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Seasonal training load quantification in elite English Premier League soccer players

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Authors Names and Affiliations (in order):

James J. Malone[1]; Rocco Di Michele[2]; Ryland Morgans[3]; Darren Burgess[4]; James P. Morton[1,3]; Barry Drust[1,3]

[1] Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, Liverpool, UK

[2] Department of Biomedical and Neuromotor Sciences, University of Bologna, Bologna, Italy

[3] Liverpool Football Club, Melwood Training Ground, Liverpool, England, UK

[4] Port Adelaide Football Club, Adelaide, Australia

Corresponding Author:

Prof. Barry Drust

Liverpool John Moores University, Tom Reilly Building, Liverpool, UK, L3 3AF

Tel: 0151 904 6267

Email: B.Drust@ljmu.ac.uk

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Abstract

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 RPE) during the daily training sessions comprising the 2011-2012 pre-season and in-season period. Pre-season data were analysed across 6 x 1 week microcycles. In-season data were analysed across 6 x 6 week mesocycle blocks and 3 x 1 week microcycles at start, mid and end time points. Data were also analysed with respect to number of days prior to a match. ***Results:*** Typical daily training load (i.e. total distance, high speed distance, % HRmax, s-RPE) did not differ during each week of the pre-season phase. However, daily total distance covered was 1304 (95% CI: 434 – 2174) m greater in the first mesocycle compared with the sixth . %HRmax values were also greater (3.3 (1.3 – 5.4) %) in the third mesocycle compared with the first. Furthermore, training load was lower on the day before match (MD-1) compared with two (MD-2) to five (MD-5) days before match, though no difference was apparent between these latter time-points. ***Conclusions:*** We provide the first report of seasonal training load in elite soccer players and observed 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 is facilitative of optimal training adaptations and match day performance.

Keywords: soccer training; team sport; GPS; heart rate; periodization.

Introduction

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 popularisation of monitoring player activities quantitatively on a daily basis. The combination of factors that can be manipulated for training planning, i.e. volume and intensity, is commonly referred to in soccer as 'training load'[1]. Training load (TL) can be divided into two separate sub-sections termed external and internal TL. The external load refers to the specific training prescribed by coaches, whilst 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 TL that are associated with their individual requirements is limited. Therefore this has resulted in an increased demand for applied objective and subjective data in order to monitor the TL and subsequent response in order to maximise 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 has allowed practitioners to analyse external load in team sports. Examples of such systems include semi-automated multi-camera systems, local positioning systems and global positioning systems (GPS). In modern soccer, teams will typically employ a combination of the above mentioned 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 surrounds TL quantification in soccer, the body of work has focused on either individual training drills or short periods of a training programme. A popular topic at present relates to the quantification of small sided games (SSG) under a variety of conditions. Recent studies have used a combination of methods to quantify such drills, including HR telemetry[4,5] and GPS[6,7,8]. Other studies have attempted to quantify TL across multiple sessions. The majority of this work has been carried out during the in-season phase, of which includes short training microcycles of 1-2 weeks[1,9,10] mesocycles consisting of 4-10 weeks[11,12,13,14] and longer training blocks of 3-4 months[15,16]. Some work has also attempted to quantify the TL across the pre-season phase[17] and also compare the TL experienced during the pre-season and in-season phases[18]. However the majority of these studies only provide limited information regarding the TL, using duration and session-RPE 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's positions) across a full competitive season. There is also currently limited information relating to TL in elite soccer players (i.e. 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, team's will often employ a coaches 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 pre-season 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 isn't 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 six central defenders (CD), six wide defenders (WD), nine central midfielders (CM), six wide midfielders (WM) and three 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 2011-2012 annual season from July 2011 until May 2012. The team used for data collection competed in four official competitions across the season, including European competition, which often meant the team played two matches per week. For the purposes of the present study, all the sessions carried out as the main team sessions were considered. This refers to training sessions in which both the starting and non-starting players trained together. Therefore several types of sessions were excluded from analysis including individual training, recovery sessions, rehabilitation training and additional training for non-starting 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 pre-season 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 (e.g. 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 five separate categories to allow full analysis of the competitive season (Figure 1). The season consisted of the pre-season (6 weeks duration) and in-season (39 weeks duration) phases. The pre-season phase was separated into 6 x 1 weekly blocks for analysis of TL during this phase. The in-season phase was divided into 6 x 6 week blocks because such division allowed the investigation of loading patterns incorporated within this training unit (frequently defined as a mesocycle). Within the in-season data, three separate weekly microcycles (weeks 7, 24 and 39) consisting of the same training structure were selected in order to analyse the TL at the start, middle and end of the in-season phase. The microcycles selected were the only weeks available which were deemed as full training weeks. These weeks consisted of one match played and four training sessions scheduled on the same days prior to the match. Training data were also analysed in relation to number of days away from the competitive match fixture (i.e. match day minus). In a week with only one 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 three consecutive training sessions (MD-3, MD-2 and MD-1, respectively) leading into the next match.

****Figure 1 near here****

Methodology

The player's physical activity during each training session was monitored using portable GPS technology (GPSports© SPI Pro X, Canberra, Australia). The device provides position, velocity and distance data at 5 Hz. Each player wore the device inside a custom made vest supplied by the manufacturer across the upper back between the left and right scapula. All devices were activated 30-minutes before data collection to allow acquisition of satellite signals as per manufacturer's instructions. Following each training session, GPS data were downloaded using the respective software package (GPSports© Team AMS software v2011.16) 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 revealed the devices to have high inter-unit variability[22]. This research revealed high limits of agreement (LoA) values when such devices were used to quantify movements around a soccer-specific track of 366.6m total length for both total distance (LoA 2m to -49 m) and high velocity (> 5.5 m/s) distance (LoA 29m to 51m) covered. Therefore each player wore the same GPS device for each training session in order 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 above 5.5 m/s) and training duration. Numerous variables are now available with commercial GPS devices, including acceleration/deceleration efforts and the estimation of metabolic power[12]. Recently, Akenhead et al.[23] concluded that GPS technology may be unsuitable for the measurement of instantaneous velocity during high magnitude (> 4 m/s^2) 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/validity of such measures using commercial GPS devices. Therefore it was the approach of the researchers 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 analysed using the software package (Firstbeat Sports©, Jyväskylä, Finland) to determine the percentage of HR maximum (%HRmax). Each player's maximal HR value was determined prior to data collection using the Yo-Yo intermittent recovery level 2 test. Immediately following the end of each training session, players were asked to provide an RPE rating. Players were prompted for their RPE individually using a custom-designed application on a portable computer tablet (iPad©, Apple Inc., California, USA). The player selected their RPE rating by touching the respective score on the tablet, which was then automatically saved under the player's profile. This method helped minimise factors that may influence a player's RPE rating, such as peer pressure and replicating other player's ratings[24]. Each individual RPE value was multiplied by the session duration to generate a session-RPE (s-RPE) value[25].

Statistical Analysis

Data were analysed using mixed linear modelling using the statistical software R (Version 3.0.1). Mixed linear modelling can be applied to repeated measures data from unbalanced designs, which was the case in the present study since players differed in terms of the number of training sessions they participated in[26]. Mixed linear modelling can also cope with the mixture of both fixed and random effects as well as missing data from players[27]. In the present study, time period (mesocycles, microcycles and days in relation to the match (i.e. MD minus) and player's 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 analysed data set among a set of candidate models, that were compared using likelihood ratio tests. Significance was set at $P < 0.05$. When one or more fixed effects were statistically significant in the selected model, Tukey post-hoc pairwise comparisons were performed to examine contrasts between pairs of categories of the significant factor(s). The effect size (ES) statistic was calculated to determine the magnitude of effects by standardising the coefficients according to the appropriate between-subject standard deviation, and was assessed using the following criteria: < 0.2 = trivial, 0.2-0.6 = small effect, 0.6-1.2 = moderate effect, 1.2-2.0 =

large effect, and > 2.0 = very large[28]. 95% confidence intervals (CI) of the raw and standardised contrast coefficients were also calculated. Data is represented as mean ± SD, or, for pairwise comparisons of time periods or positional roles, as contrast (95% CI).

Results

Pre-season 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 s-RPE. Thus, no differences were evident between the six microcycle weeks for all outcome variables. Overall, CD players reported significantly lower total distance values compared to CM players (660 (366 - 594) 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 2a). ST players also reported significantly lower total distance values compared to CM players (660 (309 – 1011) m, ES = 0.31 (0.15 – 0.48), small) and WD players (: 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 compared to 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 compared to CM players (6.2 (2.8 – 9.5) m/min, ES = 0.52 (0.24 – 0.80), small) (Figure 2b). There were no significant differences found between positions for duration, high speed distance, %HRmax and s-RPE across the pre-season phase (P > 0.05 in all likelihood ratio tests).

****Figure 2 near here****

In-season mesocycle analysis

Total distance values were significantly higher at the start of the annual season (weeks 7-12) compared to the end (weeks 37-42; Figure 3a) (1304 (434 – 2174) m, ES = 0.84 (0.28 – 1.39), moderate). %HRmax values were significantly higher in weeks 19-24 compared to weeks 7-12 (Figure 3b; = 3.3 (1.3 – 5.4) %, ES = 0.49 (0.19 – 0.79), small). CM players covered significantly more total distance compared to: 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 compared with 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 compared to: 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 higher %HRmax compared with 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.

****Figure 3 near here****

In-season microcycle analysis

%HRmax was significantly lower in week 7 compared to both week 24 (6.9 (4.6 – 9.2) %, ES = 1.06 (0.71 – 1.41), moderate) and week 39 (4.5 (2.2 – 6.9) %, ES = 0.69 (0.34 – 1.05), moderate) (Table 1). CM players covered higher total distance compared to 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 compared to 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 compared to CD (94 (43 – 145) m, ES = 0.47 (0.22 – 0.73), small). CD players recorded higher %HRmax values compared to 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 s-RPE.

****Table 1 near here****

In-Season Match Day Minus Training Comparison

MD-1 displayed significantly lower values compared with 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; %HRmax: 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). MD-1 also displayed significantly lower values compared to 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; %HRmax: 3.3 (1.9 – 4.7) %, ES = 0.49 (0.28 – 0.69), small; s_RPE: 178 (139 – 217) au, ES = 1.29 (1.01 – 1.58), large). MD-5 displayed higher values compared to MD-1 for: duration (20 (11 – 28) min, ES = 1.10 (0.61 – 1.58), moderate); total distance (2116 (1387 – 2845) m, ES = 1.38 (0.91 – 1.86, large); high speed distance (135 (45 – 225) m, ES = 1.10 (0.36 – 0.83), moderate); and s-RPE 152 (90 – 213) au, ES = 1.10 (0.66 – 1.55), moderate). CD players displayed lower values for duration compared to WM (5 (2 – 8) min, ES = 0.27 (0.09 – 0.45), small) and ST (7 (3 – 11) min, ES = 0.38 (0.16 – 0.60), small). WD players also recorded lower values for duration compared to WM (4 (1 – 8) min, ES = 0.25 (0.07 – 0.42), small) and ST (6 (3 – 10) min, ES = 0.36 (0.14 – 0.58), small) across all four training day types. CM players covered higher total distance compared to CD (465 (251 – 679) m, ES = 0.30 (0.16 – 0.44), small). CD players recorded higher %HRmax values compared to WD (6.9 (2.8 – 11.0) %, ES = 1.01 (0.41 – 1.62), moderate), and ST (8.1 (3.1 – 13.2) %, ES = 1.20 (0.46 – 1.94), large. There were no significant differences found between positions for average speed, high speed distance, and s-RPE.

****Figure 4 near here****

Discussion

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

The emphasis during pre-season is on the rebuilding of fitness parameters following the detraining that occurs during the off-season[29]. In comparison to previous studies, the HR response observed in the present study was higher than that reported by Jeong et al.[18]. In their study based on professional Korean soccer players, the average %HRmax value across all pre-season sessions was 64 ± 3 %HRmax which is significantly lower than the 70 ± 7 %HRmax value reported in the present study. In addition the highest s-RPE value during training for the Korean players was 321 ± 23 au compared to an average of 447 ± 209 au in the present study. The marked differences between the two studies may relate to the external work performed by each respective team during pre-season. Manzi et al.[17] reported average s-

RPE values of 644 ± 224 au for elite Italian soccer players during an 8 week pre-season phase. Although these 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.[17]. Therefore it appears that the TL undertaken by players in the present study may be unique to the design and pre-season schedule employed.

During the in-season phase, the emphasis of training reverts to technical and tactical development and the maintenance of the physical capacities developed during pre-season[29]. In the present study, we investigated the TL pattern across 6 week mesocycle blocks during the in-season phase of an annual season. It was observed that the players covered more total distance at the start compared to the final mesocycle of the season, with an estimated difference of 1304 m between the two 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 pre-season phase. Interestingly the %HRmax response in the players was higher during the third mesocycle (weeks 19 – 24) in comparison to the first mesocycle (weeks 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 %HRmax values during this time. Such differences between positions are not uncommon in elite soccer, with the findings in the present 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.

In order to further analyse the TL patterns, the data were broken down further into microcycle periods. It was found that %HRmax values were higher during the first microcycle analysed (week 7) compared to the seasonal mid-point (week 24) and end-point (week 39) microcycles. When the data were broken down further in respect to the number of days prior to a match, it was found that TL was significantly reduced on MD-1 with no differences observed across the remaining training days. It would appear in the present study that the coaches employed similar overall TL on the majority of training days, then attempted to unload on MD-1 in order to increase player readiness leading into the match. In comparison to previous work, the average total distance covered was 5181m which was higher than the range of values reported by Gaudino et al.[12] (3618 – 4133m). However both the distances covered in the present study and that of Gaudino et al.[12] fell short in comparison to those reported by Owen et al.[9](6871m). In terms of high speed distance, the values reported (average 118m) fall within the range of that of Gaudino et al.[12] (88 – 137m) across different positions. The %HRmax response was higher (69%) compared to that of elite Korean players[18] (58%). Despite this finding, the s-RPE values were relatively low (272 au) in the present study compared to that of Jeong et al.[18] (365 au) and in semi-professional soccer players[16] (462 au). Overall it would appear that in comparison to elite soccer players, the TL employed fall 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 in order 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 in which the load was significantly reduced compared to 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 unknown in the literature whether unloading in this way will lead to the dissipation of fatigue and optimise 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 – 28 days prior to 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 periodisation models. It may be so that practitioners in elite soccer must develop their own sport-specific periodisation 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 which 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 the researcher’s control (e.g. technical issues with equipment, player injuries, and player transfers). In order to combat this, we have employed mixed linear modelling 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 present 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 TL directly impact 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 pre-season 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 mid-point of the season. Positional differences were found during both pre-season 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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Figures and Tables

Figure 1. Outline of the experimental design. Each small block represents an individual weekly period across the annual cycle. Large blocks represent 6-week mesocycle periods across the in-season phase. Minus symbol represents training session in respect to number of days prior to a competitive match. MD = match day; O = day off.

Figure 2. Training load data represented across 6 x 1 week microcycles during the pre-season phase between positions. a) total distance; b) average speed. **#** denotes CM sig. difference vs. CD and ST; **$** denotes WD sig. difference vs. CD and ST; ≠ denotes WD sig. difference vs. ST; CD = Central defenders; WD = Wide defenders; CM = Central midfielders; WM = Wide midfielders; ST = Strikers. Data represents average values per session in the time period selected.

Figure 3. Training load data represented across six separate 6 week mesocycle periods during the in-season phase between positions. a) total distance; b) % HRmax. * denotes weeks 7-12 sig. difference vs. weeks 37-42; # denotes weeks 19-24 sig. difference vs. weeks 7-12; ¥ denotes CM sig. difference vs. CD, WM and ST; $ denotes WD sig. difference vs. CD and ST; ∑ denotes WM sig. difference vs. ST; **Δ** denotes CD sig. difference vs. WM; £ denotes ST sig. difference vs CD, WD and CM; CD = Central defenders; WD = Wide defenders; CM = Central midfielders; WM = Wide midfielders; ST = Strikers. Data represents average and SD values per session in the time period selected.

Figure 4. Training load data represented on training day in respect to days prior to a competitive match during the in-season phase between positions. a) duration; b) total distance; c) s-RPE. * denotes MD-2 sig. difference vs. MD-1; # denotes MD-3 sig. difference vs. MD-1; $ denotes MD-5 sig. difference vs. MD-1; ¥ denotes CD and WD sig. difference vs. WM and ST; **Δ** denotes CD sig. difference vs. CM and WM; CD = Central defenders; WD = Wide defenders; CM = Central midfielders; WM = Wide midfielders; ST = Strikers. Data represents average values per session in the time period selected.

Table 1. Training load data represented across 3 separate one week microcycles during the in-season phase between positions. * denotes week 7 sig. difference vs. week 24 and week 39. # denotes CM sig. difference vs. CD and ST; **Δ** denotes WM sig. difference vs. CD; $ denotes CM sig. difference vs. ST; £ denotes CD sig. difference vs. WM and ST; CD = Central defenders; WD = Wide defenders; CM = Central midfielders; WM = Wide midfielders; ST = Strikers. Data represents average and SD values per session in the time period selected