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Effect of training day, match, and length of the microcycle on the worst-case scenarios in professional soccer players

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ABSTRACT

This study aimed to describe in-season worst-case scenarios (WCS) of professional soccer players and compare the WCS between training and match days (MD), considering the length of microcycle. A cohort study was designed for four competitive mesocycles in LaLiga123. The WCS of distance covered (DIS), high-speed running distance (HSRD), and sprinting distance (SPD) for four different WCS durations (1′, 3′, 5′, 10′) were analysed. Statistical differences between the WCS from training and MD were found at all intensities and periods. The magnitude of differences was moderate in DIS-1′ (F= 15.49; p< 0.01; ω_p^2= 0.09) and DIS-3′ (F= 20.99; p< 0.01; ω_p^2= 0.12), and high in the rest of variables (F= 26.53–89.41; p< 0.01; ω_p^2= 0.15–0.38). Specifically, the WCS from MD reported the highest values at all intensities and periods. Regarding training days, the greatest WCS of DIS, HSRD, and SPD were found on MD-4, MD-3, and MD+1. Considering the length of microcycle, significant differences (p< 0.05) in training-days' WCS, but not in MD (p> 0.05). In conclusion, specific WCS training programmes (e.g., including 1 min to 10-min training drills in MD-4) may be useful to prepare the demands required on MD.

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Team sports; game analysis; most demanding passages

Introduction

In recent years, various studies have provided a detailed analysis of training and match demands in professional soccer (Lacome et al., 2018; Martín-García et al., 2018; Martin-Garcia et al., 2019). This is possible because of the evolution of Electronic Performance Tracking Systems that provide performance data to sport professionals (sport scientists, strength and conditioning coaches, trainers) (Cummins et al., 2013). These data help

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coaches to have a better understanding of the required intensity of specific training drills and match play (Delaney et al., 2017). In addition, the comprehension of individual profiles becomes more objective (Carling et al., 2008; Reche-Soto et al., 2019).

Since previous studies have established average weekly external load demands (Abbott et al., 2018; Clemente et al., 2019), it must be taken into account that the use of averages likely underestimates peak demands (Cunningham et al., 2018). In fact, to prepare the players for the demands of the competition it is necessary to train the periods where the players are at maximum performance (Martín-García et al., 2018; Oliva-Lozano, Fortes, Muyor et al., 2020; Oliva-Lozano et al., 2020a). Consequently, new methods have been used to detect the most demanding passages (also known as worst-case scenarios, WCS), which are considered the most intense periods of a match or training (Delaney et al., 2017; Oliva-Lozano, Fortes, Muyor et al., 2020; Oliva-Lozano et al., 2020a; Reardon et al., 2017). For instance, professional soccer players may cover ~200 m/min in the WCS from match play (Oliva-Lozano, Fortes, Muyor et al., 2020). Nonetheless, this distance may be reduced to ~60 m/min when running at high-speed (i.e., above 19.8 km/h) (Oliva-Lozano, Fortes, Muyor et al., 2020). Then, strength and conditioning coaches may use these performance indicators so as to design specific training drills (e.g., transitional games and open spaces to allow longer sprinting actions), which may prepare the players for the WCS from match play (Martín-García et al., 2018; Oliva-Lozano, Fortes, Muyor et al., 2020; Oliva-Lozano et al., 2020a).

However, it has recently been studied that taking WCS from static periods may not be representative of the most demanding passages of play (Martín-García et al., 2018). The application of rolling average techniques is the synonym of a better approach to the most intense periods (Martín-García et al., 2018). This technique consists of the identification of the timeframe (e.g., 1 minute) with the highest demands in the session. As a result, coaches have valuable information to more intelligently design and evaluate the demands of training tasks (Martín-García et al., 2018; Oliva-Lozano, Fortes, Muyor et al., 2020). However, to date, limited data exist on WCS in professional soccer (Lacome et al., 2018; Martín-García et al., 2018; Martin-Garcia et al., 2019; Oliva-Lozano, Fortes, Muyor et al., 2020; Oliva-Lozano et al., 2020a). Analysis of the WCS concerning the length of the microcycle, the specific day of the microcycle, or when the WCS occur has never been reported, which could have significant practical application for coaches. Hence, the aims of this study were to: 1) describe in-season WCS of professional soccer players; 2) compare the WCS between training and match days; and 3) compare the WCS by considering the effect of the length of the microcycle.

Methods

Participants

Data were collected from 23 professional soccer players (age: 26.78 ± 3.77 years old; height: 180.83 ± 6.18 cm; weight: 75.69 ± 6.87 kg) belonging to a professional team in LaLiga 123, which is the Spanish 2nd league. Players from different playing positions were included in the study (forwards, *n* = 5; central midfielders, *n* = 4; wide midfielders, *n* = 4; full-backs, *n* = 6; central defenders, *n* = 4). However, goalkeepers were excluded from the analysis due to the different nature of their activity-demands profile. Besides, players who could not complete the whole session were not included in the analysis. The study was approved by the ethics committee and the club allowed the research team to access players' data and informed consent was provided.

Study design

A cohort study with a total of 56 sessions was conducted including 43 training sessions and 13 official matches during the 2018–2019 season. The sessions were classified as Match Day (MD), −1MD (1 day before the match), −2MD (2 days before the match), −3MD (3 days before the match), −4MD (4 days before the match), −5MD (5 days before the match), +1MD (1 day after the match) and +2MD (2 days after the match). However, −5MD and +2MD were not included in the analysis since these sessions were only available for eight-day microcycles. The training sessions consisted of tactical, technical, and physical qualities development. The aims of these sessions varied depending on the length of the microcycle. Since the average length was 7 days, the length of the microcycle was categorized as shorter than the average (five-day or six-day microcycles, which implied an inter-match period greater than 96 h), regular microcycles (seven-day microcycles), and longer than the average (eight-day microcycles).

Short microcycles

+1MD were characterized by low-impact activities and regeneration exercises; −4MD (for six-day microcycles) and −3MD (for five-day microcycles) was similar to +1MD but adding a bit of intensity through positional games; −3MD (for six-day microcycles) included positional games (~20% of total time), transition drills (~25%), and 11 vs. 11 matches (~40%); −2MD consisted of light strength training (~30%), small-sided games (~30%) and pressing tasks (~30%); and, −1MD were focused on activation drills (~10%), review of tactical elements regarding the match (~50%), and small-sided games (~30%).

Regular microcycles

+1MD were characterized by low-impact activities and regeneration exercises; +2MD were resting days; −3MD consisted of strength training (~25%), small-sided and medium-sided games (~30%), and pressing tasks (~30%); −2MD included preventive strength training (~15%), rondos (~25%), tactical tasks (~30%), control and passing tasks (~20%); and −1MD, activation drills (~10%), review of tactical elements regarding the match (~50%), and small-sided games (~30%).

Long microcycles

+1MD consisted of low-impact activities and regeneration exercises; +2MD were resting days; −4MD were focused on strength training (~25%), small-sided games (~30%) and pressing tasks (~30%); −3MD were characterized by moderate-intensity positional games (~20%), transitions' tasks (~25%) and 11 vs 11 matches (~40% of total time); −2MD included preventive strength training (~15% of total time), rondos (~25% of total time), tactical tasks (~30% of total time), control and passing tasks (~20% of total time); and −1MD, activation drills (~10% of total time), review of tactical elements regarding the match (~50% of total time), and 6 × 6 + 6 small-sided games (~30% of total time).

Procedures

WIMU Pro (RealTrack Systems, Almeria, Spain) was used to collect the data at 10 Hz sampling frequency. Before the start of the session, every device was calibrated following the instructions from the manufacturing company on WIMUNET (RealTrack Systems, Almeria, Spain) (Oliva-Lozano, Fortes et al., 2020). Before the session, a member of the research team placed the devices on a flat surface, turned them on without surrounding magnetic devices, and waited for 30 seconds. At that moment, the devices were placed in a pocket at the back of a chest vest. The accuracy of this device for measuring positioning and velocity variables has previously been tested and the results showed high intra-unit and inter-unit reliability sprinting in linear actions (intra-unit intraclass correlation coefficient = 0.94; inter-unit bias = 0.01 km/h), circular actions (intra-unit intraclass correlation coefficient = 0.98; inter-unit bias = 0.02 km/h), and zig-zag actions (intra-unit intraclass correlation coefficient = 0.96; inter-unit bias = 0.01 km/h) (Bastida-Castillo et al., 2018). In addition, this device has the FIFA Quality Programme approval for the collection of positioning and velocity variables (FIFA, 2019), and it is a frequently used device in soccer research (Bastida-Castillo et al., 2018, 2017; Oliva-Lozano, Fortes, Muyor et al., 2020; Oliva-Lozano et al., 2020a).

Worst-case scenarios

Data were transferred to SPRO software in order to analyse the WCS (RealTrack Systems, Almeria, Spain). The WCS was calculated through a rolling average technique, which identified the maximum demands registered in the session. Three different WCS intensities were assessed based on time-motion variables with different speed thresholds (Martín-García et al., 2018; Oliva-Lozano et al., 2020a): distance covered (DIS, in metres above 0 km/h), high-speed running distance (HSRD, distance covered in metres at speeds higher than 19.8 km/h) and sprinting distance (SPD, distance covered in metres at speeds higher than 25.2 km/h) for four different WCS durations (1′, 3′, 5′, 10′).

Statistical analysis

Firstly, a descriptive analysis was performed to show the WCS data as mean (M) and standard deviations (±SD). The Kolmogorov–Smirnov test was used to confirm the normality of the data set. Data were analysed using a mixed analysis of variance to compare WCS concerning the length of the microcycle, training, and match days. The pairwise comparisons were realized using the Bonferroni method. The magnitudes of the differences for all variables were analysed using the 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 (Field, 2013). Alpha was set at $p < 0.05$. The data analysis was performed using Statistical Package for the Social Sciences (IBM, SPSS Statistics, V 22.0 Chicago, IL, USA) and graphs were designed using GraphPad Prism (GraphPad Software, release 8, La Jolla, CA, USA).

Results

Training vs. match days

Figure 1 shows the WCS from training sessions and MD. Statistical differences between the WCS from training and MD were found at all intensities and periods. The magnitude of the differences was moderate in DIS-1′ and DIS-3′ (F = 15.49 and 20.99, respectively; $p < 0.01$; ω_p^2 = 0.09 and 0.12, respectively) and high in the rest of variables (F = 26.53–89.41; $p < 0.01$; ω_p^2 = 0.15–0.38). Specifically, the WCS from MD reported the highest values at all intensities and periods.

When it comes to training days, the greatest WCS of DIS, HSRD, and SPD were found on MD-4, MD-3, and MD+1. However, the lowest DIS, HSRD, and SPD covered in WCS were found in −1MD and −2MD.

Effect of the length of the microcycle on the WCS from training and match days

Table 1 shows the effect of the length of microcycle in the WCS of training and match days. A significant effect of the length of the microcycle was found on the WCS with a low effect size (F = 6.43–24.82; $p < 0.01$; ω_p^2 = 0.02–0.05), except in DIS-1′ (F = 1.99; p = 0.14; ω_p^2 = 0.00). Specifically, three different profiles were found: (a) WCS from long microcycles > regular length microcycle = short microcycles in HSRD-1′, HSRD-3′, HSRD-5′, HSRD-10′, SPD-1′ and SPD 3′; (b) WCS from long microcycles = short microcycles > regular length microcycles in DIS-3′, DIS-5′ and DIS-10′; and (c) WCS from long microcycles > regular length microcycles in SPD-5′ and SPD-10′.

In addition, significant differences in the WCS from training days were found when considering the length of the microcycle in: (a) all training days for HSRD-1′, HSRD-3′, HSRD-5′ and SPD-1′; (b) MD+1, MD-4, MD-2 and MD-1 for DIS-3′, DIS-5′, DIS-10′; (c) MD+1, MD-3, MD-2 and MD-1 for SPD-3′, SPD 5′, SPD 10′; (d) MD+1, MD-4, MD-3, MD-2 for HSRD-10′; and (e) MD+1, MD-2 and MD-1 for DIS-1′. Regarding the WCS from MD, there were no significant differences ($p > 0.05$) when considering the length of the microcycle.

Discussion

This study aimed to describe in-season WCS of professional soccer players, compare the WCS between training and match days, and compare the WCS scenarios considering the effect of the length of the microcycle. This study showed that there were significant differences in the WCS depending on the day of the microcycle. For example, training days such as −3MD and −4MD (days furthest from the competition) showed greater demands in the WCS than MD-2, MD-1, or MD+1 (closest days to the competition). However, no differences were observed between MD. A further novel finding was that differences between the training and competition WCS were observed, which implies that the WCS from training did not meet the demands of the competition. Also, these findings confirmed that the WCS were dependent on the length of the microcycle since the WCS in training sessions were greater in longer microcycles. Nevertheless, the length of the microcycle did not seem to have a significant influence on the WCS from MD.

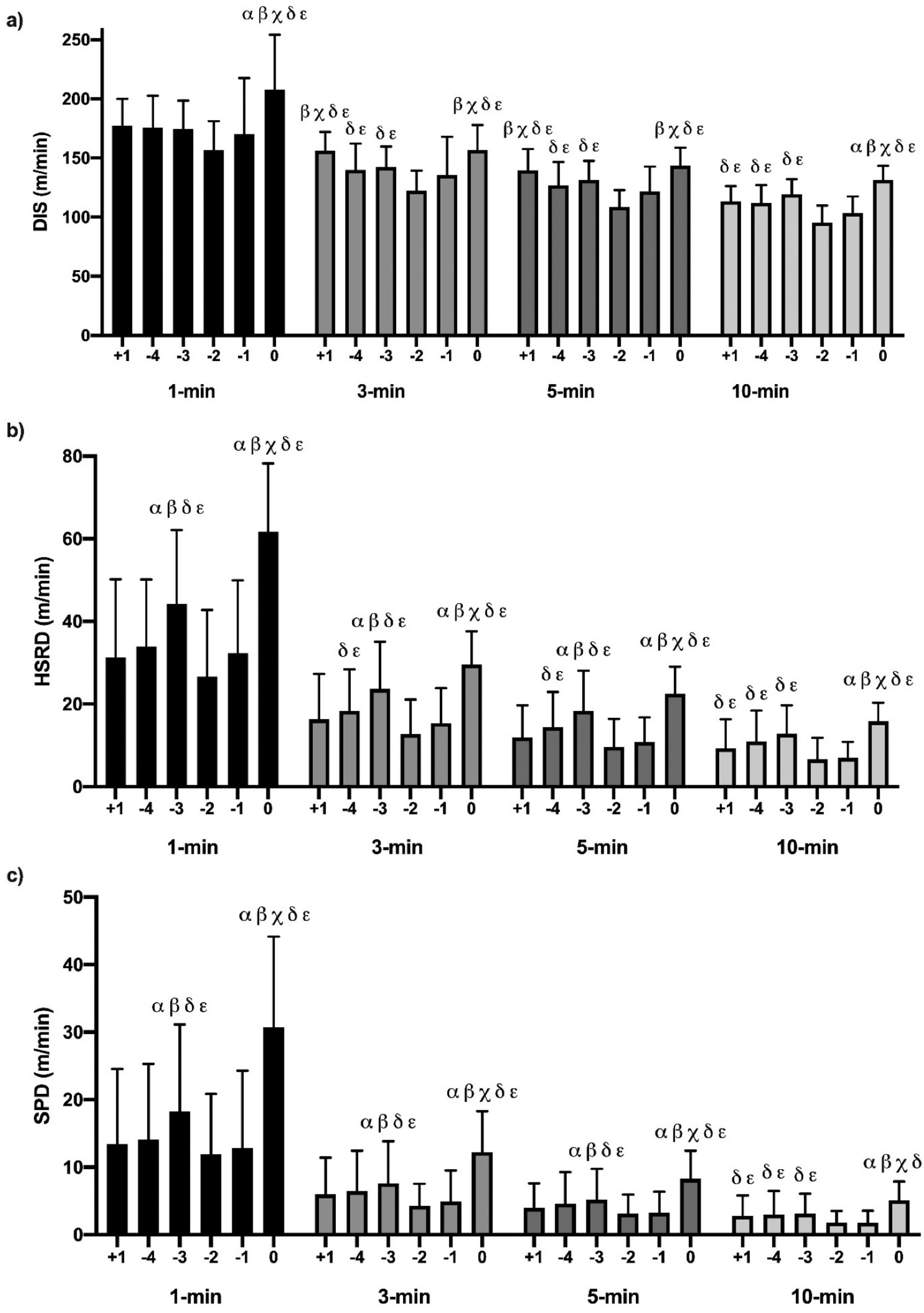

Figure 1. Pairwise comparison between the worst-case scenarios from training and competition match days (MD) in distance (DIS), high-speed running distance (HSRD) and sprinting distance (SPD). $^{\alpha}$Statistical differences with MD+1 ($p < 0.05$); $^{\beta}$Statistical differences with MD-4 ($p < 0.05$); $^{\chi}$Statistical differences with MD-3 ($p < 0.05$); $^{\delta}$Statistical differences with MD-2 ($p < 0.05$); $^{\varepsilon}$Statistical differences with MD-1 ($p < 0.05$).

Table 1. Worst-case scenarios from training and match days and comparative analysis based on the length of the microcycle.

		Short microcycles (M ± SD)	Regular microcycles (M ± SD)	Long microcycles (M ± SD)	*F (p-value)*	*ω_p^2 (magnitude)*	*Post-hoc*
DIS-1	+1 MD	207.93 ± 20.11	160.92 ± 11.41	187.54 ± 13.97	61.16 (<0.01)	0.44 (high)	a b c
(m/min)	−4 MD	165.45 ± 4.15	179.60 ± 29.52	181.63 ± 26.92	1.60 (0.21)	0.00	
	−3 MD	173.07 ± 14.15	175.49 ± 30.39	181.01 ± 36.85	2.53 (0.09)	0.00	
	−2 MD	169.43 ± 11.70	163.54 ± 50.96	158.19 ± 13.66	4.19 (0.02)	0.04 (low)	a
	−1 MD	182.31 ± 34.62	158.35 ± 15.33	192.57 ± 54.89	5.90 (<0.01)	0.06 (moderate)	c
	MD	198.41 ± 23.12	217.33 ± 65.03	201.05 ± 15.45	2.75 (0.07)	0.00	
DIS-3	+1 MD	161.99 ± 13.27	145.55 ± 16.80	162.96 ± 15.69	7.05 (<0.01)	0.07 (moderate)	a c
(m/min)	−4 MD	150.55 ± 8.38	139.96 ± 22.17	146.35 ± 19.29	3.40 (0.04)	0.02 (low)	a
	−3 MD	143.89 ± 12.19	141.32 ± 20.23	143.93 ± 16.48	0.49 (0.61)	0.00	
	−2 MD	137.73 ± 10.17	119.44 ± 24.56	119.06 ± 8.88	22.18 (<0.01)	0.22 (high)	a b
	−1MD	148.54 ± 28.56	125.26 ± 12.08	141.38 ± 33.25	8.14 (<0.01)	0.09 (moderate)	a c
	MD	156.12 ± 19.60	156.98 ± 26.39	156.99 ± 12.62	0.02 (0.98)	0.00	
DIS-5	+1 MD	145.03 ± 12.51	126.05 ± 14.92	154.14 ± 13.90	27.70 (<0.01)	0.26 (high)	a c
(m/min)	−4 MD	147.30 ± 10.43	126.90 ± 19.80	131.93 ± 14.22	9.22 (<0.01)	0.10 (moderate)	a b
	−3 MD	131.68 ± 12.72	131.16 ± 18.84	132.31 ± 14.45	0.09 (0.91)	0.00	
	−2 MD	122.01 ± 10.41	101.98 ± 11.86	107.44 ± 6.53	28.05 (<0.01)	0.26 (high)	a b c
	−1 MD	128.42 ± 18.74	115.52 ± 10.62	123.55 ± 19.59	6.28 (<0.01)	0.06 (moderate)	a c
	MD	145.00 ± 17.13	141.41 ± 16.28	145.61 ± 11.50	1.29 (0.28)	0.00	
DIS-10	+1 MD	136.49 ± 12.26	107.64 ± 5.56	111.78 ± 7.25	62.09 (<0.01)	0.45 (high)	a b
(m/min)	−4 MD	113.93 ± 6.86	111.88 ± 12.29	120.50 ± 9.90	6.24 (<0.01)	0.06 (moderate)	c
	−3 MD	118.98 ± 11.21	118.67 ± 13.87	120.66 ± 12.91	0.40 (0.67)	0.00	
	−2 MD	108.51 ± 12.85	85.60 ± 8.70	94.85 ± 5.65	27.54 (<0.01)	0.26 (high)	a b c
	−1 MD	103.81 ± 11.12	100.66 ± 10.93	105.39 ± 12.00	3.65 (0.03)	0.02 (low)	c
	MD	132.77 ± 15.93	129.99 ± 11.85	132.01 ± 9.07	0.74 (0.48)	0.00	
HSRD-1	+1 MD	56.35 ± 10.79	22.76 ± 6.46	42.43 ± 12.82	80.26 (<0.01)	0.51 (high)	a b c
(m/min)	−4 MD	23.44 ± 10.16	37.44 ± 13.91	43.21 ± 13.77	23.72 (<0.01)	0.23 (high)	a b c
	−3 MD	35.56 ± 8.96	46.05 ± 16.31	54.58 ± 19.28	24.88 (<0.01)	0.24 (high)	a b c
	−2 MD	40.96 ± 10.44	15.31 ± 6.64	32.84 ± 13.91	26.99 (<0.01)	0.26 (high)	a b c
	−1 MD	42.66 ± 14.65	30.07 ± 10.72	48.47 ± 18.99	16.32 (<0.01)	0.17 (high)	a c
	MD	61.10 ± 15.51	60.94 ± 18.64	63.33 ± 13.90	0.33 (0.72)	0.00	
HSRD-3	+1 MD	27.01 ± 5.48	10.49 ± 3.52	25.10 ± 8.70	72.01 (<0.01)	0.48 (high)	a c
(m/min)	−4 MD	10.53 ± 3.57	21.44 ± 10.79	20.27 ± 5.48	16.41 (<0.01)	0.17 (high)	a b c
	−3 MD	18.04 ± 6.70	25.20 ± 10.92	29.40 ± 11.76	21.15 (<0.01)	0.21 (high)	a b c
	−2 MD	20.03 ± 5.35	5.84 ± 3.35	15.83 ± 7.87	25.88 (<0.01)	0.25 (high)	a b c
	−1 MD	20.44 ± 7.73	15.34 ± 6.63	21.44 ± 8.60	7.90 (<0.01)	0.08 (moderate)	a c
	MD	28.93 ± 8.04	28.32 ± 7.87	31.79 ± 7.98	2.85 (0.06)	0.00	

(*Continued*)

Table 1. (Continued).

		Short microcycles (M ± SD)	Regular microcycles (M ± SD)	Long microcycles (M ± SD)	*F (p-value)*	ω_p^2 *(magnitude)*	*Post-hoc*
HSRD-5 (m/min)	+1 MD	21.00 ± 4.42	7.97 ± 2.89	17.63 ± 4.80	90.66 (<0.01)	0.54 (high)	a b c
	−4 MD	8.22 ± 2.11	16.57 ± 9.11	16.32 ± 5.46	17.20 (<0.01)	0.17 (high)	a b c
	−3 MD	13.33 ± 5.12	19.80 ± 9.55	22.90 ± 9.98	20.37 (<0.01)	0.20 (high)	a b
	−2 MD	15.92 ± 4.62	3.75 ± 2.46	11.61 ± 5.64	32.66 (<0.01)	0.29 (high)	a b c
	−1 MD	15.25 ± 5.95	11.03 ± 5.14	13.83 ± 5.44	3.30 (0.04)	0.02 (low)	c
	MD	24.92 ± 6.71	23.33 ± 6.33	24.58 ± 6.29	1.82 (0.17)	0.00	
HSRD-10 (m/min)	+1 MD	16.45 ± 4.10	5.27 ± 2.37	14.55 ± 5.76	65.35 (<0.01)	0.46 (high)	a c
	−4 MD	5.57 ± 2.15	12.86 ± 8.53	12.20 ± 4.94	12.89 (<0.01)	0.13 (moderate)	a b c
	−3 MD	9.99 ± 4.83	13.66 ± 6.49	15.78 ± 7.50	14.97 (<0.01)	0.15 (high)	a b
	−2 MD	11.32 ± 4.17	2.40 ± 1.92	8.05 ± 4.52	24.79 (<0.01)	0.24 (high)	a b c
	−1 MD	9.88 ± 3.96	7.18 ± 3.44	8.53 ± 3.26	2.08 (0.12)	0.00	
	MD	16.03 ± 5.14	15.02 ± 4.70	16.75 ± 3.60	2.15 (0.12)	0.00	
SPD-1 (m/min)	+1 MD	26.73 ± 9.55	5.15 ± 3.84	11.92 ± 8.87	23.56 (<0.01)	0.23 (high)	a b c
	−4 MD	3.85. ± 2.75	11.84 ± 9.14	12.13 ± 8.69	6.53 (<0.01)	0.06 (moderate)	b c
	−3 MD	9.39 ± 7.07	18.32 ± 11.09	24.90 ± 15.67	22.36 (<0.01)	0.22 (high)	a b c
	−2 MD	16.11 ± 7.88	2.02 ± 1.49	10.96 ± 8.50	9.38 (<0.01)	0.10 (moderate)	a c
	−1 MD	18.67 ± 15.60	9.04 ± 7.93	16.70 ± 12.33	9.58 (<0.01)	0.10 (moderate)	a c
	MD	32.15 ± 13.41	28.47 ± 14.06	32.90 ± 12.16	1.81 (0.16)	0.00	
SPD-3 (m/min)	+1 MD	10.78 ± 4.70	1.77 ± 1.26	6.25 ± 5.45	12.79 (<0.01)	0.13 (moderate)	a b c
	−4 MD	1.28 ± 0.92	5.76 ± 5.41	4.87 ± 3.85	2.87 (0.06)	0.00	
	−3 MD	3.65 ± 3.01	7.63 ± 5.91	10.82 ± 6.95	20.20 (<0.01)	0.20 (high)	a b c
	−2 MD	5.83 ± 2.89	0.67 ± 0.50	3.90 ± 3.16	9.24 (<0.01)	0.10 (moderate)	a
	−1 MD	7.24 ± 6.04	3.70 ± 3.82	6.00 ± 4.32	6.63 (<0.01)	0.06 (moderate)	a c
	MD	12.29 ± 5.73	11.62 ± 6.57	13.07 ± 5.44	0.81 (0.45)	0.00	
SPD-5 (m/min)	+1 MD	7.34 ± 2.95	1.12 ± 0.83	4.15 ± 3.59	14.36 (<0.01)	0.15 (high)	a b c
	−4 MD	0.81 ± 0.54	4.05 ± 4.32	3.22 ± 2.75	3.00 (0.06)	0.00	
	−3 MD	2.40 ± 1.95	5.18 ± 4.35	7.47 ± 5.27	18.49 (<0.01)	0.17 (high)	a b c
	−2 MD	4.57 ± 2.89	0.41 ± 0.30	2.47 ± 2.02	8.64 (<0.01)	0.09 (moderate)	a
	−1 MD	4.94 ± 4.04	2.42 ± 2.71	3.83 ± 2.86	6.56 (<0.01)	0.06 (moderate)	a
	MD	8.08 ± 4.06	7.84 ± 4.53	9.07 ± 3.60	1.28 (0.28)	0.00	
SPD-10 (m/min)	+1 MD	5.07 ± 2.90	0.56 ± 0.43	3.08 ± 3.14	9.61 (<0.01)	0.10 (moderate)	a c
	−4 MD	0.40 ± 0.27	2.61 ± 3.17	1.94 ± 1.96	2.54 (0.09)	0.00	
	−3 MD	1.38 ± 1.16	3.03 ± 2.58	4.73 ± 3.62	20.20 (<0.01)	0.20 (high)	a b c
	−2 MD	2.58 ± 1.78	0.25 ± 0.28	1.47 ± 1.42	6.50 (<0.01)	0.06 (moderate)	a c
	−1 MD	2.83 ± 2.34	1.32 ± 1.51	2.07 ± 1.61	6.98 (<0.01)	0.06 (moderate)	a
	MD	5.10 ± 2.85	4.84 ± 2.93	5.48 ± 2.44	0.76 (0.47)	0.00	

M: Mean; SD: Standard deviation; F: F-Value of ANOVA; p: significance; ω_p^2: Partial omega squared.
[a]Differences between short microcycles and regular length microcycles *($p < 0.05$)*
[b]Differences between short microcycles and long microcycles *($p < 0.05$)*
[c]Differences between long microcycles and regular length microcycles *($p < 0.05$)*.

The present investigation found that the greatest demands in the WCS of DIS, HSRD, and SPD from training sessions were identified in MD-4, MD-3, and MD+1. In addition, significant differences between training sessions and MD in all intensities and periods were observed. This reverse J-shaped loading is in line with recent literature, in which the physical demands were reported during competitive days and decreased gradually until the following MD (Castillo et al., 2019; Oliva-Lozano, Gómez-Carmona et al., 2020; Oliveira et al., 2019; Stevens et al., 2017). For instance, professional soccer players from a Dutch Eredivisie team covered ~121 m/min in MD, but their performance was reduced to ~82 m/min in MD-4, ~75 m/min in MD-3, ~68 m/min in MD-2, and ~65 m/min in MD-1 (Stevens et al., 2017). However, these studies reported the average demands of training and match sessions but the WCS were not analysed (Castillo et al., 2019; Oliva-Lozano, Gómez-Carmona et al., 2020; Oliveira et al., 2019; Stevens et al., 2017). This explains why there are large differences between our DIS or HSRD covered in the WCS and previous studies' data (Castillo et al., 2019; Oliva-Lozano, Gómez-Carmona et al., 2020; Oliveira et al., 2019; Stevens et al., 2017). Also, these results need to be analysed with caution and no generalization should be done since different contextual variables such as match outcome, match location, opponent team ranking, environmental conditions, or length of the microcycle (Gonçalves et al., 2020; Mohr et al., 2012; Oliva-Lozano et al., 2020a) might influence the microcycle load's distribution. For instance, winning the match may result in greater DIS, HSRD, and SPD in the WCS than drawing or losing the match (Oliva-Lozano et al., 2020a). Also, a previous study observed that the sequences of peak intensity were significantly lower when the team was leading or losing the match by at least two goals (Schimpchen et al., 2020). However, goal differential did not affect the high-intensity distance covered (Schimpchen et al., 2020). Also, regarding the effect of match location, a study found a significant interaction ($p < 0.01$) between the WCS and the TD, HSRD, and SPD covered. Specifically, the WCS were always more demanding when playing away matches not only in 1-min WCS but also in 3-min, 5-min, and 10-min WCS (Oliva-Lozano et al., 2020a). For example, this study showed that professional soccer players covered ~220 m/min in 1-min WCS when playing away while they covered ~195 m/min when playing home matches (Oliva-Lozano et al., 2020a). This was similar for HSRD (e.g., 1-min WCS: ~58 m/min in home matches vs ~69 m/min in away matches) and SPD (e.g., 1-min WCS: ~28 m/min in home matches vs ~39 m/min in away matches) (Oliva-Lozano et al., 2020a).

Based on the weekly WCS analysis from this study, the results show that the WCS distribution during training days may differ depending on the length of the microcycle. This finding is similar to other recent studies in which differences in training load were found depending on week schedules (one, two or three matches per week) (Anderson et al., 2016; Castillo et al., 2019; Oliveira et al., 2019). However, the comparison of our results with previous research on WCS is limited since, to the best of the authors' knowledge, this is the first study to analyse the effect of the length of the microcycle on the WCS from professional soccer players. Previous investigations observed that there were higher values of training duration in microcycles with one or two matches compared to microcycles with three matches (Anderson et al., 2016; Oliveira et al., 2019). This might explain the higher WCS in the long microcycles compared to the regular and short ones given more time may be spent in high-intensity actions (Anderson et al., 2016).

Although there were differences in WCS between training sessions, there were no differences between MD when the effect of microcycle length was explored. Previous investigations on professional soccer players observed that some variables from the external load profile may not be highly influenced by the length of the microcycle (Lago-Peñas et al., 2011; Oliva-Lozano et al., 2020b). However, a recent study, which was conducted on youth soccer players who played three competitive matches within 8 days, found that the greatest demands from the WCS were reported in the central match of the microcycle (i.e., a match from the international league) (Castellano et al., 2020). Nonetheless, the TD and HSRD covered during the WCS from the first and third matches were similar (Castellano et al., 2020). Then, these results suggest that contextual variables such as league level or competitive level from the opponent team may influence the performance during the WCS (Castellano et al., 2020; Oliva-Lozano et al., 2020a). Additionally, these results may be explained by tactical or strategical factors when programming competitions. For instance, strength and conditioning coaches may reduce the training frequency and training duration while maintaining the intensity, which is associated with an increase in MD demands (Fessi et al., 2016). Also, the compensatory training strategies could lead to a maintenance of MD demands regardless of the differences in weekly training load (Azcárate et al., 2018). Then, coaching and medical decisions might influence training and match performance and these results should be interpreted based on a context-specific perspective.

Although a novel approach through the analysis of WCS from training and MD considering the length of the microcycle was carried out, our findings may present some limitations. The data were collected in one professional soccer team. Some situational or contextual variables (e.g., environmental conditions, match location, playing formation, playing position) that may influence match and training demands were not considered. For instance, although a recent study did not observe significant differences between playing positions in 1-min WCS for any of the external load variables analysed (i.e., DIS, HSRD, and SPD) in match play, positional differences may exist in DIS and HSRD for longer WCS (e.g., 3, 5, or 10 minutes) (Oliva-Lozano et al., 2020a). Also, it would be of interest for future studies to analyse the relationship between internal load variables (e.g., rate of perceived exertion) and WCS. In addition, the speed thresholds for HSRD and SPD were selected based on the protocol from previous studies (Martín-García et al., 2018; Martin-Garcia et al., 2019; Oliva-Lozano, Fortes, Muyor et al., 2020; Oliva-Lozano et al., 2020a), which implies that the individualization of the data through individual speed thresholds (e.g., considering individual maximum speed) was not considered. Future studies are encouraged to consider the above-mentioned limitations in order to explore the impact of other methodological approaches on this type of investigation. For example, given the limitations of GPS technology (e.g., satellite connection) (Malone et al., 2017), the use of local positioning systems may be suggested as an alternative instrument to increase the accuracy of the data collected (Bastida-Castillo et al., 2018; Pino-Ortega et al., 2021). Furthermore, the lack of information on the analysis of WCS resulted in difficulty when comparing the present findings to other recent studies in this specific population. Nonetheless, future investigations on different age groups (e.g., youth soccer players from under-11, under-13, under-15, under-17, under-20 levels) are also necessary since differences may exist in both training and match demands and coaches need to be aware of these differences in order to individualize the training load as much as possible while considering that this is a team sport (Palucci-Vieira et al., 2018).

Conclusions

The results from this study indicate that there were differences in the WCS within the microcycle depending on the day. For example, the WCS from −4MD and −3MD (i.e., far from MD) usually reported greater demands than −2MD, −1MD, or +1MD (i.e., sessions which are closer to MD). Besides, the WCS from training days did not meet the demands of MD. Regarding the effect of the length of the microcycle on the WCS, a low effect of this variable was observed within the microcycle. However, this may have a double meaning since there was a clear effect of the length of the microcycle on training days (usually moderate or high) but not in competition. Therefore, it may be concluded that the WCS from training sessions may be dependent on the length of the microcycle while this length seems to have no significant influence on the WCS of the competition.

Practical applications

Considering the professional soccer competitive demands and in the light of the present results, some findings could be addressed by coaching and medical staff. Specifically, strength, conditioning and recovery programmes may need to be reoriented based on the differences found on WCS between training sessions and MD in addition to the effect of the length of the microcycle on each training day. The high volume and intensity required on MD and the dynamic of the load throughout the microcycles represented a weekly or consecutive reverse J-shaped load, where MD is the maximum effort and pre-match day is the lowest. In consequence, specific WCS training programmes (e.g., including 1 min to 10-min training drills in MD-4 or MD-3 in order to simulate WCS from MD) may be useful to attenuate the effect of the high demands of MD and the subsequent training days. Moreover, strength and conditioning coaches should consider that the match tends to be the best stimuli to increase performance and training sessions are presented as an opportunity to balance loads and recover physical, physiological, and perceptual capacities throughout the microcycle. Nonetheless, future studies need to investigate if training sessions, which are focused on the development of such high-intensity actions to simulate the match demands, may gradually lead the player to experience a decrease in performance due to overtraining.

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