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3. The citation “Fessi et al., 2016” has been changed to “Fessi et al. 2016a, b” to match the author name/date in the reference list. Please check if the change is fine in this occurrence and modify the subsequent occurrences, if necessary.

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Oliveira R, Brito JP, Martins A, Mendes B, Marinho DA, Ferraz R, Marques MC (2019b). In-season internal and external training load quantification of an elite European soccer team. PLoS ONE 14(4). https://doi.org/10.1371/journal.pone.0209393

6. The citation “Oliveira et al. 2021” has been changed to “Oliveira et al. 2021a” to match the author name/date in the reference list. Please check if the change is fine in this occurrence and modify the subsequent occurrences, if necessary.

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Manipulation and Delivery of Training Load Into a Seasonal Schedule

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Abstract

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Training load monitoring has evolved into a requisite practice within both professional and nonprofessional soccer settings. The primary objective of this chapter is to elucidate prevalent practices regarding the manipulation of training load, aiming to optimize intensity throughout a season schedule. In pursuit of these objectives, the chapter expounds upon periodization concepts and provides practical examples illustrating the applied load during mesocycles and microcycles, including those with one, two, and three matches.

The chapter's insights reveal that mesocycles during the preseason and the initial phase of the season (first three mesocycles) impose a higher load when juxtaposed with subsequent mesocycles in the season. Analyzing data from microcycles underscores that match days exhibit the highest intensity, closely followed by training sessions on midweek days. Notably, the peak load tends to occur between 5 and 3 days before a match, while the lowest values are observed on the day preceding the match.

In essence, this chapter aims to furnish information on structuring diverse seasonal schedules, accommodating weeks with a solitary match and congested weeks featuring multiple matches (i.e., more than one match per week). The intention is to offer a comprehensive guide on how to navigate and optimize training loads across various scenarios within a soccer season.

Keywords

Training load management
Schedule
Congested calendar
Periodization

Training load monitoring has become a mandatory practice in professional and nonprofessional soccer. The aim of this chapter was to describe the common practices on the manipulation of the training load and how to deliver a better intensity in a season schedule. To accomplish these aims, this chapter **AQ1** described information on periodization concepts and practical example on the load applied during mesocycles and microcycles with one, two, and three matches. The information of this chapter contextualized that mesocycles from preseason and from the beginning of the season (first three mesocycles) provided higher load when compared with the remaining mesocycles of the season. Considering data from microcycles, matches revealed to be the days with the highest intensity, being followed by training sessions of middle days of the week. Specifically, higher load was found between 5 and 3 days before the match, while the lowest values were found on the day before the match.

This chapter intends to present information on how to organize different seasonal schedules for weeks with one match or congested weeks (i.e., more than one match per week). The topic about training load is frequent and constitutes a daily practice in professional clubs (Weston 2018). Recently **AQ2** , the term "load" was discussed and its replacement with the term "intensity" was suggested by the "International System of Units" (Staunton et al. 2021). To avoid confusion to the readers, "training load" was used in this chapter according to a significant number of research, although intensity may be a better definition.

One of the biggest challenges for coaches is the design of training programs to induce optimal training adaptations and maximize performance at the desired instants of the competitive season (Mujika et al. 2018). Depending on the level of the competition and team, soccer players should be prepared to complete between 3 and 7 training sessions per week and compete once or twice a week during the competition period (i.e., for 9–10 months of a domestic league). Although some high-level soccer teams often experience congested calendars, most young, amateur, and professional soccer teams usually have to play one match per week. However, the organization of the weekly training load should warrant peak performance in the most important session of the week, which is the official match, regardless of the competition level and match fixtures (Rico-González et al. 2020).

Soccer is continually evolving and this requires coaches to design training protocols with different periodization strategies that optimize physical and technical adaptations (Fessi et al. 2016a, b **AQ3** ; Kelly et al. 2020; Moalla et al. 2016). However, weekly soccer training programs differ according to the phase of the annual plan, the number of season weeks, and/or the experience of the coach as mentioned before (Bangsbo et al. 2006). Training plans are usually divided into mesocycles. Each mesocycle is generally divided into 3 to 5 microcycles, which have a specific training goal that ultimately focuses on the final performance target (Gamble 2006; Jeong et al. 2011; Mujika et al. 2018). To achieve optimal performance on match day, Gamble's approach suggests a variation of each summated microcycle duration according to the schedule of competitive matches (Gamble 2006). Consequently, coaches must find a balance between training stimulus and recovery to optimize physiological adaptations and performance. Indeed, most coaches carry out a short-term reduction of training load, usually at the end of each mesocycle block (Fessi et al. 2016a, b). This short-term progressive reduction of training load is called "tapering" and is intended to decrease fatigue caused by training and to optimize physiological and psychological adaptations before a competition (Moalla et al. 2021).

With such different scenarios and variables to manipulate, it is extremely important to understand the training periodization strategies applied to soccer teams. Therefore, the aim of this chapter is to present training periodization conceptualization and training load periodization strategies for regular competitive schedules and congested calendars.

8.1. Training Periodization

The concept of periodization is a common topic of discussion among coaches and sports scientists. Classically, periodization can be divided into three levels: the macrocycle (long length, lasting 3–4 months), the mesocycle (mid-length, lasting 2–4 weeks), and the microcycle (short length, lasting 1–7 days). Each macrocycle generally begins with a format of high-volume, low-intensity training and ends with a reverse format of high-intensity, low-volume training (Bompa and Haff 2009; Matveyev 1981; Plisk and Stone 2003). In general, the macrocycle comprises four phases: preparation (general and special), competition, peaking, and transition or active rest. All these phases have different goals and degrees of variation.

However, classic periodization is somewhat difficult to put into practice during soccer trainings because it is essential that the team is well prepared for the game every week. For instance, top European players usually participate in 1–2 training sessions between two consecutive matches. For this reason and in this case, coaches can only implement recovery training (Akenhead et al. 2016; Anderson et al. 2016a, b; Malone et al. 2015; Stevens et al. 2017).

According to a previous study, the periodization plan for team sports could be divided in the following phases (Mujika et al. 2018):

- General preparation.
- Specific preparation, which is also known as pre-competition.

- Main competition or regular season.
- Playoffs or finals.
- Transition/off-season/injury.

When applied to soccer, general and specific preparations are associated to the preseason period where strength and conditioning capacities are developed in the beginning, and a higher intensity is then applied along with soccer-friendly matches. Then, the players get into the main competition or regular season, in which training and official matches occur. Playoffs or finals may also belong to this period (it depends on the level of the soccer team and the competitions the team belong). Finally, the last period is known as off-season for an active and passive recovery of the players. Thus, training load needs to be monitored during these phases.

8.2. Microcycle Periodization

One of the first studies that analyzed seasonal training load data from soccer players during a full season was published in 2015 (Malone et al. 2015). These authors analyzed English Premier League players in weeks with one match during pre- and in-season periods (Malone et al. 2015). The study analyzed microcycles with four training sessions, namely, MD−5, 5 days before the match; MD−3, 3 days before the match; MD−2, 2 days before the match; and MD−1, the day before the match. MD−4 and the day after the match (MD + 1) were days off. The AQ4 day after the match. The authors found that MD−1 was the day with the lowest load while the other days presented similar values in variables such as total distance, high-speed running distance, and session RPE. There was a few load variation across the typical microcycle over the season. The authors also found positional differences regarding the load applied (Malone et al. 2015) which should be considered when preparing training periodization for the entire team.

Recently, a similar study with Elite Portuguese Premier League soccer players AQ5 (Oliveira et al. 2019b) analyzed 10 in-season mesocycles and the most typical microcycle for weeks with only one match of the in-season period. It was concluded that despite the existence of some significant differences between mesocycles, there were minor changes across the in-season period (a tendency of higher values in the first three mesocycles of the in-season was observed) for internal and external training load (e.g., total distance, high-speed running, or session RPE) and perceived wellness, which was collected through the Hooper index. Furthermore, a microcycle pattern showed that MD−1 presented a general reduction of training load while the other days kept a similar training intensity. In addition, Hooper index variables only showed significant differences in the day after the match where higher values were revealed, while the other days remained identical.

Even more recently, a study analyzed the effect of the length of the microcycle across a full season in La Liga 123 (Oliva-Lozano et al. 2022). In this study, short (five training sessions), regular (six training sessions), and long microcycles (seven training sessions) were considered. The study found that the highest intensity and volume were found to be on match day, being followed by MD−4 and MD−3 for total distance covered, total number of high-intensity accelerations and decelerations, total number of high-speed running actions, high-speed running distance, and player load regardless of the microcycle length. Intrinsically, this study showed the lowest values on MD−2 (but the values were similar to MD−1) regardless of the microcycle length. Finally, when comparing data from different microcycles, a significant effect on all variables were found with the exception for high-intensity accelerations and decelerations and high metabolic load distance (Oliva-Lozano et al. 2022). In the same line with the previous studies, other studies considered the worst-case scenario analysis (the most demanding passages, which are considered the most intense periods of a match or training) and found the same results (Oliva-Lozano et al. 2021).

In line with the previous information is a systematic review (in press) that found a post-match recovery strategy followed by an increase in intensity until MD−3 and MD−2 (Cano et al. 2022). The same study added that microcycles with more matches per week presented a higher focus on recovery, meaning a decrease in intensity through the microcycle. During the 2 matches' week, a lower intensity or one recovery day is suggested after the match. Meanwhile, in the 3 matches' week, coaches should prescribe recovery sessions in the days between matches (Cano et al. 2022).

Considering weeks with one match, coaches should program the training with a higher load between MD−5 and MD−3 (50–75% (<52 m/min) of the match distance covered, between 25% and 72% of match high-speed running covered (< 25 m/min), and between 57% and 92% of the total accelerations performed during the competition. Moreover, weeks with two matches present a similar pattern of weeks with one match. For the most intense sessions (MD−3 and MD−2), a total distance covered between 60% and 66% of the match independently of the microcycle length, between 15% and 39% of the match high-intensity running covered, and between 3% and 19% at sprint distance covered. Finally, in weeks with three matches, the intensity should be reduced for maintaining between 51% and 98% of total distance covered at low intensity during competition (Cano et al. 2022).

A general consensus that match day is the day with higher load was shown to be in line with several studies (Bradley et al. 2009; Los et al. 2017; Los Arcos et al. 2014; Malone et al. 2015; Oliva-Lozano et al. 2022; Oliveira et al. 2019a, b; Stevens et al. 2017). The reasons that explained the results were associated with the need to win matches that obliged coaches to reduce load when MD was near (i.e., MD−1) (Malone et al. 2015; Oliveira et al. 2019 This reference is the following:
Oliveira R, Brito JP, Martins A, Mendes B, Marinho DA, Ferraz R, Marques MC (2019b). In-season internal and external training load quantification of an elite European soccer team. PLoS ONE 14(4). https://doi.org/10.1371/journal.pone.0209393
), in order to avoid injuries and illness (Akenhead et al. 2016; Fessi et al. 2016a, b; Jeong et al. 2011; Malone et al. 2015).

Moreover, a systematic review about in-season weekly training load for weeks with one match showed that training load that came from the match represented 38% of the weekly differentiated session RPE, being almost the exclusive source of weekly high-speed and sprinting (90–97%) in professional soccer players. It was also found that the number of weekly training sessions carried out by the team does not seem to influence weekly training load in both professional and young soccer players. Training load progressively increased up to 4 days after the previous match (i.e., 3 days before the next match) to get reduced up to the day before the competition in professional soccer players, but a clear trend for weekly training load distribution was not apparent for young soccer players (Rico-González et al. 2020).

Furthermore, two recent systematic reviews summarized information on training intensity in young (Oliveira et al. 2021c) and professional soccer players (Oliveira et al. 2022). Similar to the previous reports, both studies confirmed the lowest intensity on MD−1 considering external and internal measures. In young soccer players, this finding was evident between under-15 and under-19 categories (Oliveira et al. 2021c). Both studies found higher values in the middle days of the week (Oliveira et al. 2021a **AQ6** , 2022).

However, the complex nature of soccer competition and training complicates the individual prescription of the weekly training load, which results in considerable differences in training load between soccer players of the same team (Akubat et al. 2012), since there are different playing positions (Clemente et al. 2020; Oliveira et al. 2019 This reference is the following: Oliveira R, Brito JP, Martins A, Mendes B, Marinho DA, Ferraz R, Marques MC (2019b). In-season internal and external training load quantification of an elite European soccer team. PLoS ONE 14(4). https://doi.org/10.1371/journal.pone.0209393
) and status (starters and nonstarters) (Nobari et al. 2020a, b, c, 2021a).

In a soccer match, only 11 players participate from the beginning of the match and only three could be replaced, which means the other players in the bench do not participate in the most demanding session of the week (Los et al. 2017; Los Arcos et al. 2014). As a consequence, coaches apply compensatory training strategies, but several studies reported higher weekly training load for the starters when compared to nonstarters (Azcárate et al. 2018; Los et al. 2017; Nobari et al. 2020a, c, 2021a, b, c). In addition, strategical (e.g., playing system and positions) and situational variables (e.g., opponent's level, match location, and period of the season) (Nobari et al. 2021b; Oliveira et al. 2020, 2021a) can substantially influence training and match loads.

Regarding the microcycle training sessions, some studies (Anderson et al. 2016b; Los et al. 2017; Thorpe et al. 2016) found that coaches periodized training contents to attain the highest weekly training load in the middle of the week. Training load increased until 4 days following the previous match (i.e., 3 days before the next match) and later decreases up to the day before the competition (Los et al. 2017; Thorpe et al. 2016). As a result, an increasing-decreasing training load trend is suggested during the training week until the most demanding session of the week, the official match, in professional soccer players. Then, a recovery period needs to be applied to manage fatigue.

Therefore and according to previous research (Rico-González et al. 2020), professional soccer teams accumulate lower session RPE (1200–1600 AUs) for one-match young soccer players (2500–4000 AUs) during in-season period. Moreover, inter-player training, match, and weekly training load variability are greater for professional soccer players in comparison to young soccer players. Match participation is the main contributor of the one-match weekly training load (>32–36% of the total internal and external weekly training load) and almost the exclusive source of weekly high-speed and sprinting running in professional soccer players. However, the impact of the match on the one-match weekly training load is less clear in young soccer teams. It seems that the number of training sessions carried out by the teams during the week does not influence the global weekly training load in both professional and young soccer players. Training load progressively increased up to 4 days after the previous match (i.e., 3 days before the next match) to get reduced up to the day before the competition in professional soccer players, but a clear trend for weekly training load distribution along the week in young soccer players is not apparent.

8.3. Mesocycle Periodization

Since periodization includes more than one microcycle analyses across the entire season, it is relevant to acknowledge are the strategies for mesocycles. According to Coutts et al. (2008), coaches have been recommended to adopt effective recovery strategies between training sessions and impose a short-term reduction of training load at the end of every mesocycle. The reduction of training load is known as "tapering." In other words, tapering consists of reducing the physiological and psychological stress of training to maximize performance after an intense training period (Bosquet et al. 2007). Regarding microcycle training, it was observed that training load was reduced to MD−1, what could be considered as a tapering strategy (Anderson et al. 2016b; Los et al. 2017; Malone et al. 2015; Oliveira et al. 2019a, b, 2021b).

Basically, tapering could be characterized by a reduction of the training load volume and frequency. However, training intensity should be maintained during the taper period which can be achieved by performing high-intensity interval training (Bosquet et al. 2007).

In this regard, some authors (Fessi et al. 2016a, b) examined the effect of decreasing training load during taper weeks on physical match activities in professional soccer players. They concluded that decreasing training load by ~25% during taper weeks by reducing training duration and frequency but maintaining intensity was associated with a 15% increase in physical activities during matches.

On the other hand, a previous study analyzed 10 mesocycles of the in-season period. However, no such strategies were identified and the general conclusion showed that mesocycles were similar across the in-season with higher values being noted in the beginning of the in-season (mesocycles 1–3) (Oliveira et al. 2019b).

Two studies (Kelly et al. 2020; Malone et al. 2015) also examined training load quantification and its distribution throughout the season utilizing a periodization of six standard and equivalent mesocycles separated into 6 weeks. One study (Malone et al. 2015) found that the preseason training load showed limited variation across each microcycle, while the other study (Kelly et al. 2020) concluded that training load across the mesocycle periods showed limited variation and suggests that training schedules of elite soccer may be highly repetitive, likely reflecting the nature of the competition demands. However, a recent study highlighted that the duration of the mesocycle can influence changes in match running performance following a tapering period in soccer. The study showed no significant difference in the training load parameters or match running performance during matches within standard weeks. Meanwhile, match running performance following the taper weeks varied according to mesocycle duration, though the difference in training load parameters is not significant (Moalla et al. 2021). Consequently, the authors suggested that mesocycles of four microcycles should end with a tapering period (3 standard weeks with 1 tapering week), which depends on the match objectives to enhance physical activities, prevent acute fatigue and overtraining, and maintain match readiness. Therefore, soccer coaches should consider designing tapering weeks by decreasing the training frequency and duration while maintaining intensity compared to the previous training load already accomplished in pre-tapering to optimize match running performance, especially high-intensity activities (Moalla et al. 2021).

8.4. Recommendations for Future Studies

Indeed, there are a lot of literature in training load quantification with respect to soccer periodization strategies; however, the majority of the scientific evidence only presents the different internal and external measures applied (session RPE, heart rate, blood lactate, total distance, different speed thresholds, accelerations, deceleration, player load, metabolic power, etc.) as well as workload measures (training monotony, strain, and acute/chronic workload ratio). Therefore, this chapter recommends that future studies could analyze and explain what the training periodization strategies are applied with special regard to the different types of exercises that are applied. Only with such information, it will be possible to properly understand periodization strategies as well as to replicate studies.

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