Seasonal Training-Load Quantification in Elite English Premier League Soccer Players

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Purpose: To quantify the seasonal training load completed by professional soccer players of the English Premier League. Methods: Thirty players were sampled (using GPS, heart rate, and rating of perceived exertion [RPE]) during the daily training sessions of the 2011–12 preseason and in-season period. Preseason data were analyzed across 6 × 1-wk microcycles. In-season data were analyzed across 6 × 6-wk mesocycle blocks and 3 × 1-wk microcycles at start, midpoint, and end-time points. Data were also analyzed with respect to number of days before a match. Results: Typical daily training load (ie, total distance, high-speed distance, percent maximal heart rate [%HRmax], RPE load) did not differ during each week of the preseason phase. However, daily total distance covered was 1304 (95% CI 434–2174) m greater in the 1st mesocycle than in the 6th. %HRmax values were also greater (3.3%, 1.3–5.4%) in the 3rd mesocycle than in the 1st. Furthermore, training load was lower on the day before match (MD-1) than 2 (MD-2) to 5 (MD-5) d before a match, although no difference was apparent between these latter time points. Conclusions: The authors provide the 1st report of seasonal training load in elite soccer players and observed that periodization of training load was typically confined to MD-1 (regardless of mesocycle), whereas no differences were apparent during MD-2 to MD-5. Future studies should evaluate whether this loading and periodization are facilitative of optimal training adaptations and match-day performance.

Keywords: soccer training, team sport, GPS, heart rate, periodization

The evolving nature of professional soccer has led to the requirement for a scientific background to training planning and structure. With this demand has followed an increase in the popularization of monitoring player activities quantitatively on a daily basis. The combination of factors that can be manipulated for training planning, that is, volume and intensity, is commonly referred to in soccer as training load (TL).1 TL can be divided into 2 separate subsections termed external and internal TL. The external load refers to the specific training prescribed by coaches, while internal load refers to the individual physiological response to the external stressor.2 Due to the unstructured movement patterns associated with soccer training, the likelihood that players will receive TLs that are associated with their individual requirements is limited. This has resulted in an increased demand for applied objective and subjective data to monitor the TL and subsequent response to maximize performance.

In recent years, the integrated use of technology to monitor TL has grown exponentially in both soccer and other sports. Initially soccer teams were limited to the use of subjective scales to monitor TL, in particular the use of the rating-of-perceived-exertion (RPE) scale initially developed by Borg.3 This was followed by the use of heart-rate (HR) telemetry, which allowed practitioners to measure the cardiovascular response to a given exercise session. However, both of these measures only provide an indication of the internal response of a player, with a lack of quantification of the external work performed to attain such a response. This gap in the TL-monitoring conundrum led to the development of athlete-tracking systems that have allowed practitioners to analyze external load in team sports. Examples of such systems include semiautomated multicamera systems, local positioning systems, and global positioning systems (GPS). In modern soccer, teams will typically employ a combination of these methods to quantify both the external and internal TL. This growth in the amount of data available to practitioners has led to an increased amount of research focusing on TL quantification using such methods.

Of the current available research literature on TL quantification in soccer, the body of work has focused on either individual training drills or short periods of a training program. A popular topic at present relates to the quantification of small-sided games under a variety of conditions. Recent studies have used a combination of methods to quantify such drills, including HR telemetry4,5 and GPS.6–8 Other studies have attempted to quantify TL across multiple sessions. The majority of this work has been carried out during the in-season phase, which includes short training microcycles of 1 to 2 weeks,1,9,10 mesocycles consisting of 4 to 10 weeks,11–14 and longer training blocks of 3 to 4 months.5,15 Some work has also attempted to quantify the TL across the preseason phase17 and also compare the TLs experienced during the preseason and in-season phases.18 However the majority of these studies only provide limited information regarding the TL, using duration and RPE load (RPE × session duration) without the inclusion of HR and GPS data. In addition, no study has attempted to quantify TL with respect to changes between mesocycles and microcycles (both overall and between player positions) across a full competitive season. There is also currently limited information relating to TL in elite soccer players.
(ie, those who play in the highest-level professional leagues), with the majority of previous work conducted using adolescent soccer players. This is an important factor as the physiology of elite soccer players differs significantly from those of a lower standard.19

Due to the lack of current data available in elite soccer players, the periodization practices of elite teams is currently unknown. Anecdotally, teams will often employ a coach’s own training philosophy based on years of coaching experience. However, it is unknown whether the periodization practices adopted demonstrate variation in TL that is typically associated with existing periodization practices.20 In addition, the differences in TL between playing positions has yet to be fully established in the literature, with positional-difference information limited to match-play data.21

Therefore, the purpose of this study was to quantify the TL employed by an elite professional soccer team across an annual season including both the preseason and in-season phases using current applied monitoring methods. The study aimed to investigate the TL performed by English Premier League players, as such data are not currently available in the literature.

Methods

Subjects

Thirty elite outfield soccer players belonging to a team in the English Premier League with a mean ± SD age, height, and mass of 25 ± 5 years, 183 ± 7 cm, and 80.5 ± 7.4 kg, respectively, participated in this study. The participating players consisted of 6 central defenders (CD), 6 wide defenders (WD), 9 central midfielders (CM), 6 wide midfielders (WM), and 3 strikers (ST). The study was conducted according to the requirements of the Declaration of Helsinki and was approved by the university ethics committee of Liverpool John Moores University.

Design

TL data were collected over a 45-week period during the 2011–12 annual season from July 2011 until May 2012. The team used for data collection competed in 4 official competitions across the season, including European competition, which often meant the team played 2 matches/wk. For the purposes of the current study, all the sessions carried out as the main team sessions were considered. This refers to training sessions in which both the starting and nonstarting players trained together. Therefore, several types of sessions were excluded from analysis, including individual training, recovery sessions, rehabilitation training, and additional training for nonstarting players. Throughout the data-collection period, all players wore GPS and HR devices and provided an RPE post–training session. A total of 3513 individual training observations were collected during the preseason and in-season phases, with a median of 111 training sessions per player (range = 6–189). Goalkeepers were excluded from data analysis. A total of 210 individual observations contained missing data (5.9%) due to factors outside of the researcher’s control (eg, technical issues with equipment). The training content was not in any way influenced by the researchers. Data collection for this study was carried out at the soccer club’s outdoor training pitches. TL data were broken down into 5 separate categories to allow full analysis of the competitive season (Figure 1). The season consisted of the preseason (6-wk duration) and in-season (39-wk duration) phases. The preseason phase was separated into 6 × 1-week blocks for analysis of TL during this phase. The in-season phase was divided into 6 × 6-week blocks because such division allowed the investigation of loading patterns incorporated in this training unit (frequently defined as a mesocycle). Within the in-season data, 3 separate weekly microcycles (wk 7, 24, and 39) consisting of the same training structure were selected to analyze the TL at the start, middle, and end of the in-season phase. The microcycles selected were the only weeks available that were deemed full training weeks. These weeks consisted of 1 match played and 4 training sessions scheduled on the same days before the match. Training data were also analyzed in relation to number of days away from the competitive match fixture (ie, match day minus). In a week with only 1 match, the team typically trained on the second day after the previous match (match day [MD] minus 5; MD-5), followed by a day off and then 3 consecutive training sessions (MD-3, MD-2, and MD-1) leading into the next match.

Methodology

The players’ physical activity during each training session was monitored using portable GPS technology (GPSports Pro X, Canberra, Australia). The device provides position, velocity, and distance data at 5 Hz, which is extrapolated and provided in a 15-Hz format. Each player wore the device inside a custom-made vest supplied by the manufacturer across the upper back between the left and right scapulae. All devices were activated 30 minutes before data collection to allow acquisition of satellite signals as per manufacturer’s instructions. After each training session, GPS data were downloaded using the respective software package (GPSports Team AMS software v 2011.16) on a personal computer and exported for analysis. A custom-built GPS receiver (GPSports, Canberra, Australia) and software application (GPSports SPI Realtime V R1 2011.16) were used to time-code the start and end periods for each training session. Unpublished research from our laboratory found the devices to have high interdevice variability.22 That research revealed high limits-of-agreement (LoA) values when such devices were used to quantify movements around a soccer-specific track of 366.6 m total length for both total distance (LoA 2 to –49 m) and high-velocity (>5.5 m/s) distance (LoA 29–51 m) covered. Therefore, each player wore the same GPS device for each training session to avoid this variability.

The following variables were selected for analysis: total distance covered, average speed (distance covered divided by training duration), high-speed distance covered (total distance covered >5.5 m/s), and training duration. Numerous variables are now available with commercial GPS devices, including acceleration and deceleration efforts and the estimation of metabolic power.12 Recently, Akenhead et al23 concluded that GPS technology may be unsuitable for the measurement of instantaneous velocity during high-magnitude (>4 m/s²) efforts. The estimations of metabolic power are also potentially very useful for the assessment of TL. However, at present no study has fully quantified the reliability and validity of such measures using commercial GPS devices. Therefore, it was our approach to use established variables for the analysis of TL across the season.

During each training session, all players wore a portable team-based HR receiver system belt (Acentas GmbH, Freising, Germany). The data were transmitted to a receiver connected to a portable laptop and analyzed using a software package (Firstbeat Sports, Jyväskylä, Finland) to determine the percentage of HR maximum (%HR max). Each player’s maximal HR value was determined before data collection using the Yo-Yo Intermittent Recovery Test level 2. Immediately after the end of each training session, players were asked to provide an RPE rating. They were prompted for

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their RPE individually using a custom-designed application on a portable computer tablet (iPad, Apple Inc, California, USA). Each player selected his RPE rating by touching the respective score on the tablet, which was then automatically saved under the player’s profile. This method helped minimize factors that may influence a player’s RPE rating, such as peer pressure and replicating other players’ ratings. Each individual RPE value was multiplied by the session duration to generate an RPE-load value.

24 Statistical Analysis

Data were analyzed using mixed linear modeling using the statistical software R (version 3.0.1). Mixed linear modeling can be applied to repeated-measures data from unbalanced designs, which was the case in the current study since players differed in terms of the number of training sessions they participated in. Mixed linear modeling can also cope with the mixture of both fixed and random effects, as well as missing data from players. In the current study, time period (mesocycles, microcycles, and days in relation to the match; ie, MD minus) and player position (CD, WD, CM, WM, and ST) were treated as categorical fixed effects. Random effects were associated with the individual players and single training sessions. A stepwise procedure was used to select the model of best fit for each analyzed data set among a set of candidate models that were compared using likelihood ratio tests. Significance was set at \( P < .05 \). When 1 or more fixed effects were statistically significant in the selected model, Tukey post hoc pairwise comparisons were performed to examine between pairs of categories of the significant factors. The effect-size (ES) statistic was calculated to determine the magnitude of effects by standardizing the coefficients according to the appropriate between-subjects standard deviation and was assessed using the following criteria: \( <0.2 = \) trivial, \( 0.2 \) to \( 0.6 \) = small effect, \( 0.6 \) to \( 1.2 \) = moderate effect, \( 1.2 \) to \( 2.0 \) = large effect, and \( >2.0 \) = very large. 95% confidence intervals (CI) of the raw and standardized coefficients were also calculated. Data are represented as mean ± SD or, for pairwise comparisons of time periods or positional roles, as 95% CI.

Results

Preseason Microcycle Analysis

There were no significant differences (\( P > 0.05 \)) between the models with and without the effect of microcycle for duration, total distance, average speed, high-speed distance, %HRmax, and RPE load. Thus, no differences were evident between the 6 microcycle weeks for all outcome variables. Overall, CD players reported significantly lower total distance values than CM players (660 [366] m, ES = 0.31 [0.17–0.45], small) and WD players (546 [227–865] m, ES = 0.26 [0.11–0.41], small) (Figure 2[a]). ST players also reported significantly lower total distance values than CM players (660 [309–1011] m, ES = 0.31 [0.15–0.48], small) and WD players.
Malone et al (543 [171–915] m, ES = 0.26 [0.08–0.43], small). Similar findings were evident for average speed values, with ST players reporting significantly lower values than CM (8.2 [4.1–12.3] m/min, ES = 0.69 [0.35–1.04], moderate) and WD (6.1 [1.8–10.4] m/min, ES = 0.52 [0.15–0.88], small). CD players also had significantly lower values than CM players (6.2 [2.8–9.5] m/min, ES = 0.52 [0.24–0.80], small) (Figure 2[b]). There were no significant differences found between positions for duration, high-speed distance, %HRmax, and RPE load across the preseason phase (P > .05 in all likelihood ratio tests).

In-Season Mesocycle Analysis

Total distance values were significantly higher at the start of the annual season (wk 7–12) than at the end (wk 37–42; 1304 [434–2174] m, ES = 0.84 [0.28–1.39], moderate) (Figure 3[a]). %HRmax values were significantly higher in weeks 19 to 24 than in weeks 7 to 12 (3.3% [1.3–5.4%], ES = 0.49 [0.19–0.79], small) (Figure 3[b]). CM players covered significantly more total distance than CD (577 [379–775] m, ES = 0.37 [0.24–0.50], small); ST (849 [594–1104] m, ES = 0.54 [0.38–0.71], small), and WM (330 [123–537] m, ES = 0.21 [0.08–0.34], small). CM players also had a higher average speed than ST (4.5 [1.4–7.6] m/min, ES = 0.53 [0.17–0.90], small) and CD (4.0 [1.5–6.6] m/min, ES = 0.47 [0.17–0.77], small). WD players reported significantly higher total distance values than CD (350 [150–550] m, ES = 0.22 [0.10–0.35], small) and ST (622 [366–879] m, ES = 0.40 [0.23–0.56], small). Differences were also found between WM and ST for total distance (519 [252–786] m, higher total distance for WM, ES = 0.33 [0.16–0.50], small) and between WD and CD for average speed (3.6 [1.0–6.2] m/min, higher average speed for WD, ES = 0.42 [0.12–0.72], small). CD players covered significantly lower high-speed distance than all other positions (44 [16–72] m against CM, ES = 0.34 [0.12–0.56], small; 61 [24–99] m against ST, ES = 0.48 [0.19–0.77], small; 56 [27–86] m against WD, ES = 0.44 [0.21–0.67], small; 74 [43–105] m against WM, ES = 0.58 [0.33–0.82], small). ST players reported lower %HRmax values than CD (11.4 [7.0–15.8], ES = 1.68 [1.04–2.33], large), WD (8.1 [3.7–12.4], ES = 1.19 [0.55–1.82], moderate), and CM (7.2 [2.9–11.4], ES = 1.06 [0.43–1.68], moderate). CD reported

Figure 2 — Training-load data for (a) total distance and (b) average speed across 6 × 1-week microcycles during the preseason phase between positions, mean ± SD. Abbreviations: CD, central defenders; WD, wide defenders; CM, central midfielders; WM, wide midfielders; ST, strikers. $WD$ significant difference versus CD and ST; #CM significant difference versus CD and ST; ≠ WD significant difference versus ST.
higher %HR\textsubscript{max} than WM (7.4 [3.8–10.9], ES = 1.09 [0.56–1.61], moderate). There were no significant differences found between positions for duration and s-RPE.

In-Season Microcycle Analysis

%HR\textsubscript{max} was significantly lower in week 7 than in either week 24 (6.9 [4.6–9.2], ES = 1.06 [0.71–1.41], moderate) or week 39 (4.5 [2.2–6.9], ES = 0.69 [0.34–1.05], moderate) (Table 1). CM players covered higher total distance than CD (576 [321–831] m, ES = 0.34 [0.19–0.49], small) and ST (489 [175–803] m, ES = 0.29 [0.10–0.47], small). ST players reported lower overall average speed values than CM players (7.7 [2.2–13.3] m/min, ES = 0.99 [0.28–1.71], moderate). WM players covered a higher amount of high-speed distance across the different microcycles than CD (94 [43–145] m, ES = 0.47 [0.22–0.73], small). CD players recorded higher %HR\textsubscript{max} values than both WM (8.1 [4.0–12.2], ES = 1.24 [0.61–1.87], large) and ST players (8.0 [3.2–12.8], ES = 1.23 [0.49–1.96], large). There were no significant differences found between positions for duration and RPE load.

In-Season Match-Day-Minus Training Comparison

MD-1 displayed significantly lower values than MD-2 for all variables with the exception of high-speed distance (duration 19 [14–24] min, ES = 1.06 [0.79–1.34], moderate; total distance 1914 [1506–2322] m, ES = 1.25 [0.98–1.52], large; average speed 3.9 [1.4–6.4] m/min, ES = 0.46 [0.17–0.76], small; %HR\textsubscript{max} 2.0 [0.7–3.3], ES = 0.29 [0.11–0.48], small; sRPE 145 [111–178] au, ES = 1.05 [0.81–1.29], moderate) (Figure 4). MD-1 also displayed significantly lower values than MD-3 for all variables (duration 25 [19–31] min, ES = 1.39 [1.08–1.70], large; total distance 2260 [1805–2715] m, ES = 1.48 [1.18–1.77], large; average speed 6.5 [3.8–9.2] m/min, ES = 0.77 [0.45–1.09], moderate; high-speed distance 82 [37–126] m, ES = 0.67 [0.30–1.03], moderate; %HR\textsubscript{max} 3.3 [1.9–4.7] %, ES = 0.49 [0.28–0.69], small; RPE load 178...
### Discussion

The purpose of the current study was to quantify the TL employed by an elite professional soccer team across an annual season that included both the preseason and in-season phases. The study revealed that TL variables demonstrated limited relevant variation across both the preseason and in-season phases. This finding was evident despite marked differences between positions across each microcycle. When analyzing TL in respect to number of days before a match, it was found that TL remained similar across all days with the exception of MD-1, when the load was significantly reduced. The findings of the current study provide novel data on the TL undertaken by elite English Premier League players throughout a competitive season.

The emphasis during preseason is on rebuilding fitness parameters after the detraining that occurs during the off-season. In comparison with previous studies, the HR response observed in the current study was higher than that reported by Jeong et al. In their study based on professional Korean soccer players, the average %HR\textsubscript{max} value across all preseason sessions was 64 ± 3 %HR\textsubscript{max}, which is significantly lower than the 70 ± 7 HR\textsubscript{max} value reported in the current study. In addition, the highest RPE-load value during training for the Korean players was 321 ± 23 arbitrary units (au), compared with an average of 447 ± 209 au in the current study. The marked differences between the 2 studies may relate to the external work performed by each respective team during preseason. Manzi et al reported average RPE-load values of 644 ± 224 au for elite Italian soccer players during an 8-week preseason phase. Although those values are higher than those reported in our study, the likely reason for the differences was the inclusion of friendly-match data in the study by Manzi et al. Therefore it appears that the TL undertaken by players in the current study may be unique to the design and preseason schedule employed.

### Table 1 Training-Load Data Represented Across 3 Separate 1-Week Microcycles During the In-Season Phase Between Positions, Mean ± SD

<table>
<thead>
<tr>
<th>Period, position</th>
<th>Duration (min)</th>
<th>Total distance (m)</th>
<th>Average speed (m/min)</th>
<th>High-speed distance (m)</th>
<th>%HR\textsubscript{max}</th>
<th>RPE load (au)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wk 7</strong></td>
<td></td>
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</tr>
<tr>
<td>CD</td>
<td>74 ± 28</td>
<td>6066 ± 1885</td>
<td>78 ± 10</td>
<td>190 ± 202</td>
<td>70.7 ± 4.4£</td>
<td>330 ± 175</td>
</tr>
<tr>
<td>WD</td>
<td>71 ± 27</td>
<td>6024 ± 1990</td>
<td>84 ± 8</td>
<td>224 ± 223</td>
<td>66.8 ± 4.4</td>
<td>413 ± 260</td>
</tr>
<tr>
<td>CM</td>
<td>76 ± 25</td>
<td>6426 ± 1804#</td>
<td>85 ± 105</td>
<td>234 ± 225</td>
<td>65.3 ± 5.9</td>
<td>328 ± 178</td>
</tr>
<tr>
<td>WM</td>
<td>77 ± 26</td>
<td>6265 ± 1936</td>
<td>80 ± 6</td>
<td>293 ± 262A</td>
<td>61.8 ± 3.6</td>
<td>345 ± 176</td>
</tr>
<tr>
<td>ST</td>
<td>78 ± 28</td>
<td>5780 ± 1823</td>
<td>74 ± 5</td>
<td>303 ± 258</td>
<td>63.6 ± 6.2</td>
<td>375 ± 210</td>
</tr>
<tr>
<td><strong>overall</strong></td>
<td>75 ± 26</td>
<td>6182 ± 1841</td>
<td>81 ± 9</td>
<td>243 ± 229</td>
<td>65.7 ± 5.7*</td>
<td>350 ± 191</td>
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<tr>
<td><strong>Wk 24</strong></td>
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<tr>
<td>CD</td>
<td>70 ± 15</td>
<td>5719 ± 1066</td>
<td>82 ± 5</td>
<td>169 ± 186</td>
<td>76.9 ± 3.8£</td>
<td>407 ± 201</td>
</tr>
<tr>
<td>WD</td>
<td>72 ± 15</td>
<td>6274 ± 1201</td>
<td>88 ± 4</td>
<td>237 ± 195</td>
<td>75.8 ± 3.0</td>
<td>301 ± 120</td>
</tr>
<tr>
<td>CM</td>
<td>73 ± 13</td>
<td>6515 ± 1065#</td>
<td>89 ± 65</td>
<td>271 ± 283</td>
<td>73.8 ± 5.5</td>
<td>374 ± 160</td>
</tr>
<tr>
<td>WM</td>
<td>74 ± 13</td>
<td>6148 ± 1105</td>
<td>83 ± 4</td>
<td>217 ± 169A</td>
<td>70.0 ± 2.1</td>
<td>264 ± 98</td>
</tr>
<tr>
<td>ST</td>
<td>73 ± 14</td>
<td>5602 ± 1111</td>
<td>80 ± 5</td>
<td>244 ± 224</td>
<td>65.0 ± 3.9</td>
<td>409 ± 185</td>
</tr>
<tr>
<td><strong>overall</strong></td>
<td>72 ± 13</td>
<td>6105 ± 1121</td>
<td>85 ± 6</td>
<td>225 ± 213</td>
<td>73.4 ± 5.3</td>
<td>340 ± 155</td>
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<tr>
<td><strong>Wk 39</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>CD</td>
<td>58 ± 21</td>
<td>4203 ± 1514</td>
<td>75 ± 5</td>
<td>75 ± 80</td>
<td>75.9 ± 4.0£</td>
<td>262 ± 145</td>
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<tr>
<td>WD</td>
<td>60 ± 16</td>
<td>4815 ± 1403</td>
<td>81 ± 7</td>
<td>137 ± 92</td>
<td>70.9 ± 3.9</td>
<td>292 ± 129</td>
</tr>
<tr>
<td>CM</td>
<td>62 ± 22</td>
<td>4911 ± 1669#</td>
<td>82 ± 55</td>
<td>161 ± 121</td>
<td>73.7 ± 4.7</td>
<td>255 ± 119</td>
</tr>
<tr>
<td>WM</td>
<td>62 ± 23</td>
<td>4616 ± 1634</td>
<td>77 ± 5</td>
<td>179 ± 103A</td>
<td>67.4 ± 5.3</td>
<td>222 ± 130</td>
</tr>
<tr>
<td>ST</td>
<td>67 ± 26</td>
<td>4866 ± 2102</td>
<td>76 ± 9</td>
<td>184 ± 105</td>
<td>61.5 ± 3.0</td>
<td>271 ± 143</td>
</tr>
<tr>
<td><strong>overall</strong></td>
<td>61 ± 21</td>
<td>4714 ± 1581</td>
<td>79 ± 7</td>
<td>146 ± 104</td>
<td>70.6 ± 5.9</td>
<td>259 ± 129</td>
</tr>
</tbody>
</table>

Abbreviations: HR\textsubscript{max}, maximal heart rate; RPE, rating of perceived exertion; au, arbitrary units; CD, central defenders; WD, wide defenders; CM, central midfielders; WM, wide midfielders; ST, strikers.

*Wk 7 significant difference vs wk 24 and wk 39; #CM significant difference vs CD and ST; ΔWM significant difference vs CD; ΔCM significant difference vs ST; £CD significant difference vs WM and ST.
Figure 4 — Training-load data for (a) duration, (b) total distance, and (c) rating of perceived exertion (RPE) load on training day in respect to days before a competitive match during the in-season phase between positions, mean ± SD. Abbreviations: CD, central defenders; WD, wide defenders; CM, central midfielders; WM, wide midfielders; ST, strikers. *MD-2 significant difference versus MD-1; #MD-3 significant difference versus MD-1; $MD-5 significant difference versus MD-1; ¥CD and WD significant difference versus WM and ST; ΔCD significant difference versus CM and WM.
During the in-season phase, the emphasis of training reverts to technical and tactical development and the maintenance of the physical capacities developed during preseason.\(^{29}\) In the current study, we investigated the TL pattern across 6-week mesocycle blocks during the in-season phase of an annual season. We observed that the players covered more total distance at the start than in the final mesocycle of the season, with an estimated mean difference of 1304 m between the 2 mesocycles. The higher distances covered at the beginning of the in-season phase may be due to the coaches’ still having some emphasis on physical conditioning as a continuation of the preseason phase. Notably, the %HR\(_{\text{max}}\) response in the players was higher during the third mesocycle (wk 19–24) than the first mesocycle (wk 7–12). This was found in spite of the players’ covering higher total distance during the first mesocycle period. In general, CM and WD covered the highest total distance, with CD players displaying the lowest values. Defenders (CD and WD players) were found to display higher %HR\(_{\text{max}}\) values during this time. Such differences between positions are not uncommon in elite soccer, with the findings in the current study also replicated in positional match-play data (with the exception of high-speed distance).\(^{21}\) Therefore it appears that there is some marked variation in TL across 6-week mesocycle periods during the in-season.

To further analyze the TL patterns, the data were broken down further into microcycle periods. We found that %HR\(_{\text{max}}\) values were higher during the first microcycle analyzed (wk 7) than at the seasonal midpoint (wk 24) and end-point (wk 39) microcycles. When the data were broken down further in respect to the number of days before a match, we found that TL was significantly reduced on MD-1, with no differences observed across the remaining training days. It would appear in the current study that the coaches employed similar overall TL on the majority of training days, then attempted to unload on MD-1 to increase player readiness leading into the match. In comparison with previous work, the average total distance covered was 5181 m, which was higher than the range of values reported by Gaudino et al\(^{12}\) (3618–4133 m). However, the distances covered in both the current study and that of Gaudino et al\(^{12}\) fell short in comparison with those reported by Owen et al\(^{10}\) (6871 m). In terms of high-speed distance, the values reported (average 118 m) fall within the range of that of Gaudino et al\(^{12}\) (88–137 m) across different positions. The %HR\(_{\text{max}}\) response was higher (69%) than that of elite Korean players\(^{18}\) (58%). Despite this finding, the RPE-load values were relatively low (272 au) in the current study compared with that of Jeong et al\(^{19}\) (365 au) and in semiprofessional soccer players\(^{18}\) (462 au). Overall, it would appear that in comparison with elite soccer players, the TL employed during the in-season falls within the boundaries of what has been previously observed.

The limited relevant variation observed in TL across the full competitive season would suggest that training in professional soccer may be highly monotonous. In accordance with traditional periodization models, TL must be varied to elicit optimal physiological adaptations and limit the native effects of fatigue.\(^ {30}\) Indeed, the only noticeable consistent variation in TL occurred on MD-1, when the load was significantly reduced compared with the other training days. This approach may be an attempt by the coaches to unload the players to increase player readiness leading into a match. However, it is currently not noted in the literature whether unloading in this way will lead to the dissipation of fatigue and optimize readiness. The majority of research relating to unloading (commonly referred to as tapering) relates to individual sports in which TL is reduced over the course of 7 to 28 days before competition.\(^ {31}\) Such time frames of unloading are not relevant to the competition scheduling associated with soccer. Although anecdotal evidence is available relating to the practices and methodologies of elite soccer coaches, little information is available in the research literature relating to soccer-specific periodization models. It may be that practitioners in elite soccer must develop their own sport-specific periodization models with minimal use of the traditional approaches described in individual sports.\(^ {20}\)

### Practical Applications

This study provides useful information relating to the TL employed by an elite English Premier League team. It provides further evidence of the value of using the combination of different measures of TL to fully evaluate the patterns observed across a full competitive season. For coaches and practitioners, the study generates reference values for players of this elite level that can be considered when planning training sessions. When conducting a large-scale study such as this one, it is clear that some limitations may arise from the process. There were numerous true data points missing across the 45-week data-collection period due to several external factors beyond our control (eg, technical issues with equipment, player injuries, player transfers). To combat this, we employed mixed linear modeling due to the unbalanced design, although we cannot rule out the overall influence on results. The lack of available GPS competitive-match data in the overall analysis will obviously have a significant effect on overall loading throughout a season. The current study is unable to provide “optimal” TL values without undertaking further research linking TL to other factors such as physiological testing and injury records. What would be even more valuable to both researchers and practitioners would be to establish how these TLs directly affect soccer performance, but this is a complex phenomenon with a multitude of factors.

### Conclusions

In summary, this study systematically quantified the TL employed by an elite English Premier League soccer team across an annual season using a combination of applied monitoring methods. The data from the study revealed that the TL employed across the preseason phase displayed limited variation across each individual microcycle. There was further variation shown during the in-season phase, with higher total distances covered in the early stages of the competitive season and the highest HR response occurring at the midpoint of the season. Positional differences were found during both preseason and in-season phases. Future research should focus on how the TL employed is directly related to performance and injury in elite soccer. Furthermore, data derived from multiple teams and competitive leagues would also enhance our understanding of TL in the elite setting.

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References


