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Most running demand passages of match play in youth soccer congestion period

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ABSTRACT: The objective of this study was to determine whether there is a decrease in the physical performance of the players in the most demanding passages (MDP) during periods of competition congestion. The study involved 15 under-19 players, belonging to a club in Spain's first division (age: 18.1 ± 0.8 years, weight: 70.2 ± 4.9 kg and height: 1.78 ± 0.06 m), who were monitored during 23 national and international official matches in the 2018/19 season. The Youth League matches were played between two matches in the national championship in six different weeks. The league matches corresponded to the first 17 matches of the league championship, the period in which the 6 matches in the Youth League were played. The two physical variables analysed were total distance (TD) and distance at > 21 $km \cdot h^{-1}$ (TD21). Using the rolling average, four time windows were taken (1, 3, 5 and 10 min), and the values were relativized to the minute ($m \cdot min^{-1}$). The main results were that: there were more MDP in the first halves than in the second halves of all the time windows; 2) the central match in the week (Youth League) was the most demanding one; and 3) the players maintained the TD and TD21 in the MDP in the third match compared to the first. The results of this study could provide trainers with information on the need to design training tasks that simulate the demands of competition in relation to the TD and the TD21 according to different time windows.

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INTRODUCTION

Elite players have to withstand a great deal of stress to perform at their best in each match in which they play. The analysis of match running performance is not new [1] and has been conducted for various purposes (e.g., to distinguish profiles of the positions, to assess potential temporary fatigue, etc.), although a more tactical-strategic perspective should also be considered [2]. Currently, weeks congested with matches in different competitions, long journeys in some cases and calendars limited by international events expose players to significant physical, physiological and psychological stress [2]. Inevitably, and most likely for commercial purposes, competitive international demands and the stress of a number of competitions in elite football are now reaching junior football as well [3].

The importance of high-speed actions in professional football is known [4], and this importance seems to increase when the competitive level [5] or level of the opponent [6–7] is higher. In particular, in the past few years an interest has emerged in the most demanding passages (MDP) in competition matches [8] with the goal of showing whether the mean values usually used as referents for analysing running performance in competition matches are actually representative of all possible passages. The MDP which are most valid or best reflect this reality come from the moving average technique, which has been applied to football in previous studies [9–10–11]. Depending on the time window chosen, from the shortest, 1 minute, to the longest, 45 minutes [11], this results in a decreasing magnitude of the particular variable studied following the *power law* [12].

Even though there is extensive literature on the match running performance of players in periods congested with matches [13], the results do not always show a decrease in the distance run by players. Here it could be useful to ascertain whether in a succession of matches the players, regardless of whether they maintain or lower the total volume of work in successive matches, are capable of responding equally to the MDP. Even though the players may restore their baseline 72–90 hours after the match [14], the impossibility of replicating a similar MDP between matches may indicate a failure to recover between matches which is associated with an increase in injuries [15].

Based on the foregoing, the main objective of this study is to identify whether there is a decrease in the running distance above 21 $km \cdot h^{-1}$ among players as the matches succeed one another in a period of match congestion in competition (e.g., three matches in eight days), considering exclusively the MDP with different time windows. The results of this study may alert trainers to customise the small sided games with which they simulate the demands of competition in relative distance running and high-intensity distance running according to different time windows.

MATERIALS AND METHODS

Participants

Fifteen players in the under 19 (U-19) category participating in a club in Spain's first division (age: 18.1 ± 0.8 years, weight: 70.2 ± 4.9 kg and height: 1.78 ± 0.06 m) were evaluated during 23 competitive matches in the 2018–19 season; 17 league matches (11 wins, 2 draws and 4 defeats) and six matches in the group phase of the Youth League (3 wins, 2 draws and 1 defeat). The matches in the Youth League were played on the central days of the week (Tuesday or Wednesday) with at least two days of rest between matches in the two competitions. Data were collected on players who repeated and completed the first (MD1) and second (MD2) match of the week (n = 33), 20 of whom also competed in the third match (MD3). The team systematically played in a 1-4-3-3 formation, with a goalkeeper, two fullbacks (19 players; 218 individual files), two central defenders, a midfielder, two wide midfielders and three forwards. Goalkeepers were excluded from the analysis. On the other hand, field players who did not complete the first and second match in the same week were not included in the analysis. Data arose as a condition of the players' employment whereby they were assessed daily. Although ethics committee clearance was not required [16], prior to the commencement of the study, all the subjects were informed of the aims and requirements of the research, and players gave their informed consent to participate in the research. The study conformed to the recommendations of the Declaration of Helsinki.

Design

During the matches studied, the players' running was recorded with a portable GPS unit (WIMU PRO TM, Realtrack Systems S.L., Almeria, Spain). The device has two sensors to record spatial position, speed and acceleration: GNSS/GPS at 10 Hz. The GPS model used in this study was worn in a vest designed for this purpose, inside a mini pocket positioned in the centre of the upper back, just above the shoulder blades, thus not affecting the mobility of the upper limbs and torso. Upon completion of each match, the GPS data were extracted using proprietary software (WIMU PRO TM, Realtrack Systems S.L., Almeria, Spain).

Most Demanding Passages and Match Running Variables

Using SPRO^{TM} software (Realtrack Systems S.L., Almería, Spain), the MDP were obtained based on four time windows and two running variables. The four time windows were 1, 3, 5 and 10 minutes (P1, P3, P5 and P10, respectively), and they were calculated using the rolling procedure [17]. The two variables analysed, based on which the MDP were calculated, were total distance (TD; $m \cdot min^{-1}$) and total distance run at > 21 $km \cdot h^{-1}$ (TD21; $m \cdot min^{-1}$). These four different durations were analysed because they correspond to the usual length of the training drills in the team studied. To facilitate a comparison of the values of both variables in all four time windows, the data were relativized to the minute ($m \cdot min^{-1}$).

Congestion Periods

When three consecutive matches were played within eight days, this was considered a period of congestion [13]. In this study, the first (MD1) and third (MD3) match of the week corresponded to matches being played as part of the national championship, while the second of the matches (MD2) was part of the international championship. The league matches corresponded to the first 17 fixtures of the league championship, a period when the six matches in the Youth League were played. The weeks with three matches were interspersed in the international matches between the 3rd-4th, 5th-6th, 8th-9th, 10th-11th, 13th-14th and 16th-17th fixtures.

Statistical Analysis

Data are presented with means and standard deviation of measurement (SEM) in Figures 1 and 2 for both TD covered and distance covered TD21, respectively. T-test paired analysis was performed (95% CI for mean difference) in order to compare differences between halves for each match and differences among matches (only using the MDP from the first half). In addition, Cohen's effect size (d) was also calculated and is shown in Figures 3 and 4. The Hopkins scale was used for magnitude interpretation: < 0.2: trivial; > 0.2-to-0.6: small; > 0.6-to-1.2: moderate; > 1.2: large [18].

RESULTS

Figures 1 and 2 show the values for both physical variables (TD and TD21) for each rolling average period (P1, P·, P5, and P10),, half (H1 and H2) and match (MD1, MD2 and MD3). Comparing halves, the paired difference in the mean, 95% CI, T-test value and significance level ($p < 0.05$), were as follows: a) for TD the MDP in H1 was higher than in H2, in MD1 for P1 (8.0, 2.7–13.3, t = 3.07), P3 (7.3, 3.2–11.3, t = 3.66), P5 (9.2, 5.8–12.6, t = 5.47) and P10 (9.7, 7.4–12.1, t = 8.43); in MD2 for P3 (10.3, 3.2–17.3, t = 2.98), P5 (13.8, 8.4–19.3, t = 5.18) and P10 (10.3, 6.3–14.2, t = 5.31); in MD3 for P3 (5.4, 1.3–9.6, t = 2.73), P5 (8.2, 3.7–12.8, t = 3.79) and P10 (8.8, 4.9–12.7, t = 4.73); b) for TD21 the MDP in H1 was higher than in H2, in MD2 for P1 (9.9, 3.0–16.8, t = 2.91), P3 (6.7, 4.0–9.3, t = 5.17), P5 (5.0, 3.1–6.9, t = 5.29) and P10 (3.1, 1.7–4.5, t = 4.50).

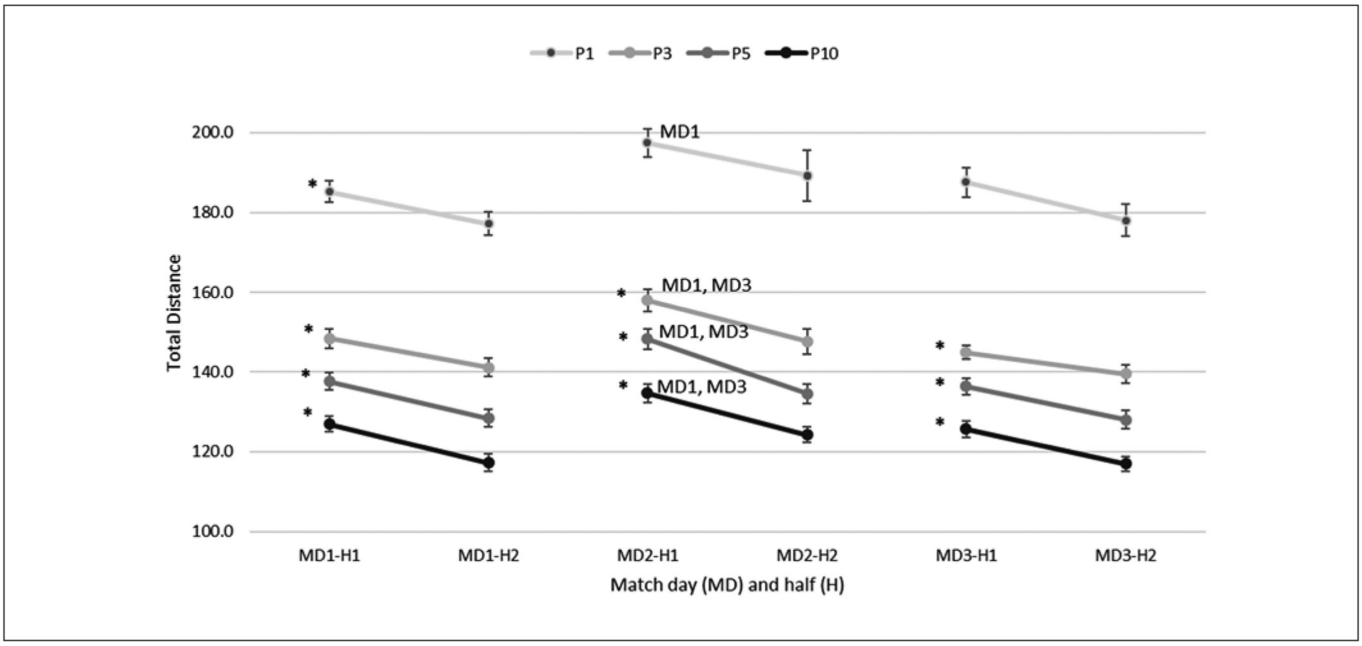

FIG. 1. Total distance covered per minute in individual analyses for the four different periods (P1, P3, P5 and P10 are 1, 3, 5 and 10 minutes of rolling average) across the halves (H1 is first half and H2 is second half) during three consecutive matches (MD1, MD2 and MD3) over eight days. * is > H2, MD1 is > MD1 and MD3 is > MD3.

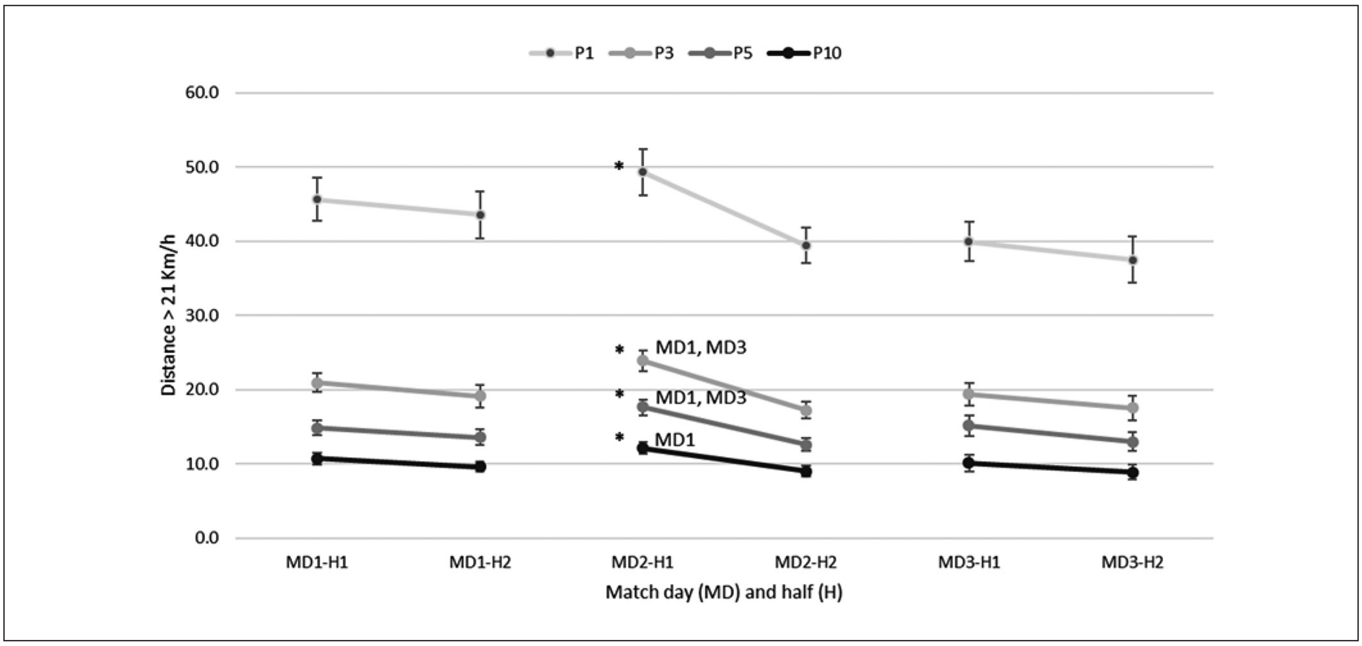

FIG. 2. Total distance above 21 km·h^{-1} covered per minute in individual analyses for the four different periods (P1, P3, P5 and P10 are 1, 3, 5 and 10 minutes of rolling average) across the halves (H1 is first half and H2 is second half) during three consecutive matches (MD1, MD2 and MD3) over eight days. * is > H2, MD1 is > MD1 and MD3 is > MD3.

The qualitative assessment of the differences between halves for almost all the matches, the two physical variables and the time periods was decreasing, with a range between small and moderate, with the exception of the league matches (MD1 and MD3), where the difference was trivial for TD21. The remaining qualitative assessments based on Cohen's d were the following: a) for TD in P1 in the three matches there was a small decrease, in P3 for MD1 and MD3 there was a small decrease, while for MD2 there was a moderate decrease, in P5 and P10 all the matches showed a moderate decrease: b) for TD21 in P1 the MD2 showed a moderate decrease, in P3, P5 and P10 both MD1 and MD3 had a small decrease, while for MD2 the decrease was moderate.

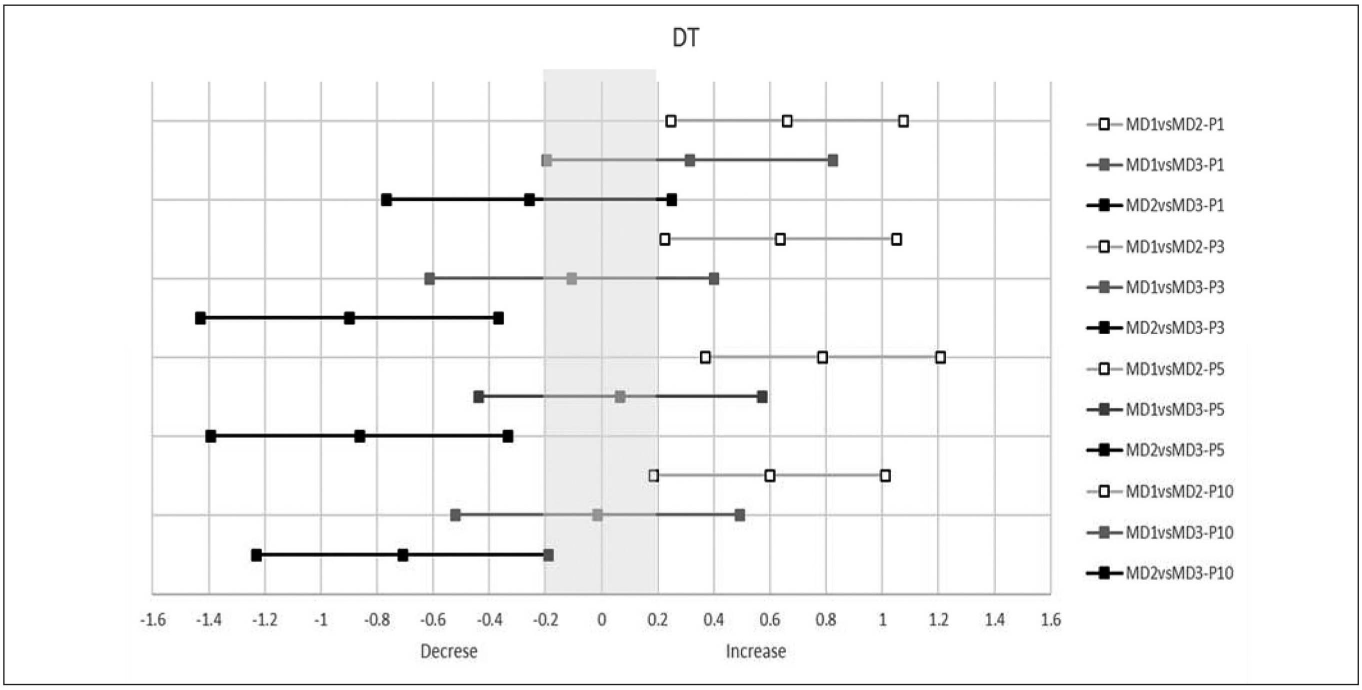

FIG. 3. Standardised effect sizes and 95% confidence intervals for the total distance (TD) comparing the most demanding passages among matches in four periods (P1 is the rolling average of one minute, P3 is three minutes, P5 is five minutes and P10 is ten minutes). Negative values represent lower results during the previous match.

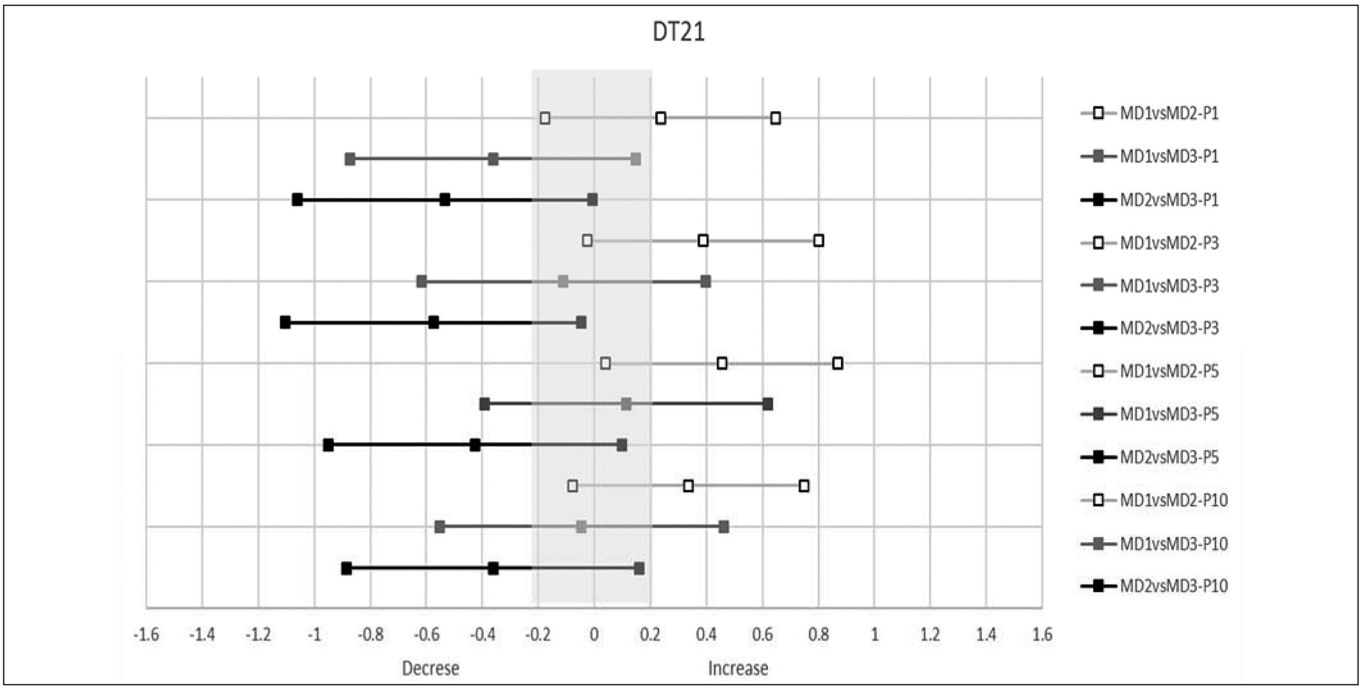

FIG. 4. Standardised effect sizes and 95% confidence intervals for the total distance at > 21 $km \cdot h^{-1}$ (TD21), comparing the most demanding passages among matches in four periods (P1 is the rolling average of one minute, P3 is three minutes, P5 is five minutes and P10 is ten minutes). Negative values represent lower results during the previous match.

When we compare MDP significant differences ($p < 0.05$) among matches, the results were higher in MD2 than in MD1 for TD in the periods P1 (-12.0, -19.0--5.0, t = -3.50), P3 (-9.6, -14.9--4.2, t = -3.66), P5 (-10.7, -15.3--6.2, t = -4.81) and P10 (-7.3, -10.8--3.8, t = -4.23), and for TD21 in the periods P3 (-3.0, -5.6--0.3, t = -2.24), P5 (-2.7, -4.5--0.9, t = -3.06) and P10 (-1.6, -2.9--0.2, t = -2.34). Also, there were significant differences between MD2 with respect MD3 (MD2 > MD3) for TD in the periods P3 (12.0, 5.2–18.8, t = 3.68), P5 (11.2, 5.1–17.3, t = 3.84) and P10 (8.1, 3.1–13.0, t = 3.41), and for TD21 in the periods

P3 (4.7, 0.3–9.0, t = 2.24) and P5 (2.8, 0.0–5.6, t = 2.10). There were no differences in TD and TD21 between MD1 and MD3.

From a qualitative standpoint, the magnitude of the differences among matches ranged from trivial to large depending on the variable (TD or TD21) and the rolling average periods (P1, P3, P5 and P10) selected. Summarising the results, just the moderate and large differences can be described as follows: a) in MD2 there was a large increase (for periods P1, P3 and P5) compared to MD1 and a moderate increase (P10) for TD, and a moderate increase for all the periods in TD21; b) in MD1, there was a moderate increase in the TD compared to MD3; and, c) there was a moderate decrease, MD2 < MD3, for the periods P3, P5 and P10 for TD. The rest of the magnitudes can be seen in Figures 3 and 4.

DISCUSSION

The purpose of this study was to compare the activity of young football players during the MDP in two or three consecutive matches played over a period of 4 or 8 days, respectively. To the authors' knowledge, this is the first study to inquire into activity during MDP in periods of congestion in competition among young players. The main findings of this study show that in the four time windows studied (1, 3, 5 or 10 minutes), the values obtained in the first half were higher than in the second half. Furthermore, regardless of the time window, there were differences between the first and second match, with players running longer distances in the international match (MD2) and shorter distances in the third of the league matches (MD3) compared to the first one (MD1). The results show that there was probably acute fatigue during the match (difference between the first and second halves), yet the players did not show a decline in running performance in the MDP in the successive matches.

Several recent studies have described the MDP of football competition [9–10–11]. Thanks to them, we now know that tasks usually designed for training will likely result in players being underprepared for the most demanding phases of football match play [19]. While periods of 3, 5 or 10 minutes reached values close to 140 $m \cdot min^{-1}$, similar to a previous study [20] that analysed peak distance covered in 5-minute periods, when the time window selected is 1 minute this demand becomes 30% higher (e.g., around 190 $m \cdot min^{-1}$). The 1-min rolling period values in this study were slightly higher than the 180 $m \cdot min^{-1}$ [10] and 175 $m \cdot min^{-1}$ [9] reported previously. Nevertheless, the relative high-speed running distances (> 50 $m \cdot min^{-1}$) registered by Delaney et al. [9] were slightly higher than those found in this study. Differences in the speed range, 19.8 $km \cdot h^{-1}$ (Delaney's study) vs 21 $km \cdot h^{-1}$ (in this study), could be one of the reasons.

The halves of a game have been compared in numerous studies [21–22], although no consensus has been reached [23]. These inconsistent findings are probably related to the interaction of situational variables [23], where playing at home or away, the quality of the opponents [24], the scoreboard [25] or passages when the demands of the first half have been extraordinarily high [5] could alter players' running performance in the second half. This last argument could justify the results obtained in this study in a twofold way. First, a higher competitive level, e.g., international matches, put the players in MDP, while secondly, very demanding first halves led to the existence of significant differences, especially in MD2, of these situations compared to those that might arise in the second half of the matches.

According to the literature, everything points to the fact that even though the total running distance may be lower in the second half compared to the first, there may not be any differences in the distances covered in the high-intensity categories of striding, sprinting and maximal running [22]. To date, only one study has used the rolling method to compare activity between the two halves bearing in mind the MDP in competition [26]. In line with that paper, the results of this study show that the differences increased as the length of the period studied increased. The findings of this study indicate that the differences in activity between the MDP in the first and second half remain in periods of high competitive density.

The competitive level is a contextual variable which seems to influence players' activity, leading to increased activity as the level of their adversaries increases [5–6–4]). In this study, the international match (MD2) showed higher activity in the MDP compared to the matches in the regular league (MD1 and MD3); these results may be explained by the level of the opponents and/or the competition format. Based on these results, and despite the fact that it was not considered in this study, the level of fatigue generated in the international match (MD2) may be higher, which could justify greater importance of recovery processes [13] or player rotation for the third match [27, 28, 29]. For instance, Carling et al. [27] reported that only a single field player participated in and completed each match, while six took part in every match as either a starter or substitute. In another top-level French team, only four players participated in every match during an 18-day period consisting in six matches [28] and, in 22 elite English football teams playing three successive matches in five days, only 16 full individual player datasets were presented [29]. Unlike previous studies, in this study an important number of players (20 of the 60 possible, 10 players per six weeks of three matches) took part in two and three consecutive matches.

As has been previously proposed [30], this study supports the idea that match running performance is largely maintained over successive matches. Using an individualised approach, hardly any differences were found as the matches succeeded one another during the week. Specifically, only in the 3- and 5-minute periods did the values reported in MD3 show significant differences compared to the values reported in MD2, and yet there were no differences between MD1 and MD3 for any of the time windows or for either of the two physical variables (TD and TD21), which seems to indicate that fatigue does not appear between matches, or that perhaps the players can specifically respond to the MDP in matches. The players' high aerobic level may foster recovery processes between matches, explaining the maintenance of activity in the MDP between matches [30]. Finally, it is worth noting that it would be interesting to include other external physical variables such as acceleration, deceleration and player load; internal variables such as subjective perception of effort; and objective physiological measures (e.g., heart rate-based measures).

The limitations of this study include the fact that we were unable to include an analysis of tactical-technical performance [31] or collective performance [32]. Furthermore, it should also be noted that other factors that were not considered are travel to play the game or the effect of confusion which could be caused by having a different number of days between matches (3 or 4), along with the kind of recovery strategies used [13]. More situational variables (e.g., opponents' level, venue) that might have conditioned the physical demands could also have been included [3]. Another of the main limitations of this study is not knowing the players' previous and subsequent fatigue levels in each of the matches. Finally, having a single MDP per half and match means that an interesting aspect which could provide information on the number of times this kind of situation is repeated during the matches was not shown.

The main conclusions of this study are: 1) the distance covered in MDP is longer in matches where the competitive level is higher; 2) there seems to be acute fatigue in the second halves, which does not allow the MDP in the first half to be repeated; 3) regardless of the succession of matches, the players are capable of replicating the MDP in congested periods of competition.

PRACTICAL APPLICATIONS

Our data should help coaches to manage the players' external load in periods with match congestion. Firstly, second halves of the matches the MDP could be lower, specifically in a high velocity range (e.g., > 21 $Km \cdot h^{-1}$) in highly demanding matches (e.g., international tournament). Secondly, the qualified staff must manage the minutes of the players in weeks with three matches because the congestion of competition could affect the physical performance in the episodes of maximum physical demand. If the player has competed in two consecutive games, the third match may represent a lower physical performance in the MDP.

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Conflict of Interest

The authors did not report any potential conflicts of interest.

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