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The influence of opponent level on professional soccer players' training and match performance assessed by using wearable sensor technology

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ABSTRACT

Purpose. The study aim was 2-fold: to quantify and compare the weekly external training load that preceded matches; to compare in-match activities depending on the opponent level (top, middle, bottom) in a top-level team from the first professional Asian national league.

Methods. The load for 6 matches played against top-, 11 against middle-, and 11 against bottom-level teams was monitored. With a 15-Hz Global Positioning System, total duration, total distance, high-speed (18–23 km · h^{-1}) running distance, sprint (> 23 km · h^{-1}) distance, maximal speed, acceleration zone 1 (AccZ1) (< 2 m · s^{-2}), AccZ2 (2–4 m · s^{-2}), AccZ3 (> 4 m · s^{-2}), deceleration zone 1 (DecZ1) (> –2 m · s^{-2}), DecZ2 (–2 to –4 m · s^{-2}), DecZ3 (< –4 m · s^{-2}), player load, and metabolic power were collected in 12 players.

Results. DecZ3 showed higher values against top-level compared with middle- (effect size [*ES*] = 0.91) and bottom-level opponents (*ES* = 1.50). The training was significantly longer against middle-level compared with top- and bottom-level opponents (all, $p \leq 0.001$). Total distance was bigger against middle-level compared with top- ($p = 0.011$, *ES* = –0.92) and bottom-level opponents ($p = 0.027$, *ES* = 1.50). AccZ2 presented higher values when middle-level came close compared with bottom-level opponents ($p = 0.05$, *ES* = 0.79).

Conclusions. Opponent's level influences the load experienced by soccer players during matches. Total distance, high-speed running distance, AccZ1, and AccZ2 exhibited higher training values when a win or a draw approached. Decelerations in all zones were highest in matches against top-level teams.

Key words: adversary quality, performance, football, external monitoring, sports technology, load monitoring

Introduction

Soccer players perform several maximal and submaximal actions at varying intensities during matches and training. Elite soccer players have been reported to cover total distances of 9–14 km during matches [1]. They also perform close to 1350 activities such as accelerations, decelerations, changes of direction tasks, and jumps every 4–6 seconds, interspersed by shorter recovery periods [2]. Previous studies have revealed that elite English soccer players cover distances of 0.7–3.9 km [1, 3] at high-speed running and 0.2–0.6 km during sprints in competitive matches [4, 5]. In contrast, Spanish players covered smaller distances during

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friendly matches when the above-mentioned variables were analysed [6]. Further, English players performed 656 accelerations and 612 decelerations during a match [7], while Spanish players performed 581 accelerations [6]. It is estimated that during competitive matches players spend most of the time (80–90%) performing low- and medium-intensity activities, whereas the decisive moments of a match require high-speed and sprint actions [8]. Since soccer is a game that depends on various logistical factors such as match location (home/away conditions) or match status, there is a possibility that situational variables might influence running performance [8]. Therefore, it is important to track the physical load of the players to design and implement training routines that meet the demands and requirements of the game.

External load (EL) monitoring involves measuring work done during sprinting, accelerations, decelerations, etc. performed by soccer players during training and competition [9]. The main aim of this monitoring process is to keep track of the adaptation and response of each player to the training stimulus [10]. Also, measuring the training load (TL) on a daily basis helps in optimal distribution of workload to ensure maximal levels of fitness and readiness and to prevent injuries caused by overtraining [11]. Generally, EL monitoring is conducted by using various technological devices like Global Positioning Systems (GPS) and inertial sensors [12]. Further, it is also applied by sports scientists to provide a systematic and evidence-based approach to make decisions when describing training [9, 12].

Even though TL monitoring has been found to be beneficial, there are other challenging factors for practitioners while implementing monitoring strategies. Some of them might influence the activity of players during matches [13]. For instance, contextual factors such as match location, opponent standard (high, medium, or low), or match result have an impact on the player activity during competitive matches [14–17]. With regard to the quality of opponents, professional soccer players covered a bigger total distance and performed more accelerations and decelerations in different zones when playing against stronger opponents [16–18]. Therefore, the current evidence highlights that players' activity during matches might also depend on the level of the opponent.

Apart from the match-related performance, the contextual factors might also influence the preparatory TL. For instance, an under-19 French football team experienced higher load preparing a match against a medium-level team compared with bottom-level or top-level teams [19]. Further, an increase in training volume was observed in a Spanish team competing in the first division La Liga when they were preparing a match against a top-ranked opponent [20]. Therefore, quantification of accumulated TL preceding a match, depending on the opponent level, will be useful in planning training strategies and recovery protocols for players to perform better during the match and also fasten their readiness for the following games.

These findings highlight how the opponent level influences TL applied. However, there is still a paucity of literature regarding the influence of opponent level over the weekly TL in professional soccer players throughout an entire season. Further, the majority of the information and insight refers to French, Spanish, and National Collegiate Athletic Association soccer players [21]. None of the previous studies has analysed the impact of opposition standard on match performance variables particularly in an Asian professional soccer team. Also, there is still limited literature available with regard to evaluating a team's performance in matches together with the weekly TL depending on the opponent level. Such information can be useful for coaches and practitioners in understanding weekly TL and workload responses during matches in the context of match-related contextual factors, one of them being the level of the opponent team.

Therefore, the purpose of this study was to quantify the influence of opponent level on weekly EL preceding the match. The secondary aim was to quantify the in-match activity of soccer players while competing against opponents of varied levels (top, middle, or bottom) in an Asian professional soccer league. On the basis of the findings from the previous studies [19, 20], in which the opponent level influenced the performance of soccer players during training and matches in various soccer leagues across Europe, we hypothesized that the level of the opponent would be crucial in determining TL before and during the match.

Material and methods

Experimental approach to the problem

This longitudinal and observational study was conducted among a professional soccer team that participated in the Persian Gulf Premier League and knockout tournament in Iran. Training and matches data were analysed for 23 weeks. For the purpose of the current study, only weeks with 1 match from the Persian Gulf Premier League were included in order to ensure proportionality in TL. Similarly to previous studies [15, 22], the quality of the opponents was classified on the basis of the last season rankings: top-level (ranked in the top 6 league positions), middle-level (ranked 7th–13th in the league), and bottom-level (ranked in the bottom 7 positions of the league). The team analysed in this study was considered a top-level team (finished in the second position at the end of the season). Moreover, the weeks included a total of 6 matches played against top-level teams, 11 matches played against middle-level teams, and 11 matches played against bottom-level teams. Accumulated TL that preceded the match and the in-match load were monitored with a GPS device (model: SPI High-Performance Unit, GPSports Systems Pty Ltd., Canberra, Australia) and were used for further analysis.

Participants

Overall, 12 soccer players (age, 28.6 ± 2.7 years; height, 182.1 ± 8.6 cm; body mass, 75.3 ± 8.2 kg; BMI, 22.6 ± 0.7 kg · m^{-2}) were voluntarily recruited in this study. All competitors had at least 8 years of training experience and participated in an Iranian professional soccer league called Persian Gulf Premier League. The subject group was composed of 3 central defenders, 2 wide defenders, 3 midfielders, 3 wide midfielders, and 1 striker. To be included in our study, they had to satisfy the following criteria: (a) participation in at least 3 training sessions each week; (b) participation in 3 consecutive full matches. Any player who was injured or did not participate in training for more than 2 consecutive weeks was excluded. Further, we did not include goalkeepers as part of our study, as there are differences in training and match field positions. The experimental approach and study design were presented to the players.

Sample size

We calculated the design power and sample size using the G*Power software (University of Düsseldorf, Düsseldorf, Germany) [23]. Post-hoc: compute achieved power, *F* tests; ANOVA: repeated measures, within-between interaction; number of groups: 1; number of measurements: 3; α error probability: 0.5; total sample size: 12 players, and minimum effect size (*ES*): 0.6. The null hypothesis of no difference in variables has a power of 1 – β error probability, 99.3% likelihood of being appropriately rejected. A minimum *ES* of 0.6 was used on the basis of previous studies [24, 25].

Monitoring with wearable sensor technology

During the season, all workouts and match sessions were monitored by using model SPI High-Performance Unit GPS-based tracking systems for professional athletes, which offer a 5-Hz GPS microcontroller. Data are transformed by an algorithm that outputs positional data at a 15-Hz frequency [26, 27]. According to a previous study, this device has a high validity and reliability [28]. The unit was accurate for measuring high-sprinting velocities (coefficient of variation: 0.90%) [28]. There were no reported adverse weather conditions to affect data collection. Prior to the start of a match, belts were placed on the player's shoulder and chest. After each cool-down session at the end of the training, the belts were collected from the players. All belts were checked by the team's GPS manager and then entered into the dock system to download the information, which was then stored on a computer with the Team AMS software. The data from each session were automatically deleted from the belt memory after download. Prior to the next session, the belts were placed in an electric charge station. The SPI IQ absolutes were adjusted for the GPS default zone throughout the season. Also, the personal characteristics (such as height and weight) of each player were entered in the software, and each participant registered a belt in his own name for using until the end of the season. The following variables were then selected: total duration (TD) of the training session and matches, total distance, high-speed (18–23 km · h^{-1}) running distance, sprint (> 23 km · h^{-1}) distance, maximal speed (top speed achieved in the session), acceleration zone 1 (AccZ1) (< 2 m · s^{-2}), AccZ2 (2–4 m · s^{-2}), AccZ3 (> 4 m · s^{-2}), deceleration zone 1 (DecZ1) (> –2 m · s^{-2}), DecZ2 (–2 to –4 m · s^{-2}), DecZ3 (< –4 m · s^{-2}) [29, 30], body load (BL), and GPS-derived metabolic power. According to the GPS manufacturer instructions, metabolic power calculation was based on previous research that also showed a strong relationship with running distance [30]. For better clarity, BL was calculated through the following stages in each acceleration level: initializing the BL count to 0; calculating the acceleration vector (V) magnitude for the current acceleration (V = ax2 + ay2 + az2); normalizing the magnitude vector (NV) by subtracting a national 1 G (NV = V – 1.0 G). Then, the unscaled BL (USBL) was calculated with the formula: USBL = NV + [NV3] [31]. In the next step, the scaled BL (SBLC) was computed by using the accelerometer logging rate (100 Hz) and exercise factor (EF) (SBLC = USBL/100/EF). At last, the BL value was determined through the following calculation: BL = BL + SBLC [32].

Then, the average match load (mean of the matches with the same result) and the accumulated TL (sum of the TLs of all training sessions during the week) were calculated for each variable with the consideration of the level of the next opponent team with the exception for maximal speed in which the average of the week was used.

Statistical analyses

Data were analysed by using the Statistical Package for the Social Sciences for Windows, version 22.0 (SPSS Inc., Chicago, IL, USA). Normality and homogeneity of data were tested and confirmed with the Shapiro-Wilk and Levene's tests, respectively. Accordingly, data were presented as means, standard deviations, and 95% confidence intervals. Thereafter, for all variables with normal distribution, repeated measures ANOVA with post-hoc Bonferroni correction [(1 group) × 3 levels of opponents (top, middle, or bottom)] was used to compare accumulated training that preceded the match and for the match itself, depending on the different levels of opponents (top, middle, or bottom). Since there were 2 variables without normal distribution, namely AccZ3 and DecZ3, Friedman ANOVA and Mann-Whitney tests were used for the same comparisons. Statistical significance of the results was accepted at $p < 0.05$. Finally, Hedges' *ES* values were computed by subtracting the mean of 2 groups and then dividing the result with the standard deviation of the population from which the groups were sampled [33, 34]. The 95% confidence intervals were also described. The following criteria were applied for *ES* classification: < 0.2, trivial effect; 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 effect [35].

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the Ethics Committee of the University of Isfahan (approval No.: IR.UI.REC.1399.064).

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

Descriptive results and comparisons between data for matches with top-, middle-, and bottom-level opponents, as well as data for accumulated external TL that preceded matches with top-, middle-, and bottom-level opponents are presented in Tables 1 and 2, respectively.

Table 1. Comparison of average data for matches with top-, middle-, and bottom-level opponents

Variable	Top-level (T) (95% CI)	Middle-level (M) (95% CI)	Bottom-level (B) (95% CI)	*p* (T vs. M)	*p* (T vs. B)	*p* (M vs. B)
MD (min)	98.5 ± 2.8 (92.3–104.8)	97.1 ± 1.1 (94.8–99.4)	84.1 ± 5.1 (72.9–95.3)	1.000	0.028*	0.095
Total distance (m)	9864.7 ± 241.1 (9334.2–10,395.3)	9570.8 ± 317.0 (8873.1–10,268.6)	9299.9 ± 471.6 (8262.0–10,337.8)	0.526	0.509	0.811
HSR (m)	243.1 ± 23.1 (192.2–293.9)	231.3 ± 27.9 (169.9–292.7)	210.1 ± 24.2 (156.9–263.3)	1.000	0.140	0.474
Sprint (m)	27.1 ± 5.2 (15.2–39.0)	33.6 ± 5.9 (20.4–46.9)	30.2 ± 6.2 (16.1–44.3)	0.315	> 0.999	> 0.999
MS ($km \cdot h^{-1}$)	27.9 ± 0.5 (26.7–29.1)	28.2 ± 0.4 (27.4–29.0)	27.3 ± 0.8 (25.6–29.07)	> 0.999	> 0.999	0.809
Body load (au)	167.3 ± 13.1 (138.5–196.1)	161.9 ± 11.1 (137.6–186.3)	163.1 ± 9.6 (141.9–184.3)	> 0.999	> 0.999	1.000
MP ($W \cdot kg^{-1}$)	19.2 ± 0.5 (17.9–20.3)	19.1 ± 0.4 (18.1–20.1)	18.1 ± 0.8 (16.3–19.9)	> 0.999	0.125	0.469
AccZ1 (*n*)	130.2 ± 4.5 (120.2–140.2)	126.1 ± 4.0 (118.0–134.2)	123.2 ± 5.7 (110.6–135.8)	0.684	0.590	> 0.999
AccZ2 (*n*)	35.7 ± 2.7 (29.8–41.6)	35.0 ± 2.1 (30.4–39.5)	32.8 ± 2.4 (27.6–38.1)	> 0.999	> 0.999	0.916
AccZ3 (*n*)	4.6 ± 0.5 (3.5–5.7)	4.5 ± 0.4 (3.6–5.5)	3.9 ± 0.5 (2.9–4.9)	> 0.999	0.211	0.127
DecZ1 (*n*)	61.7 ± 4.1 (52.6–70.8)	50.2 ± 2.3 (45.2–55.2)	48.8 ± 4.1 (39.7–57.8)	0.019*	0.069	1.000
DecZ2 (*n*)	23.5 ± 1.4 (22.5–28.6)	22.8 ± 1.3 (19.9–25.6)	22.9 ± 1.7 (19.2–26.7)	0.089	0.372	1.000
DecZ3 (*n*)	10.3 ± 0.7 (8.8–11.9)	8.1 ± 0.7 (6.7–9.6)	7.4 ± 0.4 (6.6–8.1)	0.011*	0.003*	0.505

Data are presented as mean ± standard deviation (confidence interval). * significant difference, $p < 0.05$
MD – match duration, HSR – high-speed running distance, MS – maximal speed, MP – metabolic power, AccZ1 – accelerations in zone 1 (< $2\ m \cdot s^{-2}$), AccZ2 – accelerations in zone 2 ($2–4\ m \cdot s^{-2}$), AccZ3 – accelerations in zone 3 (> $4\ m \cdot s^{-2}$), DecZ1 – decelerations in zone 1 (> $-2\ m \cdot s^{-2}$), DecZ2 – decelerations in zone 2 (-2 to $-4\ m \cdot s^{-2}$), DecZ3 – decelerations in zone 3 (< $-4\ m \cdot s^{-2}$)

Table 2. Comparison of average data for accumulated external training load that preceded matches with top-, middle-, and bottom-level opponents

Variable	Top-level (T) (95% CI)	Middle-level (M) (95% CI)	Bottom-level (B) (95% CI)	*p* (T vs. M)	*p* (T vs. B)	*p* (M vs. B)
TD (min)	280.9 ± 6.9 (265.6–296.2)	333.1 ± 5.6 (320.8–345.5)	267.5 ± 8.8 (248.2–286.8)	< 0.001*	0.824	< 0.001*
Total distance (m)	17,525.2 ± 555.7 (16,302.2–18,748.2)	19,188.2 ± 482.5 (18,126.2–20,250.3)	16,861.0 ± 595.9 (15,549.4–18,172.7)	0.011*	> 0.999	0.027*
HSR (m)	221.9 ± 30.2 (155.3–288.4)	209.3 ± 25.6 (152.9–265.6)	174.9 ± 22.8 (124.7–225.2)	> 0.999	0.080	0.011*
Sprint (m)	10.8 ± 2.3 (5.6–16.1)	8.2 ± 2.3 (2.8–13.6)	7.4 ± 1.5 (4.0–10.7)	0.562	0.159	> 0.999
MS (km · h^{-1})	26.0 ± 0.4 (25.1–26.8)	25.8 ± 0.3 (25.2–25.6)	26.0 ± 0.3 (25.2–25.7)	> 0.999	> 0.999	> 0.999
Body load (au)	400.8 ± 30.5 (333.6–468.1)	445.4 ± 46.1 (343.9–546.8)	425.6 ± 34.1 (350.7–500.6)	0.693	> 0.999	> 0.999
MP (W · kg^{-1})	22.6 ± 0.7 (20.9–24.2)	23.1 ± 0.6 (21.8–24.4)	23.8 ± 1.1 (21.3–26.3)	> 0.999	> 0.999	> 0.999
AccZ1 (*n*)	231.7 ± 13.7 (201.5–261.9)	235.7 ± 8.2 (217.6–253.8)	214.4 ± 6.8 (199.5–229.3)	> 0.999	0.587	0.05*
AccZ2 (*n*)	70.1 ± 4.9 (59.2–80.1)	71.7 ± 3.8 (63.3–80.0)	66.7 ± 4.3 (57.3–76.1)	> 0.999	> 0.999	0.131
AccZ3 (*n*)	5.8 ± 0.6 (4.4–7.2)	6.6 ± 0.6 (5.3–7.9)	7.1 ± 0.7 (5.6–8.7)	0.148	0.080	> 0.999
DecZ1 (*n*)	27.0 ± 1.2 (24.4–29.7)	25.9 ± 1.0 (23.8–28.1)	25.6 ± 0.9 (23.6–27.7)	> 0.999	0.935	> 0.999
DecZ2 (*n*)	30.9 ± 2.5 (25.3–36.5)	33.7 ± 2.3 (28.6–38.8)	34.3 ± 2.5 (28.8–39.7)	0.438	0.336	> 0.999
DecZ3 (*n*)	7.9 ± 1.1 (5.4–10.3)	8.3 ± 0.8 (6.6–10.1)	9.3 ± 0.8 (7.4–11.1)	1.000	0.275	0.322

Data are presented as mean ± standard deviation (confidence interval). * significant difference, $p < 0.05$

TD – total duration, HSR – high-speed running distance, MS – maximal speed, MP – metabolic power, AccZ1 – accelerations in zone 1 (< 2 m · s^{-2}), AccZ2 – accelerations in zone 2 (2–4 m · s^{-2}), AccZ3 – accelerations in zone 3 (> 4 m · s^{-2}), DecZ1 – decelerations in zone 1 (> –2 m · s^{-2}), DecZ2 – decelerations in zone 2 (–2 to –4 m · s^{-2}), DecZ3 – decelerations in zone 3 (< –4 m · s^{-2})

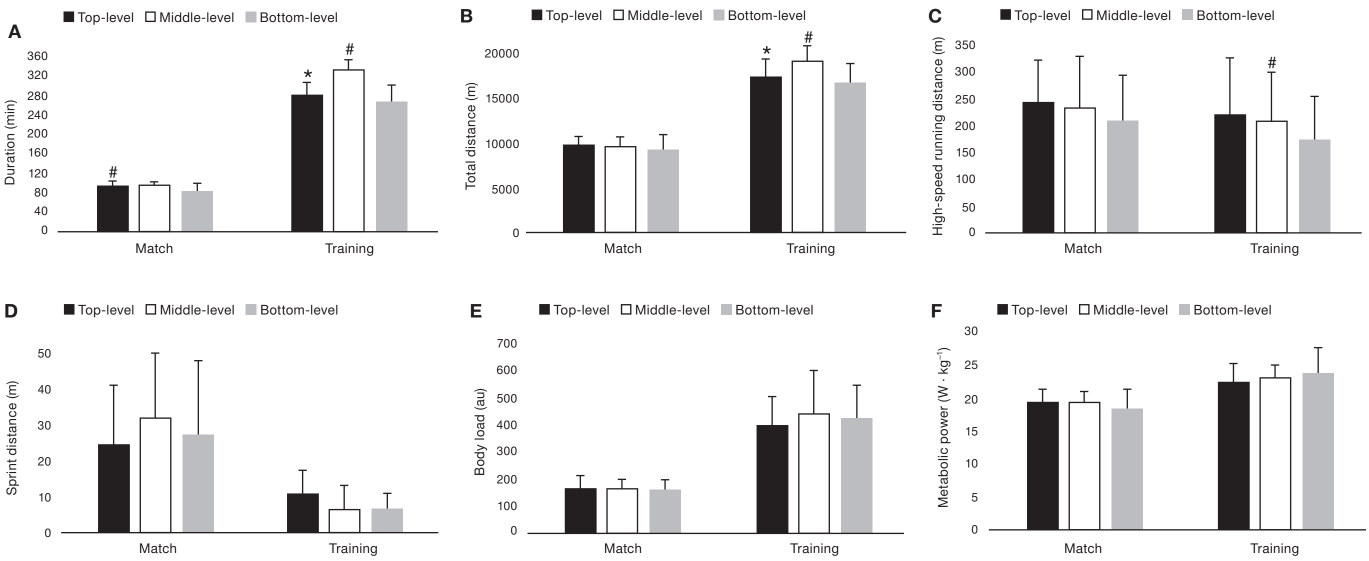
Regarding matches depicted in Table 1, only 4 significant differences were found. Match duration was significantly higher in the case of top-level opponents compared with bottom-level opponents [*ES* = –2.31 (–3.34, –1.28)]. In addition, DecZ1 exhibited higher values against top-level than against middle-level opponents [*ES* = 1.00 (0.12, 1.81)]. Finally, DecZ3 showed higher values against top-level than against middle-level opponents [*ES* = 0.91 (0.07, 1.75)] or bottom-level opponents [*ES* = 1.50 (0.59, 2.40)].

As shown in Table 2, there was a significantly higher accumulated TD in cases of middle-level opponents when compared with top-level opponents [*ES* = 3.38 (2.13, 4.63)] and bottom-level opponents [*ES* = 2.49 (1.42, 3.55)]. Also, total distance exhibited a significantly higher value against middle-level opponents when compared with top-level opponents [*ES* = –0.92 (–1.73, –0.05)] and bottom-level opponents [*ES* = 1.50 (0.59, 2.40)]. In addition, high-speed running distance was longer when top-level opponents came close; however, a significant difference was found for playing against middle- vs. bottom-level opponents, with higher values for middle-level [*ES* = 0.39 (–0.41, 1.20)]. AccZ1 showed higher values when middle-level opponents came close, with a significant difference vs. bottom-level opponents [*ES* = 0.79 (–0.04, 1.62)].

Figures 1 and 2 show comparisons between matches and accumulated external TL. In general, there were higher values for training and matches against top- and middle-level opponents. The exceptions involved BL (Figure 1F), where higher training values were found for middle- and bottom-level opponents; metabolic power (Figure 1G), where higher training values were observed in the case of bottom-level opponents; as well as AccZ3 (Figure 2C), DecZ2 (Figure 2E), and DecZ3 (Figure 2F), which exhibited higher training values for bottom-level opponents.

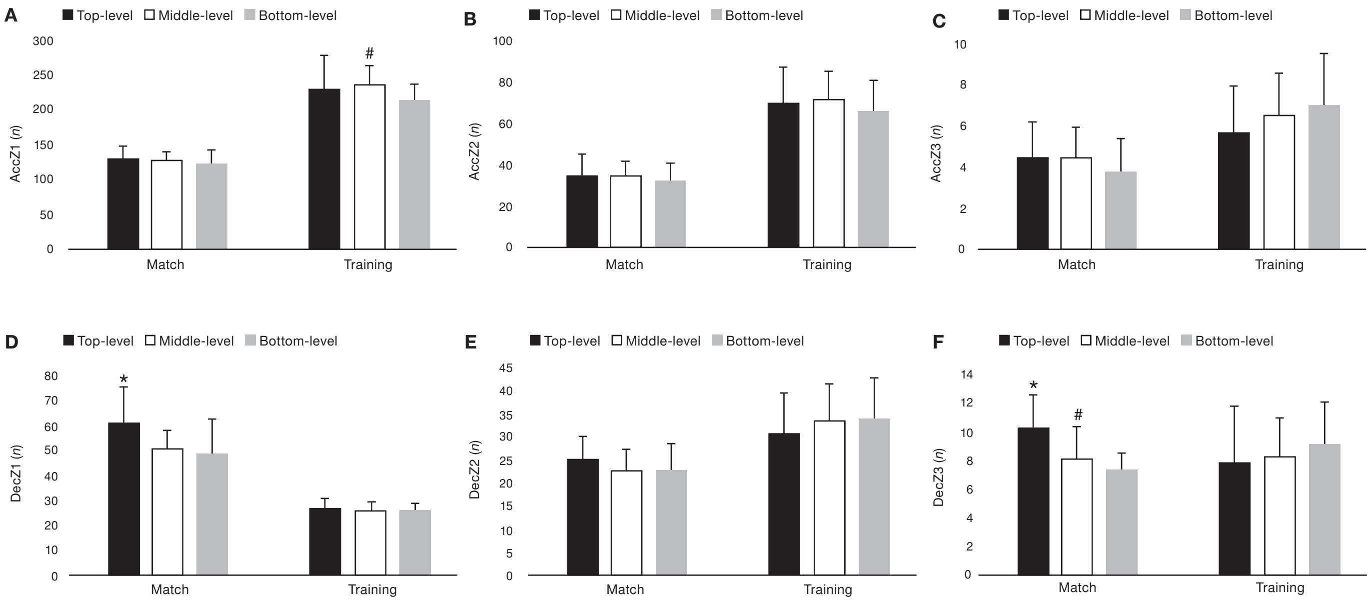
Discussion

This study provides further information regarding the influence of a contextual factor, namely opponent level, on TL prior to and during matches in an Asian professional league. TD was significantly higher in the case of middle-level opponents when compared with bottom-level opponents. DecZ3 showed higher values against top-level opponents that against middle- or bottom-level opponents. Regarding accumulated TD, there was a significantly higher value against middle-level opponents when compared with top- and bottom-level opponents. In addition, high-speed running distance was bigger when top-level opponents



* difference from middle-level, # difference from bottom-level

Figure 1. Differences of match data for top-, middle-, and bottom-level opponents, and differences of accumulated external training load that preceded matches against top-, middle-, and bottom-level opponents for duration (A), total distance (B), high-speed running distance (C), sprint distance (D), body load (E), and metabolic power (F)



* difference from middle-level, # difference from bottom-level

Figure 2. Differences of match data for top-, middle-, and bottom-level opponents, and differences of accumulated external training load that preceded matches against top-, middle-, and bottom-level opponents for acceleration zone 1 (AccZ1) (< 2 m · s^{-2}) (A), AccZ2 (2–4 m · s^{-2}) (B), AccZ3 (> 4 m · s^{-2}) (C), and deceleration zone 1 (DecZ1) (> –2 m · s^{-2}) (D), DecZ2 (–2 to –4 m · s^{-2}) (E), DecZ3 (< –4 m · s^{-2}) (F)

came close; however, a significant difference was found between middle- and bottom-level opponents, with higher values for the middle-level ones. Finally, AccZ1 exhibited higher values when middle-level opponents came close, with a significant difference vs. bottom-level opponents. The findings partially confirm our hypothesis that the opponent level influences the activity of soccer players during matches and also TL varies accordingly.

The total distance covered during matches was longer when playing against top-level teams than against middle- or bottom-level teams. However, the differences were non-significant. Our results are in agreement with previous studies in which the level of the opponent was reported to influence the match running performance of soccer players. For instance, Rampinini et al. [36] noted that TD and high-intensity running distance were greater when soccer players competed against high-quality opponents. Lago et al. [13] implied that the distance covered in jogging and walking was longer when the quality of the opponent was higher. Therefore, the findings from our study, as well as from previous research indicate that soccer players should be physically prepared to cover relatively higher distances when playing against superior opponents.

The TD covered in training while preparing for the competition showed a significant difference at all the 3 levels, with the players analysed in our study covering the longest distance against middle-level teams, followed by top- and bottom-level teams. Playing against strong opponents has been associated with lower ball possession [37, 38], and it is possible that higher distances were covered in an attempt to regain possession. Further, the EL during the preparatory phase could be related to the outcome of the previous match. Some studies highlighted that TL generally increased after losing or drawing a match, whereas TL was minor after winning a match [18, 19]. Further, a reduction in TL has been observed before and after playing against a top-level opponent [39]. This could also be one of the reasons for the lesser training duration when playing against low-level opponents. However, it has to be noted that our study involved an analysis of only 6 matches with top-level teams, whereas 11 matches were analysed for middle- and 11 for bottom-level teams. Therefore, further research needs to be conducted with a larger sample size in order to obtain a better understanding of this topic.

The players investigated in our study were observed to accumulate more distance during high-speed running while playing against top- and middle-level teams compared with bottom-level opponents. Our findings are different from the ones reported by Chena et al. [40], where players from top-ranked teams covered lesser distances in high-speed running while playing against middle- or low-level teams. These differences in results could be due to the differences in the tactical strategy of the team analysed in our study. For instance, it has been suggested that the total distance may reduce while playing against top- or bottom-level teams owing to the players accumulating at either end of the pitch [41]. However, such a situation would increase the sub-maximal and maximal running distances [41]. Therefore, it can be stated that varying EL during high-speed running could be a way to prepare athletes to successfully respond to the demands of the highly intense competition.

Our study revealed that the accelerations and decelerations were significantly different when playing against top-level teams compared with middle- and bottom-level teams. Even though the accelerations and decelerations were higher in the case of top-level opponents, the differences were non-significant. This could be due to the complexity of soccer training factors, which involve physical capacity [42], environment [1], tactical formation [18, 43], and technical level [44]. Also, this could result from the potential physical performance of players in the top-level teams and their fitness levels while performing such tasks. However, no differences in high-speed running distance were observed between the 3 conditions during the match. This further highlights that the load experience in high-speed running could be due to the teams' tactics and game plan for their opponents.

Another interesting finding was that the accelerations in AccZ1 were significantly different during the training sessions while preparing matches with middle- and bottom-level teams. The coaches might have increased TL in the middle of the week in the case of bottom-level opponents to maintain the physical fitness of the players [21]. However, it has been observed that coaches also reduce TL during the week when the play is against middle-level opponents, which is usually considered as a tactical strategy [21]. Therefore, it is suggested that practitioners vary TL with the intent to reduce fatigue [45] and maximize performance during matches [46].

Our results indicate significant differences in the DecZ1 and DecZ3 during matches. The players covered the biggest distance in the case of top-level opponents. This could be due to the greater number of sprints performed by top-level teams because of their tactical strategies. Apart from the team tactics, situational factors such as match importance, intensity, score line, competitive anxiety, higher level of athletes' commitment, and the psychological pressure on the players from the top-level team could have contributed to the increased distance covered in these acceleration and deceleration zones [47, 48].

The findings from this study have some practical applications. They complement the results from previous studies [19, 20], where the opponent level might be an important factor to consider while determining the TL and match activity of soccer players. Therefore, to draw valuable inferences by quantification of external TL relative to the match is important for training planning, especially when the goal is to optimize individual workloads. Specifically, load quantification relative to the match may be an advantageous strategy to be used by coaches within training periodization models.

There are some limitations in this study that need to be acknowledged. The number of matches analysed is very small. Further research needs to be conducted with a greater number of matches for each opponent level to provide better insight and understanding of the issue. In addition, our study included only 1 contextual variable, i.e., the opponent level. Therefore, other factors such as match location (home/away matches) or previous match outcome need to be researched and analysed to determine their influence on TL. Lastly, only 1 season was analysed in our study. Hence, future research should focus on multiple seasons in the context of TL.

Conclusions

The current study provides coaches and practitioners with valuable information regarding the influence of the opponent level on TL and match performance indicators in soccer. On the one hand, total distance, high-speed running distance, AccZ1, and AccZ2 presented higher training values in weeks in which a win or a draw approached. On the other hand, decelerations in all zones exhibited highest values for matches played against top-level teams.

The information regarding the opponent level can be used by practitioners in formulating training strategies, physical preparation, and after-game recovery protocols. Further research needs to be conducted in order to determine the load experienced in each playing position while competing against opponents of various playing levels to provide a better understanding of this topic.

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Conflict of interest

The authors state no conflict of interest.

References

1. Rampinini E, Impellizzeri FM, Castagna C, Coutts AJ, Wisløff U. Technical performance during soccer matches of the Italian Serie A league: effect of fatigue and competitive level. J Sci Med Sport. 2009;12(1):227–233; doi: 10.1016/j.jsams.2007.10.002.
2. Buchheit M. The numbers will love you back in return – I promise. Int J Sports Physiol Perform. 2016;11(4): 551–554; doi: 10.1123/IJSPP.2016-0214.
3. Bradley PS, Sheldon W, Wooster B, Olsen P, Boanas P, Krustrup P. High-intensity running in English FA Premier League soccer matches. J Sports Sci. 2009;27(2): 159–168; doi: 10.1080/02640410802512775.
4. Mohr M, Krustrup P, Bangsbo J. Match performance of high-standard soccer players with special reference to development of fatigue. J Sports Sci. 2003;21(7):519–528; doi: 10.1080/0264041031000071182.
5. Morgans R, Orme P, Anderson L, Drust B, Morton JP. An intensive winter fixture schedule induces a transient fall in salivary IgA in English Premier League soccer players. Res Sports Med. 2014;22(4):346–354; doi: 10.1080/15438627.2014.944641.
6. Mallo J, Mena E, Nevado F, Paredes V. Physical demands of top-class soccer friendly matches in relation to a playing position using Global Positioning System technology. J Hum Kinet. 2015;47(1):179–188; doi: 10.1515/hukin-2015-0073.
7. Russell M, Sparkes W, Northeast J, Cook CJ, Love TD, Bracken RM, et al. Changes in acceleration and deceleration capacity throughout professional soccer match-play. J Strength Cond Res. 2016;30(10):2839–2844; doi: 10.1519/JSC.0000000000000805.
8. Barrera J, Sarmento H, Clemente FM, Field A, Figueiredo AJ. The effect of contextual variables on match performance across different playing positions in professional Portuguese soccer players. Int J Environ Res Public Health. 2021;18(10):5175; doi: 10.3390/ijerph18105175.
9. Jaspers A, Brink MS, Probst SGM, Frencken WGP, Helsen WF. Relationships between training load indicators and training outcomes in professional soccer. Sports Med. 2017;47(3):533–544; doi: 10.1007/s40279-016-0591-0.
10. Clemente FM, Silva R, Chen Y-S, Aquino R, Praça GM, Castellano J, et al. Accelerometry-workload indices concerning different levels of participation during congested fixture periods in professional soccer: a pilot study conducted over a full season. Int J Environ Res Public Health. 2021;18(3):1137; doi: 10.3390/ijerph18031137.
11. Gabbett TJ. Debunking the myths about training load, injury and performance: empirical evidence, hot topics and recommendations for practitioners. Br J Sports Med. 2020;54(1):58–66; doi: 10.1136/bjsports-2018-099784.

12. Borresen J, Lambert MI. Quantifying training load: a comparison of subjective and objective methods. Int J Sports Physiol Perform. 2008;3(1):16–30; doi: 10.1123/ijspp.3.1.16.
13. Lago C, Casais L, Dominguez E, Sampaio J. The effects of situational variables on distance covered at various speeds in elite soccer. Eur J Sport Sci. 2010;10(2):103–109; doi: 10.1080/17461390903273994.
14. Aquino R, Munhoz Martins GH, Palucci Vieira LH, Menezes RP. Influence of match location, quality of opponents, and match status on movement patterns in Brazilian professional football players. J Strength Cond Res. 2017;31(8):2155–2161; doi: 10.1519/JSC.0000000000001674.
15. Castellano J, Blanco-Villaseñor A, Álvarez D. Contextual variables and time-motion analysis in soccer. Int J Sports Med. 2011;32(6):415–421; doi: 10.1055/s-0031-1271771.
16. Folgado H, Duarte R, Fernandes O, Sampaio J. Competing with lower level opponents decreases intra-team movement synchronization and time-motion demands during pre-season soccer matches. PLoS One. 2014;9(5):e97145; doi: 10.1371/journal.pone.0097145.
17. Rago V, Silva J, Mohr M, Randers M, Barreira D, Krustrup P, et al. Influence of opponent standard on activity profile and fatigue development during preseasonal friendly soccer matches: a team study. Res Sport Med. 2018;26(4):413–424; doi: 10.1080/15438627.2018.1492400.
18. Aquino R, Palucci Vieira LH, Carling C, Martins GHM, Alves IS, Puggina EF. Effects of competitive standard, team formation and playing position on match running performance of Brazilian professional soccer players. Int J Perform Anal Sport. 2017;17(5):695–705; doi: 10.1080/24748668.2017.1384976.
19. Brito J, Hertzog M, Nassis GP. Do match-related contextual variables influence training load in highly trained soccer players? J Strength Cond Res. 2016;30(2):393–399; doi: 10.1519/JSC.0000000000001113.
20. Rago V, Rebelo A, Krustrup P, Mohr M. Contextual variables and training load throughout a competitive period in a top-level male soccer team. J Strength Cond Res. 2021;35(11):3177–3183; doi: 10.1519/JSC.0000000000003258.
21. Gonçalves LGC, Kalva-Filho CA, Nakamura FY, Rago V, Afonso J, de Souza Bedo BL, et al. Effects of match-related contextual factors on weekly load responses in professional Brazilian soccer players. Int J Environ Res Public Health. 2020;17(14):5163; doi: 10.3390/ijerph17145163.
22. Oliveira R, Brito JM, Loureiro N, Padinha V, Ferreira B, Mendes B. Effects of match location, match result and the quality of opposition in training load on a two-matches week in a top-class elite European soccer team. Cuad Psicol Deporte. 2021;21(2):183–197; doi: 10.6018/cpd.465531.
23. Faul F, Erdfelder E, Lang A-G, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods. 2007;39(2):175–191; doi: 10.3758/bf03193146.
24. Nobari H, Banoocy NK, Oliveira R, Pérez-Gómez J. Win, draw, or lose? Global Positioning System-based variables' effect on the match outcome: a full-season study on an Iranian professional soccer team. Sensors. 2021;21(17):5695; doi: 10.3390/s21175695.
25. Nobari H, Brito JP, Pérez-Gómez J, Oliveira R. Variability of external intensity comparisons between official and friendly soccer matches in professional male players. Healthcare. 2021;9(12):1708; doi: 10.3390/healthcare9121708.
26. Johnston RJ, Watsford ML, Kelly SJ, Pine MJ, Spurrs RW. Validity and interunit reliability of 10 Hz and 15 Hz GPS units for assessing athlete movement demands. J Strength Cond Res. 2014;28(6):1649–1655; doi: 10.1519/JSC.0000000000000323.
27. Rawstorn JC, Maddison R, Ali A, Foskett A, Gant N. Rapid directional change degrades GPS distance measurement validity during intermittent intensity running. PLoS One. 2014;9(4):e93693; doi: 10.1371/journal.pone.0093693.
28. Tessaro E, Williams JH. Validity and reliability of a 15 Hz GPS device for court-based sports movements. Sport Perform Sci Rep. 2018;29(1).
29. Nobari H, Praça GM, Clemente FM, Pérez-Gómez J, Vivas JC, Ahmadi M. Comparisons of new body load and metabolic power average workload indices between starters and non-starters: a full-season study in professional soccer players. Proc Inst Mech Eng P J Sports Eng Technol. 2021;235(2):105–113; doi: 10.1177/1754337120974873.
30. Osgnach C, Poser S, Bernardini R, Rinaldo R, di Prampero PE. Energy cost and metabolic power in elite soccer: a new match analysis approach. Med Sci Sports Exerc. 2010;42(1):170–178; doi: 10.1249/MSS.0b013e3181ae5cfd.
31. Nobari H, Mainer-Pardos E, Zamorano AD, Bowman TG, Clemente FM, Pérez-Gómez J. Sprint variables are associated with the odds ratios of non-contact injuries in professional soccer players. Int J Environ Res Public Health. 2021;18(19):10417; doi: 10.3390/ijerh181910417.
32. Nobari H, Gonçalves LG, Aquino R, Clemente FM, Rezaei M, Carlos-Vivas J, et al. Wearable inertial measurement unit to measure external load: a full-season study in professional soccer players. Appl Sci. 2022; 12(3):1140; doi: 10.3390/app12031140.
33. Hedges LV, Olkin I. Statistical methods for meta-analysis. Orlando: Academic Press; 1985.
34. Lakens D. Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. Front Psychol. 2013;4:863; doi: 10.3389/fpsyg.2013.00863.

35. Hopkins WG, Marshall SW, Batterham AM, Hanin J. Progressive statistics for studies in sports medicine and exercise science. Med Sci Sports Exerc. 2009;41(1):3–12; doi: 10.1249/MSS.0b013e31818cb278.
36. Rampinini E, Coutts AJ, Castagna C, Sassi R, Impellizzeri FM. Variation in top level soccer match performance. Int J Sports Med. 2007;28(12):1018–1024; doi: 10.1055/s-2007-965158.
37. Bloomfield J, Polman R, O'Donoghue PG. Effects of score-line on team strategies in FA Premier Leaue soccer. J Sports Sci. 2005;23(2):192–193; doi: 10.1080/02640410512331334413.
38. Lago C. The influence of match location, quality of opposition, and match status on possession strategies in professional association football. J Sports Sci. 2009; 27(13):1463–1469;doi:10.1080/02640410903131681.
39. Teixeira JE, Forte P, Ferraz R, Leal M, Ribeiro J, Silva AJ, et al. Monitoring accumulated training and match load in football: a systematic review. Int J Environ Res Public Health. 2021;18(8):3906; doi: 10.3390/ijerph18083906.
40. Chena M, Morcillo JA, Rodríguez-Hernández ML, Zapardiel JC, Owen A, Lozano D. The effect of weekly training load across a competitive microcycle on contextual variables in professional soccer. Int J Environ Res Public Health. 2021;18(10):5091; doi: 10.3390/ijerph18105091.
41. Redwood-Brown AJ, O'Donoghue PG, Nevill AM, Saward C, Sunderland C. Effects of playing position, pitch location, opposition ability and team ability on the technical performance of elite soccer players in different score line states. PLoS One. 2019;14(2):e0211707; doi: 10.1371/journal.pone.0211707.
42. Krustrup P, Mohr M, Amstrup T, Rysgaard T, Johansen J, Steensberg A, et al. The Yo-Yo intermittent recovery test: physiological response, reliability, and validity. Med Sci Sports Exerc. 2003;35(4):697–705; doi: 10.1249/01.MSS.0000058441.94520.32.
43. Aquino R, Machado JC, Clemente FM, Praça GM, Gonçalves LGC, Melli-Neto B, et al. Comparisons of ball possession, match running performance, player prominence and team network properties according to match outcome and playing formation during the 2018 FIFA World Cup. Int J Perform Anal Sport. 2019;19(6):1026–1037; doi: 10.1080/24748668.2019.1689753.
44. Mohr M, Nybo L, Grantham J, Racinais S. Physiological responses and physical performance during football in the heat. PLoS One. 2012;7(6):e39202; doi: 10.1371/journal.pone.0039202.
45. Thorpe RT, Strudwick AJ, Buchheit M, Atkinson G, Drust B, Gregson W. The influence of changes in acute training load on daily sensitivity of morning-measured fatigue variables in elite soccer players. Int J Sports Physiol Perform. 2017;12(Suppl. 2):S2-107–S2-113; doi: 10.1123/ijspp.2016-0433.
46. Coutts A, Chamari K, Impellizzeri F, Rampinini E. Control and monitoring of football training: periodization and training loads [in French]. In: Dellal A (ed.), From training to performance in football [in French]. Bruxelles: De Boeck; 2008; 234–264.
47. Freitas CG, Aoki MS, Arruda AFS, Franciscon C, Moreira A. Monitoring salivary immunoglobulin A responses to official and simulated matches in elite young soccer players. J Hum Kinet. 2016;53:107–115; doi: 10.1515/hukin-2016-0015.
48. Jourkesh M. The effects of successive official competitions on salivary cortisol and immunoglobulin responses in women handballers. Serb J Sports Sci. 2011; 11(2):67–73.