motricidade

ORIGINAL ARTICLE

https://doi.org/10.6063/motricidade.41926

Variations of training workload parameters between player positions in under-17 elite European soccer team: a full-season

Alexandre Duarte Martins[1,2,3], Rafael Oliveira[2,3,4]*, João Paulo Brito[2,3,4], Nuno Loureiro[2,3], Sérgio Querido[5], Hadi Nobari[6]

ABSTRACT

The purpose of this study was to analyse variations in rating of perceived exertion (RPE), session-RPE, training duration, training monotony, training strain, and acute chronic workload ratio (ACWR) between mesocycles and within microcycles during the in-season 2017–18, across player positions in young soccer players. Seventeen young soccer players were evaluated over 50 weeks. The field positions of the players consisted of four central defenders, three wide defenders, four central midfielders, three wide midfielders, and three strikers. There were significant differences between player positions in mesocycle 6 for central defenders vs strikers (p = .047; ES = 4.02 [1.51, 7.96]) on duration of training sessions. The ACWR ratio remained similar throughout the season, between the optimum workload (.8–1.3). In microcycle analysis, match day minus 3 was the day of the week with the highest values for all variables. The findings of the present study showed no difference between positions, but lower values were found after and before the match, while higher values were found in the middle of the microcycle.

KEYWORDS: player positions; acute chronic workload ratio; young soccer; training monotony; training strain.

INTRODUCTION

Nowadays, workload quantification is a common practice performed by professional soccer teams (Miguel et al., 2021; Oliveira et al., 2022; Rico-González et al., 2024). All data derived from workload monitoring provides a better understanding of when recovery is needed and helps reduce injury risk, illness, overreaching, or overtraining, optimising the training process (Foster, 1998; Foster et al., 2001; Impellizzeri, Wookcock, et al., 2020).

However, the literature is scarce about training monitoring at the youth level (Nobari, Aquino, et al., 2020; Oliveira, Brito, et al., 2021; Rico-González et al., 2023), which makes it difficult to have optimal management of the training load intensity to plan and periodize the training process. According to a systematic review of training load in youth soccer (Oliveira, Brito, et al., 2021), a limited number of studies have focused on short observation windows, limited competitive phases, or single mesocycles, thereby limiting understanding of workload dynamics across a complete season. Moreover, evidence remains scarce regarding how internal load parameters evolve simultaneously across mesocycles, microcycles, and playing positions within the same cohort. By monitoring a full competitive season, the present study addresses these limitations and contributes longitudinal evidence from an elite European youth context.

In youth soccer, training load monitoring assumes additional relevance given ongoing biological maturation, psychological development, and progressive acquisition of technical–tactical

[1]Universidade de Évora, Comprehensive Health Research Centre (CHRC), Escola de Saúde e Desenvolvimento Humano, Departamento de Desporto e Saúde – Évora, Portugal.
[2]Santarém Polytechnic University, School of Sport – Rio Maior, Portugal.
[3]Life Quality Research Centre (CIEQV), Santarém Polytechnic University – Santarém, Portugal.
[4]Research Center in Sport Sciences, Health Sciences and Human Development (CIDESD), Santarém Polytechnic University – Rio Maior, Portugal.
[5]Universidade de Lisboa, Faculty of Human Kinetics – Lisbon, Portugal.
[6]Research Group, Department of Health and Human Performance, Faculty of Physical Activity and Sport Science (INEF), Universidad Politécnica de Madrid – Madrid, Spain.
*Corresponding author: rafaeloliveira@esdrm.ipsantarem.pt

Conflict of interests: nothing to declare. Funding: This work was supported by National Funds by FCT - Foundation for Science and Technology, under the projects UID/04045/2025 (https://doi.org/10.54499/UID/04045/2025), UID/PRR/04045/2025 (https://doi.org/10.54499/UID/PRR/04045/2025) and UID/PRR2/04045/2025.(https://doi.org/10.54499/UID/PRR2/04045/2025).
Received: 5th June 2025. Accepted: 10th December 2025.

competencies. Adolescents exhibit substantial inter-individual variability in growth, neuromuscular development, and fatigue tolerance, which may influence both perceptions and physiological responses to training stimuli (Palucci Vieira et al., 2019). Consequently, load management strategies validated in adult players cannot be directly extrapolated to youth populations, reinforcing the need for age-specific evidence.

Additionally, youth soccer periodisation requires balancing technical–tactical learning, physical development, and competitive demands across meso- and microcycles (Palucci Vieira et al., 2019). Understanding how internal load parameters fluctuate across these temporal structures provides insight into how training stimuli are distributed and adapted throughout the season, informing evidence-based periodisation strategies in youth players.

One of the most useful and low-cost tools for monitoring internal workload is the session rating of perceived exertion (s-RPE) method (Foster et al., 2001; Haddad et al., 2017), which is expressed in arbitrary units (AU). Recent research with young soccer players shows that this method should be used for workload monitoring, especially for coaches without access to global positioning systems (GPS) (Marynowicz et al., 2020). Besides, this method allows the acquisition of acute and chronic load parameters throughout variations in the workload across microcycles throughout the season.

Some indexes have also been widely suggested and calculated through the s-RPE known as training monotony (TM) (Clemente, Silva, Castillo et al., 2020; Nobari, Aquino, et al., 2020; Nobari, Oliveira, et al., 2020), training strain (TS) (Clemente, Silva, Castillo et al., 2020; Nobari, Aquino, et al., 2020; Nobari, Oliveira, et al., 2020), and acute:chronic workload ratio (ACWR) (Dalen-Lorentsen et al., 2020; Impellizzeri, Wookcock, et al., 2020; Myers et al., 2020). The original use of the aforementioned indexes provided data on weekly variations and personalised information to minimise the occurrence of injury (Enright et al., 2020; Myers et al., 2020). Moreover, this information allows researchers and coaches to better adjust the session's workload and take evidence-based decisions.

The previous indexes were validated by Foster (1998). Specifically, TM is calculated as the average workload divided by its standard deviation, while TS is the monotony multiplied by the workload. TM and TS are used to quantify changes in workload across the microcycle, the stress provided by training sessions, and the match in the athlete (Delecroix et al., 2019). They provide complementary information on weekly load distribution and accumulated stress, capturing dimensions of load variability that are not reflected by volume or intensity alone (Oliveira, Martins et al., 2021).

In addition, the ACWR (typically acute = current week and chronic = rolling 4-week average) is considered by the International Olympic Committee to be the most applicable measure of load for identifying injury risk in athletes (Soligard et al., 2016). In general, it is suggested that injury likelihood is low when the ACWR is within a range of .8–1.3 AU (protection), and high when it exceeds 1.5 AU (risk) (Gabbett, 2016; Soligard et al., 2016). Nonetheless, some studies did not support the idea that previous indices can predict injury risk (Impellizzeri, Tenan, et al., 2020; Impellizzeri, Ward, et al., 2020a, 2020b). This was also supported by a recent systematic review, which showed no clear information about whether ACWR and TM variations are a possible predictor associated with injury risks (Rico-González et al., 2023). Accordingly, the present study does not aim to test the predictive validity of ACWR as a marker of injury risk, but to describe its seasonal and positional behaviour within a well-defined youth elite context. The ACWR was included to characterise the balance between short- and long-term training exposure throughout the season.

In young soccer players, Nobari, Aquino, et al. (2020) reported that the highest weekly acute, chronic load, and TS values were observed in the mid-season, and the lowest in the start-season. Along the same lines, Nobari, Alves, et al. (2021) showed that higher variation in TM (57.6%) and TS (111.1%) occurred in the mid-season. In contrast to previous studies, the last mesocycle of the season showed the highest values for TM and TS. Even so, and to the best of the authors' knowledge, only one study analysed player positions through the ACWR, TM, and TS calculated by RPE in young soccer players (Nobari, Vahabidelshad, et al., 2021). That study found higher values of TM, TS and ACWR in the mid-season. Additionally, it found several intra-week variations across player positions using s-RPE, whereas minimal variations were observed using the ACWR, TM, and TS (Nobari, Vahabidelshad, et al., 2021).

Knowledge of such differences between player positions can provide important information to scientists, coaches, and staff to better adjust load throughout the season (Clemente, Silva, Castillo et al., 2020), and this information is also relevant for better acknowledging weekly variation during the season. Moreover, given the specific functions of players' positions and the large number of drills in the game, it is also expected that meaningful variations in internal load could occur across playing positions (Clemente, Silva, Castillo et al., 2020). In professional soccer players, a greater TS was observed for wide defenders and wingers with respect to high-speed running and the number of sprints, compared with other positions (Clemente, Silva, Castillo et al., 2020). Another study showed significant results for TM (mesocycle 2) and ACWR (mesocycle 6) between central defenders and strikers; for TS (mesocycle 10) between central defenders and central midfielders (Oliveira, Martins, et al., 2021).

Considering that the previous study of Nobari, Vahabidelshad, et al. (2021) was conducted with a small sample size of under-16 (U-16) soccer players, which avoids the generalisation of results, this study aimed to identify variations in s-RPE, training duration, training monotony, training strain, and ACWR during in-season (2017–2018) between player positions in young soccer players.

Specifically, the aim of this study was to describe and compare the temporal (mesocycle and microcycle) and positional variations of perceived internal workload parameters across a full competitive season in elite U-17 soccer players. Based on previous evidence (Nobari, Vahabidelshad, et al., 2021), it was hypothesised that temporal variations across mesocycles and microcycles would be more pronounced than positional differences in perceived internal workload parameters. Given the observational and descriptive nature of this study, the hypothesis was intentionally formulated in general terms to avoid overinterpretation of position-specific effects.

METHODS

Participants

Considering several soccer studies conducted with small sample sizes (Clemente et al., 2017, 2019; Clemente, Silva, Castillo et al., 2020; Fernandes et al., 2021; Martins et al., 2021; Nobari, Alves, et al., 2021; Oliveira et al., 2019b), 17 male U-17 soccer players belonging to a Portuguese elite team participated in this study (age: 16.18 ± 0.27 years old; height: 1.74 ± 0.09 m; body mass: 66.50 ± 3.95 kg; body mass index: 21.94 ± 2.45 kg/m^2; fat free mass: 56.33 ± 2.97 kg; and fat mass percentage: 10.17 ± 3.66%). All players had 5.7 ± 2.1 years of soccer training experience. During the study period, the team participated in the U-17 national championship in Portugal in 2017/2018. Furthermore, to realize the comparisons between playing positions, we divided in: four central defenders (CD), three wide defenders (WD), four central midfielders (CM), three wide midfielders (WM), and three strikers (ST) according to previous studies (Clemente, Silva, Castillo et al., 2020; Clemente, Silva, Ramirez-Campillo et al., 2020; Hasan et al., 2021; Oliveira, Martins, et al., 2021).

The inclusion criteria were regular participation in most of the training sessions (80% of weekly training sessions) (Clemente et al., 2017; Clemente, Silva, Castillo et al., 2020; Oliveira et al., 2019b). The exclusion criteria included: players with prolonged injury or a lack of participation in training sessions for at least two consecutive weeks, and goalkeepers were excluded from the study due to differences in training activities and workload in training and matches (Clemente, Silva, Castillo et al., 2020; Nobari, Oliveira, et al., 2020).

The participants and their parents were informed of the study design as well as the potential risks and benefits of their participation. After being informed and agreeing with the terms of participation, each player and their parent signed informed and private consent. The study design was approved by the Ethics Committee of the Instituto Politécnico de Santarém under number 252020, and ethical standards were ensured in accordance with the Helsinki Declaration of 1975, as revised in 2013, for experiments conducted in humans.

Study design

This investigation is best described as an observational longitudinal study with cross-positional comparisons, following the same cohort of players across an entire competitive season. Players were classified by their primary playing position throughout the season, as defined by the coaching staff. Players who occasionally performed secondary roles were assigned based on their predominant positional role. No outfield players who met the inclusion criteria were excluded; thus, the final sample represents the entire eligible squad.

This study followed a cross-sectional design conducted over 12 months from June 2017 to July 2018 (four weeks during the pre-season and 46 weeks during the in-season). The number of training sessions and competitive matches is shown in Table 1. The team competed in the Portuguese

Table 1. Training sessions and number of competitive matches during the 50 weeks.

Mesocycle (M)	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Phases	Pre-season	Early-season			Mid-season					End-season		
Number of weeks	4	4	4	4	4	4	4	4	4	4	4	6
Training sessions (n)	17	16	15	14	14	14	15	15	9	15	12	12
Training duration, total minutes	1690	2,420	1,334	1,213	1,208	1,209	1,261	1,203	866	1,182	900	1,424
Match duration, total minutes	189	142	190	191	191	158	179	139	87	146	0	237
Number of matches (n)	4*	4	4	4	4	4	4	3	2	3	0	7

*Friendly matches.

U-17 National Championship (top national division) and regularly qualified for the final competitive stage.

Workload data were collected over a 50-week period of competition, during which 53 matches and 168 training sessions occurred during the 2017–2018 season. Only training session data were included in the calculation of s-RPE, TM, TS, and ACWR. Data from competitive matches, rehabilitation, or additional training sessions of recuperation were intentionally excluded (Oliveira et al., 2019b; Oliveira et al., 2020) to ensure methodological consistency with previous training-load monitoring studies that focused exclusively on training exposure. This study did not influence or alter the training sessions in any way. A total of 5,100 individual training observations were collected during the study. Players participated in four training sessions and one match per week during the season [match day minus (MD-), MD-4; MD-3; MD-2, MD, and MD plus 2 (MD+2)]. MD+2 is equivalent to MD-5; however, we opted to use MD+2 because this training session was planned according to the previous match. Also, each month was considered a mesocycle (M). This approach was adapted from previous studies by Oliveira et al. (2019a; 2019b) and Oliveira et al. (2020). Given differences in pre-season microcycles, we designed only a general microcycle schedule and a comparison of each day of the week with MD during the in-season.

Workload monitoring

For workload monitoring, the internal load during pitch training sessions was quantified using the 10-point Borg scale (Foster et al., 2001). Thirty minutes after the end of each training session, the players rated their subjective intensity using an app. The scores provided by the players were also multiplied by the time of the training, in minutes, to obtain a representation of internal load (s-RPE) (Foster et al., 1995; 2001). Players were familiarised with the RPE scale during regular training sessions prior to data collection, following standardised procedures described recently (Oliveira et al., 2025) to ensure consistent understanding and reliable reporting. RPE values were recorded using a customised mobile application routinely used by the team. Familiarisation with the scale occurred over two weeks prior to data collection. Through s-RPE, the following variables were calculated: *i)* TM (mean of training load during the seven days of the week divided by the standard deviation of the training load of the seven days, with no zero load assigned to days without training) (Clemente, Silva, Castillo et al., 2020; Nobari, Aquino, et al., 2020; Nobari, Praça, et al., 2020); *ii*) TS (sum of the training loads for all training sessions during a week multiplied by training monotony) (Clemente, Silva, Castillo et al., 2020; Nobari, Aquino, et al., 2020; Nobari, Praça, et al., 2020); and *iii) ACWR (*dividing the acute workload (1-week rolling workload data) by the chronic workload (the rolling 4-week average workload data) (Dalen-Lorentsen et al., 2020; Impellizzeri, Wookcock, et al., 2020; Myers et al., 2020).

Statistical analysis

Descriptive statistics were used to characterise the sample. The Shapiro-Wilk and Levene tests were applied to assess normality and homogeneity of the data, respectively. Results were presented as mean, standard deviation (SD) and/or coefficient of variation (CV%). After this stage, a mixed-design repeated-measures ANOVA was applied (followed by Tukey HSD post hoc for pairwise comparisons) with playing position as a between-subjects factor and time (mesocycles or training days) as a within-subjects factor, to test the variation of mesocycle and microcycle for all variables (RPE, s-RPE, training duration, TM, TS, and ACWR) between playing positions (CD; WD; CM; WM; ST). Assumptions of normality and homogeneity were generally met. When sphericity was violated, Greenhouse–Geisser corrections were applied.

Tests were performed in IBM SPSS Statistics for Windows (Version 22.0; IBM Corp., Armonk, NY, USA) with $p \leq .05$.

Hedge´s *g* effect size with a 95% confidence interval was also calculated to determine the magnitude of the pairwise comparisons. The Hopkins' (Hopkins et al., 2009) thresholds for effect size statistics were used, as follows: ≤ .2, trivial; > .2, small; > .6, moderate; > 1.2, large; > 2. very large; and > 4, nearly perfect.

The statistical power of 100% was found for a post hoc F-test family (α *level* = .05; *effect size* = 1.2; five groups (playing position); ten mesocycles; and a sample of 17 participants). Then, the procedure was repeated for the post hoc F-test family (α *level* = .05; *effect size* = 1.2; one group and five moments (training and match days); and a sample of 17 participants), which provides an actual power of 100%. All calculations were made through G-Power (Faul et al., 2007).

RESULTS

The following results describe temporal and positional variations in perceived internal workload parameters across mesocycles and within the typical weekly microcycle.

Effect sizes (Hedge's g) with 95% confidence intervals are reported alongside *p*-values for pairwise comparisons.

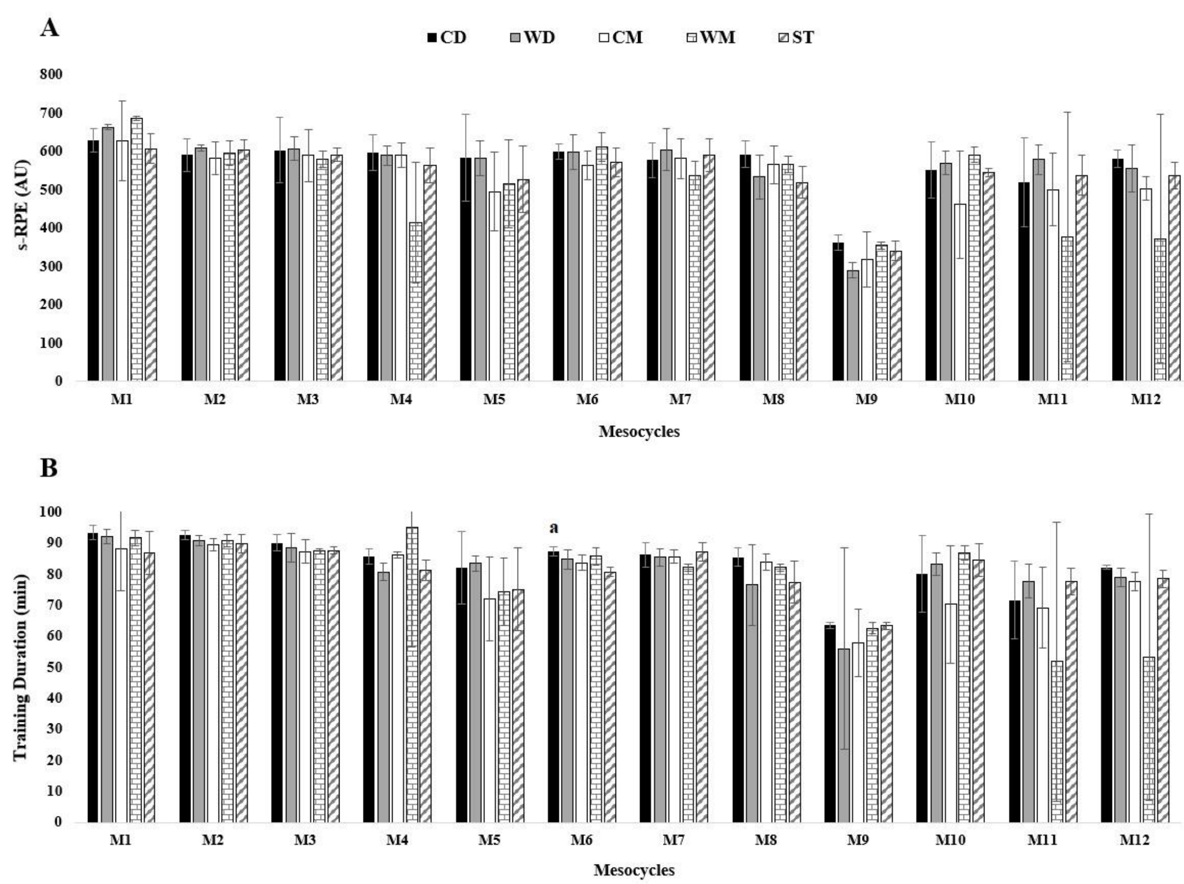
Mesocycle analyses

Overall, the highest s-RPE occurred in pre-season (*WM* = 685.15 ± 6.27 AU) and the lowest s-RPE happened in mid-season (M9) (*WM* = 289.48 ± 20.14 AU). The results indicate that s-RPE remains constant throughout the season, except for the M9 for all positions. The highest duration of training occurred in early-season (M4) (*WM* = 95.12 ± 38.40 AU). The lowest duration of training happened in the end-season (M12) (*WM* = 53.20 ± 46.10 AU). There were significant differences between player positions in M6 for CD vs ST (p = 0.047; *ES* = 4.02 [1.51, 7.96], nearly perfect effect) (Figure 1).

Figure 2 shows that TM was constant for all positions in M1, M2, M4, M5, M7, M9, and M10. The highest TM occurred in M12 (*WD* = 9.36 ± 5.73 AU), and the lowest TM happened in the M11 (*WM* = 2.43 ± 2.14 AU). The within mesocycle coefficient of variation was highest in M10 for CM's (87%) and lowest in M6 for CD's (15%). During the full-season there was an average within mesocycle coefficient of variation of 42% for CD's; 44% for WD; 50% for CM's and WM's; and 44% for ST's.

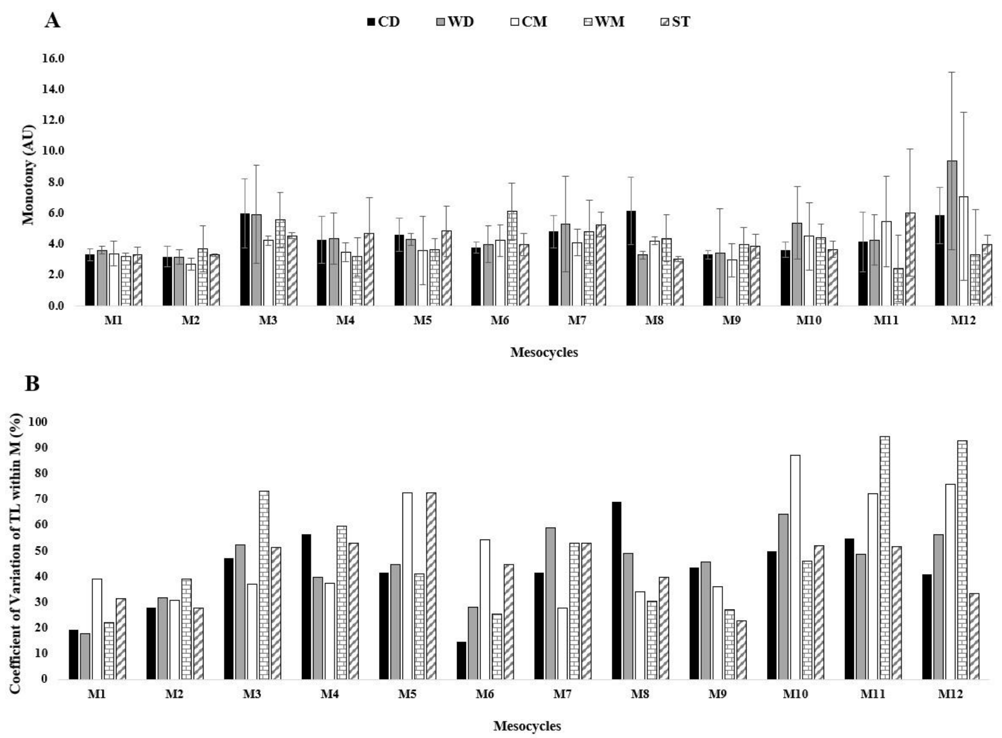
Figure 3 presents that TS was constant for all positions in M1, M2, M4, M9, and M11. The highest TS occurred in the end-season (M10) (*WD* = 10,216.320 ± 7,414.42 AU). The lowest TS happened in the mid-season (M9) (*CM* = 2,447.79 ± 709.92 AU). M12 shows an increase in WD, CM and CD compared to WM and ST (Figure 3). The within mesocycle coefficient of variation was highest in M11 for WM's (96%) and lowest in M1 for WD's and WM's (8%). During the full-season there was an average within mesocycle coefficient of variation of 33% for CD's and WD's; 38% for CM's and WM's; and 32% for ST's.

Figure 4 shows that ACWR remains constant throughout the full-season, between the optimum range (.8–1.3 AU), except in M10 where WD's showed an increase of more than 1.3 AU. The highest ACWR occurred in the end-season (M10) (*WD* = 1.42 ± 0.55 AU). The lowest ACWR happened in the end-season (M11) (*WM* = 0.61 ± 0.53 AU).



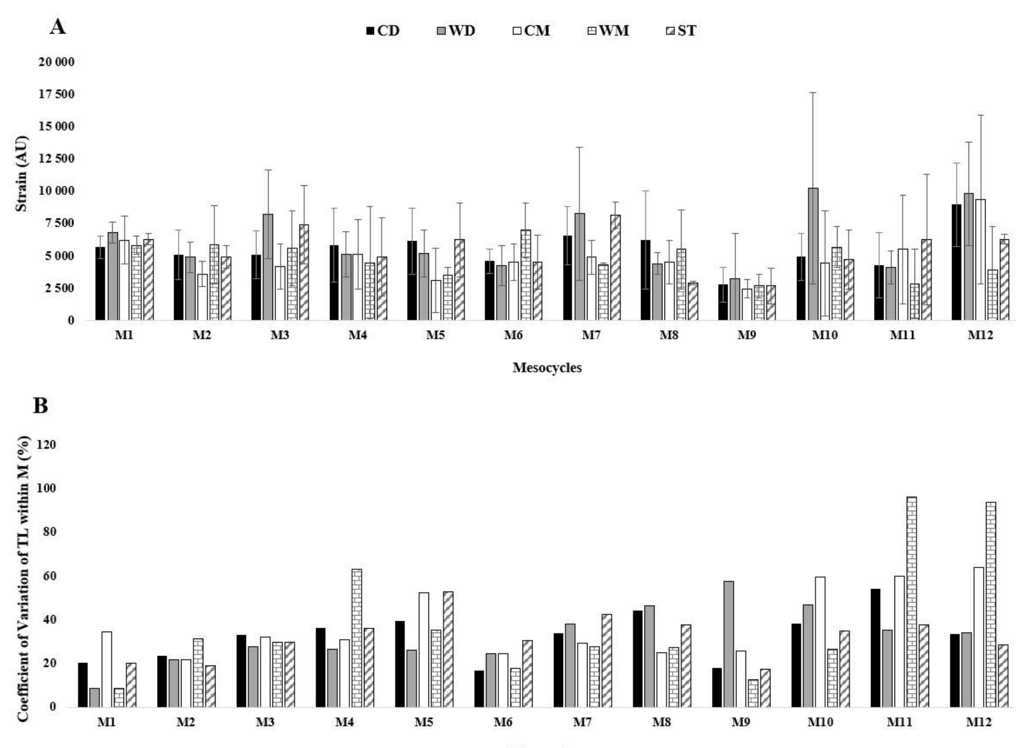
CD: central defenders; WD: wide defenders; CM: central midfielders; WM: wide midfielders; ST: strikers; a: significant difference in CD with ST, all $p \leq .05$.

Figure 1. (A) s-RPE and (B) training duration variations across 12 mesocycles between player positions.



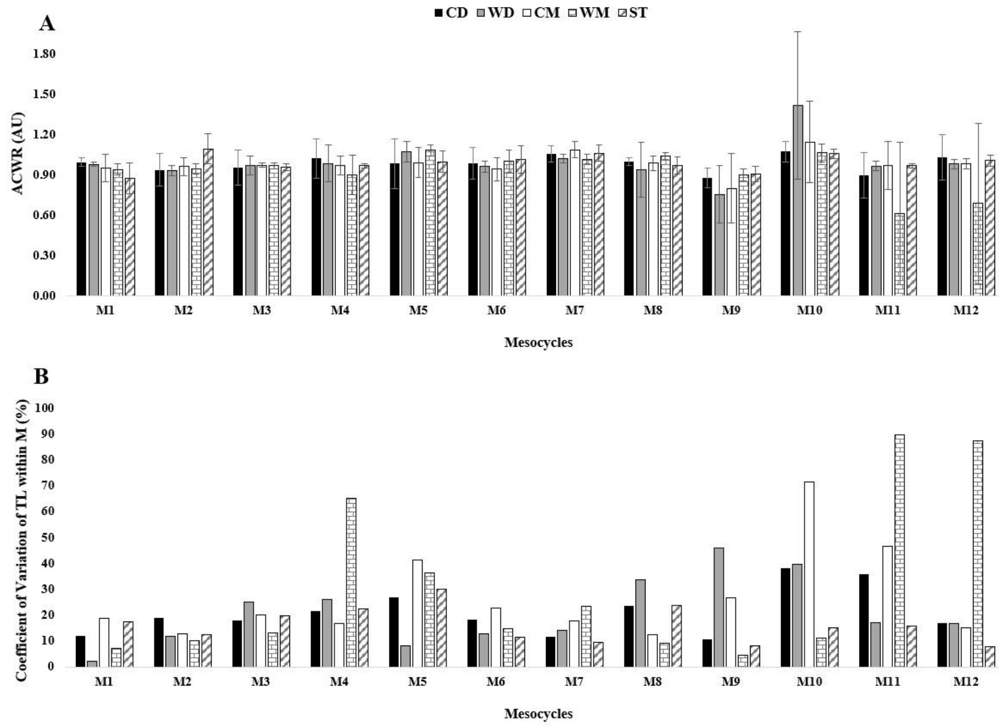
CD: central defenders; WD: wide defenders; CM: central midfielders; WM: wide midfielders; ST: strikers; No significant differences, all $p \leq .05$.

Figure 2. Monotony variations calculated through the s-RPE across 12 mesocycles between (A) player positions and (B) within Mesocycles load variations (CV%) for monotony between player positions.



CD: central defenders; WD: wide defenders; CM: central midfielders; WM: wide midfielders; ST: strikers; No significant differences, all $p \leq .05$.

Figure 3. Strain variations calculated through the s-RPE across 12 mesocycles between (A) player positions and (B) within Mesocycles load variations (CV%) for strain between player positions.



CD: central defenders; WD: wide defenders; CM: central midfielders; WM: wide midfielders; ST: strikers; No significant differences, all $p \leq .05$.

Figure 4. ACWR variations calculated through the s-RPE across 12 mesocycles between (A) player positions and (B) within Mesocycles load variations (CV%) for ACWR between player positions.

The within mesocycle coefficient of variation was highest in M12 for WM's (87%) and lowest in M1 for WD's (2%). During the full-season there was an average within mesocycle coefficient of variation of 21% for CD's and WD's; 27% for CM's; 31% for WM's; and 16% for ST's.

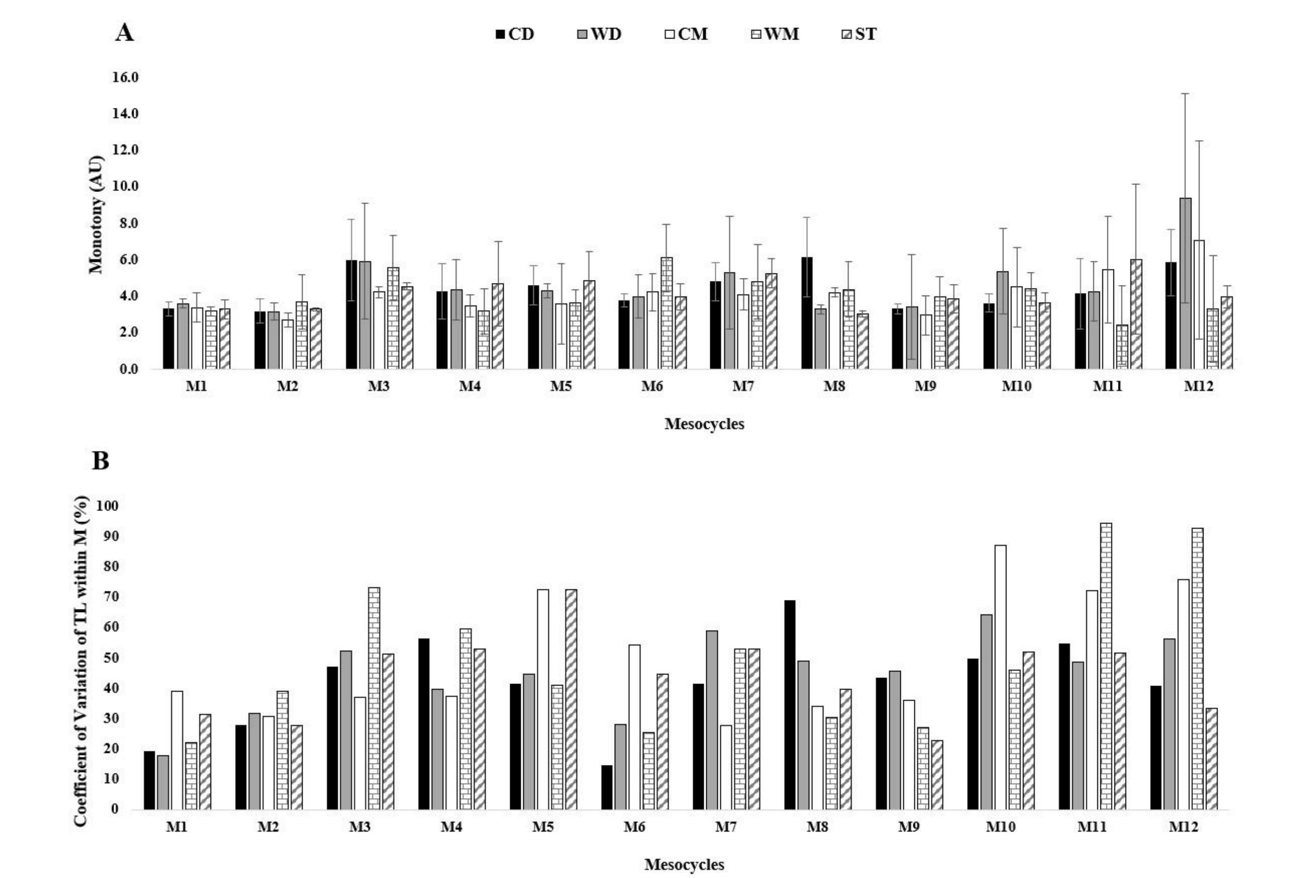
Microcycle analysis

Figure 5 displayed the general microcycle plan and comparisons between every weekday with MD in RPE, training duration, and s-RPE during in-season by playing position. No additional significant differences between playing positions were observed beyond those reported.

MD+2 presented significant differences with MD-4 ($p < .01$; *ES* = -4.02 [-5.32, -2.90], nearly perfect effect), MD-3 ($p < .01$; *ES* = -4.68 [-6.13, -3.43], nearly perfect effect) and MD ($p < .01$; *ES* = -5.01 [-6.54, -3.70], nearly perfect effect). MD-4 presented significant differences with MD-3 (p<0.01; ES = -1.59 [-2.41, -0.84], large effect), MD-2 ($p = .001$; *ES* = 3.81 [2.73, 5.06], very large effect) and MD ($p = .001$; *ES* = -2.53 [-3.50, -1.66], very large effect). MD-3 presented significant differences with MD-2 ($p = .001$; *ES* = 4.56 [3.34, 5.98], very large effect) and MD ($p = .014$; *ES* = -1.39 [-2.18, -0.67], large effect). Finally, MD-2 presented significant differences with MD ($p < .01$; *ES* = -4.83 [-6.32, -3.56], nearly perfect effect).

MD+2 presented significant differences with MD-4 ($p < .01$; *ES* = -4.07 [-5.38, -2.94], nearly perfect effect), MD-3 ($p < .01$; *ES* = -4.36 [-5.74, -3.18], nearly perfect effect), MD-2 ($p = .001$; *ES* = -1.85 [-2.69, -1.06], large effect) and MD ($p < .01$; *ES* = 3.43 [2.42, 4.60], very large effect). MD-4 presented significant differences with MD-2 ($p < .01$; *ES* = 7.81 [5.92, 10.05], nearly perfect effect) and MD ($p < .01$; *ES* = 7.26 [5.49, 9.36], nearly perfect effect). MD-3 presented significant differences with MD-2 ($p < .01$; *ES* = 10.51 [8.05, 13.40], nearly perfect effect) and MD ($p < .01$; *ES* = 7.49 [5.68, 9.65], nearly perfect effect). Finally, MD-2 presented significant differences with MD ($p < .01$; *ES* = 5.62 [4.19, 7.31], nearly perfect effect).

MD+2 presented significant differences with MD-4 ($p < .01$; *ES* = -4.35 [-5.72, -3.17], nearly perfect effect), MD-3 ($p < .01$; *ES* = -4.94 [-6.45, -3.64], nearly perfect effect) and MD-2 ($p = .042$; *ES* = -1.04 [-1.78, -0.34], moderate effect). MD-4 presented significant differences with MD-3 ($p < .01$; *ES* = -1.70 [-2.54, -0.94], large effect), MD-2 ($p < .01$; *ES* = 5.14 [3.80, 6.71], nearly perfect effect) and MD ($p < .01$; *ES* = 3.48 [2.45, 4.65], nearly perfect effect). Finally, MD-3 presented significant differences with MD-2 ($p < .01$; *ES* = 5.80 [4.33, 7.52], nearly perfect effect) and MD ($p < .01$; *ES* = 4.09 [2.96, 5.41], nearly perfect effect).



CD: central defenders; WD: wide defenders; CM: central midfielders; WM: wide midfielders; ST: strikers; a: significant difference in MD-4; b: significant difference in MD-3; c: significant difference in MD; d: significant difference in MD-2, all $p \leq .05$.

Figure 5. Workload during in-season for (A) RPE, (B) training duration, and (C) s-RPE in respect to days before a competitive match between player positions.

DISCUSSION

The purposes of the study were to identify variations in s-RPE, training duration, training monotony (TM), training strain (TS), and acute chronic workload ratio (ACWR) across player positions during the full season. The main results were: i) the highest values were verified in the pre-season for s-RPE, early-season for training duration (WM in M4), and end-season for TM (WD in M12), TS and ACWR (WD in M12); ii) the lowest load values were found in the mid-season for s-RPE (WM in M9), end-season for training duration (WM in M12), and end-season for TS (CM in M9), TM (WM in M11), and ACWR (WM in M11); iii) significant differences were observed in training duration between playing position in the M6 (CD and ST); and iv) the MD-3 have the highest values for all workload variables verified in the week, and MD+2 has the lowest load values in the week. In fact, in the present study, the major differences occurred between training days of the typical microcycle, and very few significant differences occurred between player positions on mesocycles, which is in line with a recent study (Nobari, Vahabidelshad, et al., 2021). Moreover, a recent systematic review concluded that playing position seems to have a minimal effect on the weekly training intensity of young players. However, the inclusion of only eight studies in that review (Oliveira, Brito, et al., 2021) likely reflects strict eligibility criteria and the scarcity of longitudinal youth research, which limits the strength but not the relevance of the conclusions. This result reinforces the need to quantify and monitor training load in young soccer players, even with inexpensive methods, as they are easily implemented in clubs and have been shown to be reliable and valid (Foster et al., 2001; Impellizzeri, Wookcock, et al., 2020).

The results indicate a large decrease for all variables in M9. It is important to highlight that this team achieved the main goal of the season in M9, which was to be included in the last stage of the season. Of the 48 teams, only 6 were included in this stage. Given this scenario, the coach assigned a week off to the whole team (week 34) to reward the achievement, to promote a complete recovery, and to motivate the team for the rest of the season.

This is one of the first studies to report the total volume of training sessions in young soccer players during a full season. In total, the players trained 15,910 minutes during 12 mesocycles. The information in the literature regarding the training duration in U-17 soccer players is still not clear (Verstappen et al., 2021), and no study reported these values (Dalen & Lorås, 2019; Marynowicz et al., 2020; Nobari, Aquino, et al., 2020; Raya-González et al., 2019). In this regard, the present study provides relevant information on training duration, which ranged from 85 to 99 minutes during the first two weeks. In addition, the training duration between M2 and M4 was around 90 minutes. From M10 until M12, training duration decreased for all players (69–80 minutes) because the level of the opponents was higher, and the coach decreased training volume, probably to provide higher recovery to the team. Those values seem to be in line with data from under-16 to under-18, which revealed a range interval between 70-117 minutes (Oliveira, Brito, et al., 2021).

Numerous studies have shown that the RPE scale is one of the most practical and accessible methods for monitoring internal load for intensity and load training sessions (Nobari, Aquino, et al., 2020; Nobari, Oliveira, et al., 2020; Raya-González et al., 2019). This study reports the highest RPE value of 6.80 ± .93 AU during the full season across all positions, which is not in line with the study by Marynowicz et al. (2020), which reported an average value of 4.6 ± 1.90 AU. Even so, one study conducted with under-16 and under-18 players showed ranges of 6.3–6.6 AU, respectively (Wrigley et al., 2012). Discrepancies may stem from differences in competitive calendars, training philosophies, and data-collection protocols.

Moreover, the s-RPE values during the pre-season (M1) varied between 686.15 AU and 606.97 AU for WM, while during the in-season, they ranged from 289.48 AU for WD (M9) to 612.20 AU for WM (M6). These values are in line with the only study of the authors' knowledge that quantified a full season (141 vs 168 training sessions in the present study) and reported average values of 485.86 AU during pre-season and 571.66 AU during in-season (Raya-González et al., 2019).

Our study is consistent with previous studies that have not reported differences in training workload parameters during full-season mesocycles for young soccer players (Nobari, Aquino, et al., 2020; Nobari, Vahabidelshad, et al., 2021). The present study showed high absolute values of TS (2,447.79–10,216.320 AU) compared to Iran's elite U-16 soccer players (1,196–1,735 AU) (Nobari, Aquino, et al., 2020) or another study from Iran's elite U-16 soccer players (1,309–1,505 AU) (Nobari, Vahabidelshad, et al., 2021) (all studies approximately included 4–5 training sessions and one match per week during the in-season). This difference in absolute value for TS may be related to different competition demands between continents (Asia vs. Europe) and with the preparation level of the athletes, although the athletes analysed in this study presented 16.2 years and 66.5 kg, while the athletes analysed by Nobari, Aquino, et al. (2020) presented 15 years and 64.2 kg, and Nobari, Vahabidelshad, et al. (2021) presented 15 years old and 61.4 kg. Thus, all three studies could be used as references for intensity control in their specific context (Europe vs. Asia, methodological differences), respectively.

This study provided similar results on TM and ACWR in relation to other studies (Nobari, Aquino, et al., 2020; Nobari, Vahabidelshad, et al., 2021). However, the present study covers a full season (50 weeks), whereas both Iranian studies cover only 20 weeks. The fact that the TM and ACWR values observed in the present study remain similar to those reported in investigations with shorter, advantageous follow-up periods suggests a relative temporal stability of these indicators over a complete period. This stability may reflect structural patterns of training organisation, associated with consistent periodisation models, and reinforce the practical applicability of TM and ACWR as tools for longitudinal monitoring of training load, rather than as indicators sensitive to isolated weekly variations.

Some studies reported that MD-3 presented the highest s-RPE values for senior professional soccer players (Malone et al., 2015; Oliveira et al., 2019b) and U19 soccer players (Querido & Clemente, 2020). One study in under-17 soccer player also showed the same results (*WD* = ~385; *CD* = ~390; *CM* = ~400; *WM* = ~400; *ST* = ~395 AU). In this sense, our results showed the highest s-RPE in MD-3 (*WD* = 741.53 AU vs *WM* = 690.43 AU) and MD-4 (*CD* = 695.40 AU vs *WM* = 655.37 AU) and higher values were found when compared with the previous study (Nobari, Vahabidelshad, et al., 2021). Higher-intensity training these days can be effective in eliciting physiological adaptations in soccer-specific endurance (Stølen et al., 2005). After MD, reducing the s-RPE in the MD+2 (recovery session), which can lead to ensure the optimal recovery of athletes, which in the present study also shows a reduction in training load applied by strength and conditioning coaches, which seems to be convergent with a tapering strategy based on a gradual reduction until the last day before the match (Brito et al., 2016). We speculate that a decrease in high-speed running and sprint distances when the match came close could be associated with such results (Hannon et al., 2021). However, this tendency was not always confirmed in young soccer players (e.g., sprint distance) (Teixeira et al., 2021). Some studies (Brito et al., 2016; Teixeira et al., 2021) also stated that some coaches use sprints and accelerations for pre-match neuromuscular activation, which could justify the present results.

Although there were no differences among playing positions, these results provide new insights for strength and conditioning coaches and exercise physiologists on managing optimal workloads over a season at the elite youth level, particularly for U-17 players.

In addition, our results showed the highest training duration in MD-3 (97–96 minutes) and MD-4 (96–95 minutes) revealed to be the days with higher training duration, which are in line with some studies that analyzed senior professional soccer players (Oliveira et al., 2019a; 2019b; Oliveira et al., 2020), U-19 soccer players (Delecroix et al., 2019; Querido & Clemente, 2020) and U-18 (Oliveira, Brito, et al., 2021) and U-16 (Oliveira, Brito, et al., 2021). The rationale for a similar training duration to that of older soccer players is that young players need to be physically prepared for the demands of senior soccer, and it is speculated that they will improve faster with a longer training duration.

Despite the new insights this study provides, some limitations should be addressed. The small number of players and teams in the present study is also a constant in soccer studies, as previously reported by Clemente, Silva, Castillo et al. (2020). Also, only RPE was used to quantify training load, which may have constrained the accurate quantification of physiological responses to training and matches. Another limitation of this study is the lack of external load information using GPS data, which could be improved to support the qualified findings of this study. Finally, this study failed to include additional physical tests, body composition assessment, and control of nutritional habits, which would contribute to better monitoring of the players over the season and are recommended for future studies. An additional limitation of the present study is the absence of biological maturation indicators. Although maturation status is known to influence training load responses in youth athletes, such data were not systematically collected at the time of the study and should be addressed in future research.

Practical applications

This study highlights the need for coaches and their technical staff to quantify training load in young teams. This way, it is possible to prevent overtraining and, ultimately, to avoid injuries. This study also shows that load indicators can be quantified using low-cost, easy-to-apply tools (e.g., the RPE scale and the s-RPE method).

Finally, this article provides a supplement (Excel file) that will allow coaches and technical staff to quickly and easily calculate the parameters under study (i.e., monotony, strain, and ACWR).

CONCLUSIONS

In the specific context investigated, the present findings suggest that position-specific load differentiation may not be a primary consideration in U-17 training periodisation, although other individualisation criteria, such as maturation status, training history, or injury risk, warrant further investigation.

Perceived internal workload parameters showed limited variation between playing positions but demonstrated clear temporal patterns across mesocycles and within the weekly microcycle structure. Therefore, our initial hypothesis regarding differences in training workload variables by player position cannot be fully confirmed. Thus, our study shows that planning mesocycles and microcycles based on players' positions is not effective, and there may be other, more efficient criteria that this study did not address. Ultimately, the typical microcycle distribution scheme for every weekday with MD in this study provides a deeper understanding of the variation in daily loads among young soccer players across different playing positions.

ACKNOWLEDGMENTS

We would like to thank the players, coach, and staff for their collaboration, which will increase young soccer players' knowledge of soccer science.

REFERENCES

Brito, J., Hertzog, M., & Nassis, G. P. (2016). Do match-related contextual variables influence training load in highly trained soccer players? *Journal of Strength and Conditioning Research*, *30*(2), 393–399. https://doi.org/10.1519/JSC.0000000000001113

Clemente, F. M., Clark, C., Castillo, D., Sarmento, H., Nikolaidis, P. T., Rosemann, T., & Knechtle, B. (2019). Variations of training load, monotony, and strain and dose-response relationships with maximal aerobic speed, maximal oxygen uptake, and isokinetic strength in professional soccer players. *PLOS One*, *14*(12), Article e0225522. https://doi.org/10.1371/journal.pone.0225522

Clemente, F. M., Mendes, B., Nikolaidis, P. T., Calvete, F., Carriço, S., & Owen, A. L. (2017). Internal training load and its longitudinal relationship with seasonal player wellness in elite professional soccer. *Physiology & Behavior*, *179*, 262–267. https://doi.org/10.1016/j.physbeh.2017.06.021

Clemente, F. M., Silva, R., Castillo, D., Los Arcos, A., Mendes, B., & Afonso, J. (2020). Weekly load variations of distance-based variables in professional soccer players: a full-season study. *International Journal of Environmental Research and Public Health*, *17*(9), 3300. https://doi.org/10.3390/ijerph17093300

Clemente, F. M., Silva, R., Ramirez-Campillo, R., Afonso, J., Mendes, B., & Chen, Y.-S. (2020). Accelerometry-based variables in professional soccer players: Comparisons between periods of the season and playing positions. *Biology of Sport*, *37*, 389–403. https://doi.org/10.5114/biolsport.2020.96852

Dalen, T., & Lorås, H. (2019). Monitoring training and match physical load in junior soccer players: starters versus substitutes. *Sports*, *7*(3), Article 70. https://doi.org/10.3390/sports7030070

Dalen-Lorentsen, T., Bjørneboe, J., Clarsen, B., Vagle, M., Fagerland, M. W., & Andersen, T. E. (2020). Does load management using the acute:chronic workload ratio prevent health problems? A cluster randomised trial of 482 elite youth footballers of both sexes. *British Journal of Sports Medicine*, *55*(2), 108–114. https://doi.org/10.1136/bjsports-2020-103003

Delecroix, B., Mccall, A., Dawson, B., Berthoin, S., & Dupont, G. (2019). Workload monotony, strain and non-contact injury incidence in professional football players. *Science and Medicine in Football*, *3*(2), 105–108. https://doi.org/10.1080/24733938.2018.1508881

Enright, K., Green, M., Hay, G., & Malone, J. J. (2020). Workload and Injury in professional soccer players: role of injury tissue type and injury severity. *International Journal of Sports Medicine*, *41*(2), 89–97. https://doi.org/10.1055/a-0997-6741

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/bf03193146

Fernandes, R., Oliveira, R., Martins, A., & Brito, J. (2021). Internal training and match load quantification of one-match week schedules in female first league Portugal soccer team. *Cuadernos de Psicología del Deporte*, *21*(3), 126–138. https://doi.org/10.6018/cpd.469141

Foster, C. (1998). Monitoring training in athletes with reference to overtraining syndrome. *Medicine & Science in Sports & Exercise*, *30*(7), 1164–1168. https://doi.org/10.1097/00005768-199807000-00023

Foster, C., Florhaug, J. A., Franklin, J., Gottschall, L., Hrovatin, L. A., Parker, S., Doleshal, P., & Dodge, C. (2001). A new approach to monitoring exercise training. *Journal Strength Condition Research*, *15*(1), 109-115. https://doi.org/10.1519/00124278-200102000-00019

Foster, C., Hector, L., Welsh, R., Schrager, M., Green, M., & Snyder, A. (1995). Effects of specific versus cross-training on running performance. *European Journal of Applied Physiology and Occupational Physiology*, *70*, 367–372. https://doi.org/10.1007/BF00865035

Gabbett, T. J. (2016). The training—injury prevention paradox: Should athletes be training smarter *and* harder? *British Journal of Sports Medicine*, *50*(5), 273–280. https://doi.org/10.1136/bjsports-2015-095788

Haddad, M., Stylianides, G., Djaoui, L., Dellal, A., & Chamari, K. (2017). Session-RPE method for training load monitoring: validity, ecological usefulness, and influencing factors. *Frontiers in Neuroscience*, *11*, Article 612. https://doi.org/10.3389/fnins.2017.00612

Hannon, M. P., Coleman, N. M., Parker, L. J. F., McKeown, J., Unnithan, V. B., Close, G. L., Drust, B., & Morton, J. P. (2021). Seasonal training and match load and micro-cycle periodization in male Premier League academy soccer players. *Journal of Sports Sciences*, *39*(16), 1838–1849. https://doi.org/10.1080/02640414.2021.1899610

Hasan, U. C., Silva, R., & Clemente, F. (2021). Weekly variations of biomechanical load variables in professional soccer players: Comparisons between playing positions. *Human Movement*, *22*(3), 19–34. https://doi.org/10.5114/hm.2021.100321

Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hanin, J. (2009). Progressive statistics for studies in sports medicine and exercise science. *Medicine & Science in Sports & Exercise*, *41*(1), 3–12. https://doi.org/10.1249/MSS.0b013e31818cb278

Impellizzeri, F. M., Tenan, M. S., Kempton, T., Novak, A., & Coutts, A. J. (2020). Acute:chronic workload ratio: conceptual issues and fundamental pitfalls. *International Journal of Sports Physiology and Performance*, *15*(6), 907–913. https://doi.org/10.1123/ijspp.2019-0864

Impellizzeri, F. M., Ward, P., Coutts, A. J., Bornn, L., & McCall, A. (2020a). Training load and injury part 1: the devil is in the detail-challenges to applying the current research in the training load and injury field. *Journal of Orthopaedic and Sports Physical Therapy*, *50*(10), 574–576. https://doi.org/10.2519/jospt.2020.9675

Impellizzeri, F. M., Ward, P., Coutts, A. J., Bornn, L., & McCall, A. (2020b). Training load and injury part 2: questionable research practices hijack the truth and mislead well-intentioned clinicians. *Journal of Orthopaedic and Sports Physical Therapy*, *50*(10), 577–584. https://doi.org/10.2519/jospt.2020.9211

Impellizzeri, F. M., Wookcock, S., Coutts, A. J., Fanchini, M., McCall, A., & Vigotsky, A. D. (2020). *Acute to random workload ratio is 'as' associated with injury as acute to actual chronic workload ratio: Time to dismiss ACWR and its components* [Preprint]. SportRxiv. https://doi.org/10.31236/osf.io/e8kt4

Malone, J. J., Di Michele, R., Morgans, R., Burgess, D., Morton, J. P., & Drust, B. (2015). Seasonal training-load quantification in elite english premier league soccer players. *International Journal of Sports Physiology and Performance*, *10*(4), 489–497. https://doi.org/10.1123/ijspp.2014-0352

Martins, A. D., Oliveira, R., Brito, J. P., Loureiro, N., Querido, S. M., & Nobari, H. (2021). Intra-season variations in workload parameters in europe's elite young soccer players: a comparative pilot study between starters and non-starters. *Healthcare*, *9*(8), Article 977. https://doi.org/10.3390/healthcare9080977

Marynowicz, J., Kikut, K., Lango, M., Horna, D., & Andrzejewski, M. (2020). Relationship between the session-RPE and external measures of training load in youth soccer training. *Journal of Strength and Conditioning Research*, *34*(10), 2800–2804. https://doi.org/10.1519/JSC.0000000000003785

Miguel, M., Oliveira, R., Loureiro, N., García-Rubio, J., & Ibáñez, S. J. (2021). Load measures in training/match monitoring in soccer: a systematic review. *International Journal of Environmental Research and Public Health*, *18*(5), Article 2721. https://doi.org/10.3390/ijerph18052721

Myers, N. L., Aguilar, K. V., Mexicano, G., Farnsworth, J. L., Knudson, D., & Kibler, W. B. (2020). The acute: chronic workload ratio is associated with injury in junior tennis players. *Medicine & Science in Sports & Exercise*, *52*(5), 1196–1200. https://doi.org/10.1249/MSS.0000000000002215

Nobari, H., Alves, A. R., Haghighi, H., Clemente, F. M., Carlos-Vivas, J., Pérez-Gómez, J., & Ardigò, L. P. (2021). Association between training load and well-being measures in young soccer players during a season. *International Journal of Environmental Research and Public Health*, *18*(9), Article 4451. https://doi.org/10.3390/ijerph18094451

Nobari, H., Aquino, R., Clemente, F. M., Khalafi, M., Adsuar, J. C., & Pérez-Gómez, J. (2020). Description of acute and chronic load, training monotony and strain over a season and its relationships with well-being status: A study in elite under-16 soccer players. *Physiology & Behavior*, *225*, Article 113117. https://doi.org/10.1016/j.physbeh.2020.113117

Nobari, H., Oliveira, R., Clemente, F. M., Adsuar, J. C., Pérez-Gómez, J., Carlos-Vivas, J., & Brito, J. P. (2020). Comparisons of accelerometer variables training monotony and strain of starters and non-starters: a full-season study in professional soccer players. *international Journal of Environmental Research and Public Health*, *17*(18), Article 6547. https://doi.org/10.3390/ijerph17186547

Nobari, H., Praça, G. M., Clemente, F. M., Pérez-Gómez, J., Carlos Vivas, J., & Ahmadi, M. (2020). Comparisons of new body load and metabolic power average workload indices between starters and non-starters: A full-season study in professional soccer players. *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology*, *235*(2), 105–113. https://doi.org/10.1177/1754337120974873

Nobari, H., Vahabidelshad, R., Pérez-Gómez, J., & Ardigò, L. P. (2021). Variations of Training workload in micro- and meso-cycles based on position in elite young soccer players: a competition season study. *Frontiers in Physiology*, *12*, Article 668145. https://doi.org/10.3389/fphys.2021.668145

Oliveira, R., Brito, J. P., Loureiro, N., Padinha, V., Ferreira, B., & Mendes, B. (2020). Does the distribution of the weekly training load account for the match results of elite professional soccer players? *Physiology & Behavior*, *225*, Article 113118. https://doi.org/10.1016/j.physbeh.2020.113118

Oliveira, R., Brito, J., Martins, A., Mendes, B., Calvete, F., Carriço, S., Ferraz, R., & Marques, M. C. (2019a). In-season training load quantification of one-, two- and three-game week schedules in a top European professional soccer team. *Physiology & Behavior*, *201*, 146–156. https://doi.org/10.1016/j.physbeh.2018.11.036

Oliveira, R., Brito, J. P., Martins, A., Mendes, B., Marinho, D. A., Ferraz, R., & Marques, M. C. (2019b). In-season internal and external training load quantification of an elite European soccer team. *Plos One*, *14*(4), Article e0209393. https://doi.org/10.1371/journal.pone.0209393

Oliveira, R., Brito, J. P., Moreno-Villanueva, A., Nalha, M., Rico-González, M., & Clemente, F. M. (2021). Reference values for external and internal training intensity monitoring in young male soccer players: a systematic review. *Healthcare*, *9*(11), Article 1567. https://doi.org/10.3390/healthcare9111567

Oliveira, R., Fernandes, R., Dinis, M., Ferreira, F., Brito, J.P. (2025). Analysis of internal training load variation over ten microcycles of the preparatory and competitive periods in a european youth football team. *Motricidade*, *21*, Article e41836. https://doi.org/10.6063/motricidade.41836

Oliveira, R., Martins, A., Moreno-Villanueva, A., P. Brito, J., Nalha, M., Rico-González, M., & Clemente, F. M. (2022). Reference values for external and internal training intensity monitoring in professional male soccer players: A systematic review. *International Journal of Sports Science & Coaching*, *17*(6), 1506–1530. https://doi.org/10.1177/17479541211072966

Oliveira, R., Martins, A., Nobari, H., Nalha, M., Mendes, B., Clemente, F. M., & Brito, J. P. (2021). In-season monotony, strain and acute/chronic workload of perceived exertion, global positioning system running based variables between player positions of a top elite soccer team. *BMC Sports Science, Medicine and Rehabilitation*, *13*(1), Article 126. https://doi.org/10.1186/s13102-021-00356-3

Palucci Vieira, L. H., Carling, C., Barbieri, F. A., Aquino, R., & Santiago, P. R. P. (2019). Match running performance in young soccer players: a systematic review. *Sports Medicine*, *49*(2), 289–318. https://doi.org/10.1007/s40279-018-01048-8

Querido, S. M., & Clemente, F. M. (2020). Analyzing the effects of combined small-sided games and strength and power training on the fitness status of under-19 elite football players. *Journal of Sports Medicine and Physical Fitness*, *60*(1). https://doi.org/10.23736/S0022-4707.19.09818-9

Raya-González, J., Nakamura, F. Y., Castillo, D., Yanci, J., & Fanchini, M. (2019). Determining the relationship between internal load markers and noncontact injuries in young elite soccer players. *International Journal of Sports Physiology and Performance*, *14*(4), 421–425. https://doi.org/10.1123/ijspp.2018-0466

Rico-González, M., González Fernández, F. T., Oliveira, R., & Clemente, F. M. (2024). Acute:chronic workload ratio and training monotony variations over the season in professional soccer: A systematic review. *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology*, *238*(4), 401–416. https://doi.org/10.1177/17543371231194283

Rico-González, M., Oliveira, R., González Fernández, F. T., & Clemente, F. M. (2023). Acute:chronic workload ratio and training monotony variations over the season in youth soccer players: A systematic review. *International Journal of Sports Science & Coaching*, *18*(4), 1333–1341. https://doi.org/10.1177/17479541221104589

Soligard, T., Schwellnus, M., Alonso, J.-M., Bahr, R., Clarsen, B., Dijkstra, H. P., Gabbett, T., Gleeson, M., Hägglund, M., Hutchinson, M. R., Janse van Rensburg, C., Khan, K. M., Meeusen, R., Orchard, J. W., Pluim, B. M., Raftery, M., Budgett, R., & Engebretsen, L. (2016). How much is too much? (Part 1) International Olympic Committee consensus statement on load in sport and risk of injury. *British Journal of Sports Medicine*, *50*(17), 1030–1041. https://doi.org/10.1136/bjsports-2016-096581

Stølen, T., Chamari, K., Castagna, C., & Wisløff, U. (2005). Physiology of soccer: An update. *Sports Medicine*, *35*(6), 501–536. https://doi.org/10.2165/00007256-200535060-00004

Teixeira, J. E., Forte, P., Ferraz, R., Leal, M., Ribeiro, J., Silva, A. J., Barbosa, T. M., & Monteiro, A. M. (2021). Quantifying sub-elite youth football weekly training load and recovery variation. *Applied Sciences*, *11*(11), Article 4871. https://doi.org/10.3390/app11114871

Verstappen, S., van Rijn, R. M., Cost, R., & Stubbe, J. H. (2021). The association between training load and injury risk in elite youth soccer players: a systematic review and best evidence synthesis. *Sports Medicine - Open*, *7*(1), Article 6. https://doi.org/10.1186/s40798-020-00296-1

Wrigley, R., Drust, B., Stratton, G., Scott, M., & Gregson, W. (2012). Quantification of the typical weekly in-season training load in elite junior soccer players. *Journal of Sports Sciences*, *30*(15), 1573–1580. https://doi.org/10.1080/02640414.2012.709265