations <2–3 m.s^{-2}; DEC3, number of decelerations <3–4 m.s^{-2}; DEC4, number of decelerations <4 m.s^{-2}; [b] denotes difference from MD-2; [c] denotes difference from MD; all $p \leq 0.05$; $, suggests a small effect size; # suggests a large effect size; & suggests a very large effect size.

Total distance reported a higher value for MD-4 than MD-2 (p = 0.047, ES = 0.92), which presented the lowest value of all MC days. HSR denoted significant differences between MD-5 and MD (p = 0.047, ES = 1.81); MD-4 and MD (p = 0.030, ES = 1.39); MD-3 and MD (p = 0.019, ES = 2.92); and MD-2 and MD (p < 0.001, ES = 3.11). MD showed the highest HSR value in comparison to all training days. ACC1 reported significantly higher values for: MD-5 than MD-2 (p = 0.001, ES = 2.22); MD-4 than MD-2 (p = 0.004, ES = 2.06) and; MD than MD-2 (p = 0.002, ES = 3.42). ACC2 denoted significantly higher values for MD-5 than MD-2 (p = 0.019, ES = 1.37); MD-4 than MD-2 (p < 0.001, ES = 2.83); and MD than MD-2 (p = 0.004, ES = 2.66). ACC3 showed significantly higher values for: MD-3 than MD-5 (p = 0.007, ES = 1.31); MD-3 than MD-2 (p = 0.002, ES = 1.56); and MD-3 than MD (p = 0.047, ES = 1.33). DEC1 reported significantly lower values for MD-2 than MD-5 (p = 0.011, ES = 2.15); MD-4 (p = 0.001, ES = 2.23); MD-3 (p = 0.047, ES = 2.38); and MD (p < 0.001, ES = 4.04). DEC2 denoted significantly higher values for MD-4 than MD-2 (p < 0.001, ES = 2.84); and MD than MD-2 (p < 0.001, ES = 2.60). DEC3 showed significantly lower values for MD-2 than MD-4 (p = 0.004, ES = 0.99) and MD-3 (p = 0.047; ES = 0.77). DEC4 showed significantly lower values for MD-2 than MD-4 (p = 0.015, ES = 0.37).

4. Discussion

The present study quantified the external load of female professional soccer players during a typical MC of the 2020–2021 season. The main findings were (1) total distance showed a significant difference between MD-4 and MD-2 and that MD-5 and MD-4 displayed identical total distance values to MD, for both relative (Table 1) and absolute data (Figure 1); (2) HSR reported the highest values during MD for both relative (Table 1) and absolute data (Figure 1); (3) for ACC and DEC, relative data (Table 2) showed higher values during MD-5 for ACC1, ACC2, DEC1, and DEC2, while absolute data (Figure 2) reported higher values during MD-4 for ACC2, DEC1, and DEC2; (4) absolute values of ACC3 were higher during MD-3 training sessions (Figure 2) and; (5) MD-2 presented the lowest values for all metrics compared to all training sessions and matches.

The present study revealed that total distance showed a significant difference between MD-4 and MD-2, where it can be suggested that this is related to the structure of the MC leading into MD, specifically session drill design earlier in the MC (MD-4) and tapering into MD (MD-2), and the need for training tasks to be closely associated with the demands of the game during all training sessions. This notion was further supported by the present results, which highlighted the significant difference found in HSR between MD-5 and MD-2 and MD. This finding emphasizes the balance required to optimally recover players from previous MD, provide an appropriate stimulus during the training MC in order to adequately prepare for MD, while also considering that MD is associated with the highest HSR output across the MC. Such findings were similar to previous studies [16,27] that showed MD-5 (sometimes equivalent to the first training session following the match) presents a significantly lower load, specifically for starting players from the previous match, which was evident in the present study. While MD-2 reported a decreased external load, this was the last training session pre-match. Furthermore, the load dynamics throughout a conventional competitive MC suggest that on MD+1, starters typically engaged in recovery-type activities, while non-starters (players that completed less than 45–60 min of the previous match) completed compensation training sessions aimed at maintaining squad fitness [16,28]. In the present study, MD-5 was the first session post-match, and it consisted of an active recovery session for starting players, which supports the identification of previous trends [16,28]. Previous studies [13,16,29] reported greater training load during MD-4 and MD-3 training sessions compared to MD-1 or MD+1, which corroborated previous studies conducted in professional male players [28,30]. This finding should be emphasized, as in recent years, female soccer has gained more competitiveness and thus increased physical match demands. Consequently, higher training demands have been observed [16,31]. Such trends were identical to findings of the present study except for total distance, which revealed lower values. It is still relevant to highlight that some training sessions revealed identical total distance values to MD, even with varying types of drills (e.g., ball possession games and team/opponent tactical preparation (small- and medium-sided games). This is a novel finding that contrasts with previous studies [7,13,16].

Recent research examining female soccer match performance found average total distances of 9 to 10 km per match [32], including approximately 30 sprints [33], and 200 ACC and 150 DEC per match [34]. Moreover, another study indicated that female players produced approximately 500 m of high-speed running (>19.0 km.h^{-1}) and 125 m > 22.5 km.h^{-1} [35]. A recent systematic review added that female players run from 911 to 1063 m at speeds exceeding 15.6 km.h^{-1} while male players run 618 to 1001 m at speeds exceeding 19.8 km.h^{-1} [36]. The recent literature showed running speeds of 1100 m at >15 km.h^{-1}, 255 ACC (>1 m.s^{-2}) and 78 DEC (<1 m.s^{-2}) in female players [16]. Considering the data from the present study, it seems that the analyzed team exceeded external load values compared to the existing literature, thus potentially highlighting areas of improvement from a soccer fitness perspective. Specifically, this study showed an HSR of ~1390 m, ~288 ACC (>1 m.s^{-2}), and ~284 DEC (<1 m.s^{-2}). Nonetheless, training female soccer players should consider training design associated with these specific physical outputs to adequately prepare players to cope with the demands of contemporary match play.

In the present study, ACC1 showed significantly higher values during MD-5 and MD-4 compared to MD-2. The same pattern was observed regarding ACC2, with significantly higher values during MD-4 compared to MD-2. Finally, ACC3 showed significantly higher values during MD-5 compared to MD-3. These findings may partly be explained by the modern structure of the examined MC, where the MD-4 and MD-3 were consecutive training days and thus presented an opportunity to tactically and physically expose players to intensive (ACC and DEC) and extensive (HSR and sprint) external load metrics. Recently, it was shown that female soccer players produced greater load variables, both external and internal, during MD-4 and MD-3 sessions, regardless of the number of MC days (e.g., 7, 8, or 9 days), except for ACC and DEC during MD-3 [7]. However, during shorter (5–6 days) MC structures, higher values in total distance, HSR (19–23 km.h^{-1}), sprint distance (>23 km.h^{-1}), and number of high ACC (>3 m.s^{-2}) and DEC (>−3 m.s^{-2}) were observed when compared to longer MC (regular MC—7 days, and long MC—8–9 days) [7]. The same study suggested that MC length could be a key variable when designing training sessions and developing recovery strategies, aimed at improving football fitness and freshness via appropriate load management. Thus, indicating that perhaps it may be solely related to the competitive fixture schedule or to the requirement of coaches and fitness staff. However, this would suggest a mixed approach of tactical strategy and physical development (i.e., designing and combining small- and large-sided games during single training sessions) and therefore warrants further investigation.

Undulating patterns of DEC were observed in the present study. Specifically, DEC1 showed significantly lower values during MD-2 when compared to MD-5, MD-4, and MD (Table 2 and Figure 3). DEC2 reported significantly higher values during MD-4 compared to MD-2, while the same was observed for DEC3 and DEC4 (Table 2 and Figure 3). DEC3 was significantly lower during MD-2 compared to MD-3 in relative data (Table 2), although this was absolute data (Figure 3). To maximize match play performance, a structured periodization method was proposed that incorporates increased training load during specific MC days contrasted with a significant decrease in all key physical metrics during tapered MC days [37,38]. This method requires consistent monitoring of external and internal loads [37], to ensure players cope, adapt, recover, and develop, resulting in an undulating training load pattern [38]. In the present study, the undulating pattern of DEC seems to be related to the tactical periodization model and drill design. Where MD-4 sessions were intensive-based football actions, as these were 72 h post-previous match and four days prior to the next match. Thus, allowing physiological recovery, an intensive training stimulus (MD-4) that produces the DEC patterns observed in the present study, and then tactical recovery to occur through modifications in training design during MD-2 (48 h pre-match) training sessions.

Furthermore, during a competitive MC, varying contextual factors such as MC length [18,36], fixture schedule [29], and/or season period [17] contribute to overall training volume and intensity. These contextual factors, often associated with details determining the performance in training and practice in female soccer players (e.g., rest, nutrition, and complementary training) should be carefully monitored throughout the MC, as the present results highlight that MD presented the highest value for HSR compared to all training days, which partly supports the notion that injury risks are higher during MD if not adequately prepared.

Although this study highlighted some novel findings considering the MC structure for female professional soccer players, it is essential to acknowledge certain limitations. For instance, the study only analyzed 10 female professional soccer players from a Portuguese league, the generalizability of the results should be interpreted with caution. Future research should investigate a multi-club model across varying leagues and countries. Moreover, there may be large variability in monitoring ACC and DEC during MD, based on the varying positional demands and small sample size. Indeed, positional analysis was not conducted due to the limited sample size, which consequently decreased sample power. Additionally, no internal load variables (e.g., RPE and mean heart rate) were considered, which would provide an objective individual physiological response to the external load of training and match play. Furthermore, no contextual factors such as match result, opponent ranking, team formation, and match location were examined; however, earlier findings have reported that various elements contribute to load distribution across MC structures in female soccer players [19]. Finally, the findings of this study are related to a specific team, a limited number of participants, a specific training program applied by the coach and their staff, and a total of ten matches, which means that the results can be viewed as an example that could be correct or not, depending on each context.

5. Conclusions

The present results partially confirmed the study's hypotheses that stated the lowest load during MD-2 and the highest on MD, although they were dependent on the analyzed metrics. Specifically, the HSR distance was higher during MD, while training values were significantly lower. Moreover, it was observed that the lowest data across all metrics was during the final training session prior to MD (MD-2). Furthermore, the total distance was identical in MD-5, MD-4, and MD for both absolute and relativized data.

Relative data showed higher values for ACC1, ACC2, DEC1, and DEC2 during MD-5, while absolute data showed higher values for ACC2, DEC1, and DEC2 during MD-4. Absolute values of ACC3 were also higher in MD-3. In conclusion, these findings highlight that knowledge of the MC external loading pattern is essential to understand the physical requirements of ever-increasing training and match demands of female professional soccer players, particularly considering that HSR during MD presented the highest value across the MC for both relative and absolute data. When analyzing ACC and DEC, this study showed that effect sizes were similarly independent of employing absolute and/or relative data, which seems to be associated with the specific eligibility criteria adopted for this study. This comprehensive understanding will hopefully improve physical match performance, reduce injury risk during MD, and positively contribute to match outcome.

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References

1. Halson, S.L. Monitoring Training Load to Understand Fatigue in Athletes. *Sports Med.* **2014**, *44*, 139–147. [CrossRef]
2. Miguel, M.; Oliveira, R.; Loureiro, N.; García-Rubio, J.; Ibáñez, S.J. Load Measures in Training/Match Monitoring in Soccer: A Systematic Review. *Int. J. Environ. Res. Public Health* **2021**, *18*, 2721. [CrossRef] [PubMed]
3. Williams, S.; Trewartha, G.; Cross, M.J.; Kemp, S.P.T.; Stokes, K.A. Monitoring What Matters: A Systematic Process for Selecting Training-Load Measures. *Int. J. Sports Physiol. Perform.* **2017**, *12*, S2-101–S2-106. [CrossRef]
4. Gabbett, T.J.; Nassis, G.P.; Oetter, E.; Pretorius, J.; Johnston, N.; Medina, D.; Rodas, G.; Myslinski, T.; Howells, D.; Beard, A.; et al. The Athlete Monitoring Cycle: A Practical Guide to Interpreting and Applying Training Monitoring Data. *Br. J. Sports Med.* **2017**, *51*, 1451–1452. [CrossRef]
5. Bourdon, P.C.; Cardinale, M.; Murray, A.; Gastin, P.; Kellmann, M.; Varley, M.C.; Gabbett, T.J.; Coutts, A.J.; Burgess, D.J.; Gregson, W.; et al. Monitoring Athlete Training Loads: Consensus Statement. *Int. J. Sports Physiol. Perform.* **2017**, *12*, 161–170. [CrossRef] [PubMed]
6. Malone, J.; Di Michele, R.; Morgans, R.; Burgess, D.; Morton, J.; Drust, B. Seasonal Training-Load Quantification in Elite English Premier League Soccer Players. *Int. J. Sports Physiol. Perform.* **2015**, *10*, 489–497. [CrossRef] [PubMed]
7. Posse-Álvarez, M.; Solleiro-Duran, D.; Lorenzo-Martínez, M.; Iglesias-Soler, E.; Oliva-Lozano, J.M.; Padrón-Cabo, A. Does Microcycle Length Influence the External and Internal Load in Professional Female Soccer Players? *Biol. Sport* **2024**, *42*, 215–223. [CrossRef]
8. Owen, A.L.; Lago-Penñs, C.; Gómez, M.Á.; Mendes, B.; Dellal, A. Analysis of a Training Mesocycle and Positional Quantification in Elite European Soccer Players. *Int. J. Sports Sci. Coach.* **2017**, *12*, 665–676. [CrossRef]
9. Castillo, D.; Raya-González, J.; Weston, M.; Yanci, J. Distribution of External Load During Acquisition Training Sessions and Match Play of a Professional Soccer Team. *J. Strength Cond. Res.* **2021**, *35*, 3453–3458. [CrossRef]
10. Oliva-Lozano, J.M.; Martínez-Puertas, H.; Fortes, V.; López-Del Campo, R.; Resta, R.; Muyor, J.M. Is There Any Relationship between Match Running, Technical-Tactical Performance, and Team Success in Professional Soccer? A Longitudinal Study in the First and Second Divisions of LaLiga. *Biol. Sport* **2023**, *40*, 587–594. [CrossRef]
11. Yang, G.; Leicht, A.S.; Lago, C.; Gómez, M.Á. Key Team Physical and Technical Performance Indicators Indicative of Team Quality in the Soccer Chinese Super League. *Res. Sports Med.* **2018**, *26*, 158–167. [CrossRef]

12. Afonso, J.; Bessa, C.; Nikolaidis, P.T.; Teoldo, I.; Clemente, F.M. A Systematic Review of Research on Tactical Periodization: Absence of Empirical Data, Burden of Proof, and Benefit of Doubt. *Hum. Mov.* **2020**, *21*, 37–43. [CrossRef]
13. Karlsson, U.B.; Vagle, M.; Wiig, H.; Luteberget, L.S. Training Load Quantification in Women's Elite Football: A Season-Long Prospective Cohort Study. *Int. J. Sports Physiol. Perform.* **2023**, *18*, 603–614. [CrossRef]
14. Buchheit, M.; Lacome, M.; Cholley, Y.; Simpson, B.M. Neuromuscular Responses to Conditioned Soccer Sessions Assessed via GPS-Embedded Accelerometers: Insights into Tactical Periodization. *Int. J. Sports Physiol. Perform.* **2018**, *13*, 577–583. [CrossRef]
15. Fernandes, R.; Ceylan, H.İ.; Clemente, F.M.; Brito, J.P.; Martins, A.D.; Nobari, H.; Reis, V.M.; Oliveira, R. In-Season Microcycle Quantification of Professional Women Soccer Players—External, Internal and Wellness Measures. *Healthcare* **2022**, *10*, 695. [CrossRef] [PubMed]
16. Romero-moraleda, B.; Nedergaard, N.J.; Morencos, E.; Ramirez-campillo, R.; Vanrenterghem, J.; Nedergaard, N.J.; Morencos, E. External and Internal Loads during the Competitive Season in Professional Female Soccer Players According to Their Playing Position: Differences between Training and Competition. *Res. Sports Med.* **2021**, *29*, 449–461. [CrossRef]
17. Oliveira, R.; Brito, J.P.; Moreno-Villanueva, A.; Nalha, M.; Rico-González, M.; Clemente, F.M. Range Values for External and Internal Intensity Monitoring in Female Soccer Players: A Systematic Review. *Int. J. Sports Sci. Coach.* **2022**, *18*, 1782–1819. [CrossRef]
18. Oliveira, R.; Brito, J.P.; Fernandes, R.; Espada, M.C.; Santos, F.J.; Nalha, M.; Zmijewski, P.; Morgans, R. Comparison of External Load during Differing Microcycle Structures across Two Competitive Seasons in Elite Female Portuguese Soccer Players. *Front. Sports Act. Living* **2025**, *7*, 1608382. [CrossRef]
19. Oliveira, R.; Ceylan, H.İ.; Fernandes, R.; Morgans, R.; Nobari, H.; Nalha, M.; Brito, J.P. 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. *Proc. Inst. Mech. Eng. Part P J. Sports Eng. Technol.* **2023**, *239*, 61–69. [CrossRef]
20. Faul, F.; Erdfelder, E.; Lang, A.-G.; Buchner, A. G* Power 3: A Flexible Statistical Power Analysis Program for the Social, Behavioral and Biomedical Sciences. *Behav. Res. Methods* **2007**, *39*, 175–191. [CrossRef]
21. Bradley, P.S.; Sheldon, W.; Wooster, B.; Olsen, P.; Boanas, P.; Krustrup, P. High-Intensity Running in English FA Premier League Soccer Matches. *J. Sports Sci.* **2009**, *27*, 159–168. [CrossRef]
22. Ingebrigtsen, J.; Dalen, T.; Hjelde, G.H.; Drust, B.; Wisloff, U. Acceleration and Sprint Profiles of a Professional Elite Football Team in Match Play. *Eur. J. Sport Sci.* **2015**, *15*, 101–110. [CrossRef]
23. Winter, E.M.; Maughan, R.J. Requirements for Ethics Approvals. *J. Sports Sci.* **2009**, *27*, 985. [CrossRef] [PubMed]
24. Scott, M.T.U.; Scott, T.J.; Kelly, V.G. The Validity and Reliability of Global Positioning Systems in Team Sport. *J. Strength Cond. Res.* **2016**, *30*, 1470–1490. [CrossRef]
25. Ravé, G.; Granacher, U.; Boullosa, D.; Hackney, A.C. How to Use Global Positioning Systems (GPS) Data to Monitor Training Load in the "Real World" of Elite Soccer. *Front. Physiol.* **2020**, *11*, 944. [CrossRef] [PubMed]
26. Hopkins, W.G.; Marshall, S.W.; Batterham, A.M.; Hanin, J. Progressive Statistics for Studies in Sports Medicine and Exercise Science. *Med. Sci. Sports Exerc.* **2009**, *41*, 3–13. [CrossRef]
27. Doyle, B.; Browne, D.; Horan, D. Quantification of Internal and External Training Load during a Training Camp in Senior International Female Footballers. *Sci. Med. Footb.* **2021**, *6*, 7–14. [CrossRef]
28. Silva, H.; Nakamura, F.Y.; Castellano, J.; Marcelino, R. Training Load Within a Soccer Microcycle Week—A Systematic Review. *Strength Cond. J.* **2023**, *45*, 568–577. [CrossRef]
29. Romero-Moraleda, B.; González-García, J.; Morencos, E.; Giráldez-Costas, V.; Moya, J.; Ramirez-Campillo, R. Internal Workload in Elite Female Football Players during the Whole In-Season: Starters vs Non-Starters. *Biol. Sport* **2023**, *40*, 1107–1115. [CrossRef]
30. Martín-Garcia, A.; Díaz, A.; Bradley, P.; Morera, F.; Casamichana, D. Quantification of a Professional Football Team's External Load Using a Microcycle Structure. *J. Strength Cond. Res.* **2018**, *32*, 3511–3518. [CrossRef]
31. Maneiro, R.; Losada, J.L.; Casal, C.A.; Ardá, A. The Influence of Match Status on Ball Possession in High Performance Women's Football. *Front. Psychol.* **2020**, *11*, 487. [CrossRef]
32. Datson, N.; Drust, B.; Weston, M.; Jarman, I.H.; Lisboa, P.J.; Gregson, W. Match Physical Performance of Elite Female Soccer Players during International Competition. *J. Strength Cond. Res.* **2017**, *31*, 2379–2387. [CrossRef]
33. Mara, J.K.; Thompson, K.G.; Pumpa, K.L.; Morgan, S. Quantifying the High-Speed Running and Sprinting Profiles of Elite Female Soccer Players during Competitive Matches Using an Optical Player Tracking System. *J. Strength Cond. Res.* **2017**, *31*, 1500–1508. [CrossRef]
34. Ramos, G.P.; Nakamura, F.Y.; Penna, E.M.; Wilke, C.F.; Pereira, L.A.; Loturco, I.; Capelli, L.; Mahseredjian, F.; Silami-Garcia, E.; Coimbra, C.C. Activity Profiles in U17, U20, and Senior Women's Brazilian National Soccer Teams During International Competitions: Are There Meaningful Differences? *J. Strength Cond. Res.* **2019**, *33*, 3414–3422. [CrossRef]
35. Scott, D.; Norris, D.; Lovell, R. Dose-Response Relationship between External Load and Wellness in Elite Women's Soccer Matches: Do Customized Velocity Thresholds Add Value? *Int. J. Sports Physiol. Perform.* **2020**, *15*, 1245–1251. [CrossRef]

36. Gualtieri, A.; Rampinini, E.; Dello Iacono, A.; Beato, M. High-Speed Running and Sprinting in Professional Adult Soccer: Current Thresholds Definition, Match Demands and Training Strategies. A Systematic Review. *Front. Sports Act. Living* **2023**, *5*, 1116293. [CrossRef] [PubMed]
37. Beato, M.; Madsen, E.E.; Clubb, J.; Emmonds, S.; Krustrup, P. Monitoring Readiness to Train and Perform in Female Football: Current Evidence and Recommendations for Practitioners. *Int. J. Sports Physiol. Perform.* **2024**, *19*, 223–231. [CrossRef] [PubMed]
38. González-García, J.; Romero-Moraleda, B. The Impact of a Congested Competition Schedule on Load, Recovery, and Well-Being in Under-16 Female Soccer Players: A Comparison between Starters and Non-Starters during a Development Tournament. *Appl. Sci.* **2024**, *14*, 8066. [CrossRef]