

THE EFFECT OF A CONGESTED FIXTURE PERIOD ON THE ACTIVITY OF ELITE SOCCER PLAYERS

■ Accepted
for publication
21.07.2010

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ABSTRACT: The aim of this study was to examine the effect of a succession of matches on the physical performance of elite soccer players. Forty-two players of a professional team from the Spanish Soccer League in the 2005-2006 season who played 2 full matches with 3 days in between matches 1 and 2 were monitored using a multiple-camera match analysis system. Differences on work-rate profiles of soccer players were analysed for the following variables: distance covered for all of the above activity profiles, frequency of high-intensity activities, recovery time, average speed, and top speed. Data were analyzed using a paired samples t-test. Overall, the activity profiles were not statistically influenced by the short recovery periods between matches. Difference between halves in the total distance covered was slightly greater during the first match compared to the second match (-84.4 ± 354.0 v -41.3 ± 318.8 m, respectively). Although a higher difference between halves was found in the distance covered by players at high intensity activities during the second match than in the first match (-34.0 ± 193.1 v -14.3 ± 208.2 m, respectively) this difference was not significant. There were no differences in the number of sprints and high speed runs performed by players across successive games. Difference between halves in the recovery time tended to be greater in the second match compared to the first match (13.0 ± 58.9 v 28.4 ± 87.4 s, respectively). However, this difference was not significant.

KEY WORDS: soccer, fatigue, match congestion, time-motion analysis, activity profiles, football association

INTRODUCTION

Multiple-sprint sports, such as soccer, are characterized by periods of high-intensity activity (sprinting, running, kicking, jumping, and tackling), interspersed with lower intensity actions (jogging and walking) and active or passive recovery [2]. As a result, the majority of the body's physiological systems are stressed during the course of a game and often also by strenuous training programs [22].

Some researches have suggested that distances covered during high-intensity running in matches are valid measures of physical performance in soccer because of their relationship with training status and are a distinguishing characteristic between standards of player [15]. Recent findings using computerized time-motion analysis of elite soccer players have shown a decrease in physical performance during the match. In particular, some studies have demonstrated that high-intensity running was reduced towards the end of the game and temporarily after intense periods of the game [15,16]. This decline in physical work has been linked to match-related physical fatigue. Moreover, it has been suggested that anaerobic performance decline lasting 72 hours post-game [12,13].

According to these findings, soccer players may not be able to perform at maximal level intense anaerobic activities such as those seen during a game for at least 3 days after their most recent competition. However, top international players competing in the major European soccer leagues are often required to play matches with only 2-3 days recovery [17]. Elite clubs may play additional games during a weekly microcycle due to participation in local or international tournaments. The demand for playing 2 to 3 games per week elevates the stress imposed on the players, thereby increasing the injury risk, performance decline due to fatigue, muscle damage, and/or inflammation [11,12].

Existing research investigating fatigue during soccer match-play has generally been focused to date to the influence of fatigue within matches [9,13,15,19] and over different phases of the season [15]. However, the effects of a congested fixture period on sport performance have been slightly studied.

In a recent study, Odetoyinbo et al. [18] examined the effect of a succession of matches on the activity profiles of professional soccer players when three matches were played in five days. Their findings

suggested that the activity profiles were not influenced by the short recovery periods between matches, while some fatigue may be apparent that affects certain high-intensity aspects of play.

A major limitation of the study of Odetoyinbo et al. [18] is that the number of subjects analyzed was very small ($n=16$). Consequently, the aim of this investigation was to examine the effects of a succession of matches on the physical performance of elite soccer players during a 7-day fixture period.

MATERIALS AND METHODS

Subjects. Outfield players of a professional team from the Spanish Soccer League in the 2005-2006 season were assessed during a 7-day fixture period and activity profiles were collated to evaluate each player's match contribution. For the purpose of this study only those players who played 2 full matches with 3 days in between matches 1 and 2, whilst playing in the same tactical position, were analyzed. This research model provided 42 players in a variety of outfield positions: central defenders (CD, $n=17$), external defenders (ED, $n=9$), central midfield players (CM, $n=9$), external midfield players (EM, $n=2$), and forwards (F, $n=5$). During breaks between halves all subject performed the same recovery protocol (passive recovery –seated rest- and rehydration). While recovery from competition the players were instructed to maintain their normal lifestyle during the 3 days between the matches and undertook the following recovery strategies: hydrotherapy, massage and active recovery. No control was possible over their nutritional and fluid intakes, nor sleeping quantity and quality. The players were fully informed of all experimental procedures before giving their informed consent to participate in the study. To ensure team and player confidentiality, all performance data were anonymized before analysis. Written permission was received from the sampled club to record and analyze the data.

Data collection procedure. A computerized player tracking system (AMISCO Pro®, Sport-Universal Process, Nice, France) was used to characterize activity profiles in the team. This multiple-camera system tracked the movements of every player over the course of matches. It provided information on running speeds, distances covered, and the frequency of occurrence for each activity. Player movements were tracked at a sampling rate of 25.0 Hz providing approximately 2.5 million data points per match [8]. Simultaneously, a trained operator coded each technical action involving the ball. The workings of the AMISCO Pro system have been described in more detail elsewhere [7-9]. Zubillaga et al. [25] and Randers et al. [20] have recently evaluated the reliability and validity of AMISCO Pro for quantifying displacement velocities during match-related activities relative to data obtained using timing gates.

In line with other studies [4,9,19] activity profiles were constructed for each player's contribution based on the following categories and thresholds: 0–11 $\text{km}\cdot\text{h}^{-1}$ (standing, walking, jogging); 11.1–14.0 $\text{km}\cdot\text{h}^{-1}$ (low-speed running); 14.1–19.0 $\text{km}\cdot\text{h}^{-1}$ (moderate speed running); 19.1–23.0 $\text{km}\cdot\text{h}^{-1}$ (high-speed running) and >23 $\text{km}\cdot\text{h}^{-1}$ (sprinting).

Differences on work-rate profiles of soccer players were analyzed for the following variables: distance covered for all of the above activity profiles, frequency of high-intensity (HI) activities (sprinting and high-speed running), recovery time (average time in between HI activity) (s), average speed ($\text{km}\cdot\text{h}^{-1}$), and top speed ($\text{km}\cdot\text{h}^{-1}$).

Differences on physical performance of soccer players were assessed by analyzing differences between halves and between matches 1 and 2 on work-rate profiles.

Statistical Analysis. All statistical analysis was performed using SPSS for Windows, version 17.0 (SPSS Inc., Chicago, IL, USA). For all analyses, statistical significance was set at $p<0.05$. All results are reported as means and standard deviations (mean \pm sd). A paired samples t-test was performed to examine the variation of the differences between halves in the activity profiles of professional soccer players in two consecutive matches.

RESULTS

First versus second half variations. No difference was found in the total distance covered between the two halves during matches 1 and 2 (Table 1).

In match 1, significantly less distance ($p<0.05$) was covered in the second half than in the first at low-speed run intensity (11.1-14 $\text{km}\cdot\text{h}^{-1}$). At medium (14.1-19.0 $\text{km}\cdot\text{h}^{-1}$), submaximal (19.0-23.0 $\text{km}\cdot\text{h}^{-1}$) and maximal (>23 $\text{km}\cdot\text{h}^{-1}$), however, no significant differences could be detected between halves.

In match 2, there were no significant differences between halves on distance covered by players. However, significantly more high-speed runs ($p<0.05$) were performed by players in the first half compared to the second half. The average recovery time (time in between each discrete HI activity) increased across the course of half 1 to 2 by 29 s.

Finally, the average speed during the second half of matches 1 and 2 was significantly lower ($p<0.01$) than in the first half. No difference was observed for top speed.

Comparisons between the activity profiles in two consecutive matches. Overall, the activity profiles were not statistically influenced by the short recovery periods between matches. Difference in the total distance covered between halves was slightly greater during the first match compared to the second match (Table 2). Although a higher difference between halves was found in the total distance covered by players at submaximal and maximal intensities (high-speed run and sprint) during the second match of the week than in the first match, this difference was not significant (Fig. 1).

The total distance covered between halves at medium intensities presented no difference across the two matches.

Comparing the difference in the number of sprints and high speed runs performed by players across successive games, the results show that there were no differences between matches 1 and 2. Difference in the recovery time between halves tended to be greater in the second match, but this difference was not significant. The top speed and average speed was similar in matches 1 and 2.

TABLE 1. DIFFERENCES BETWEEN HALVES ON WORK-RATE PROFILES IN MATCH 1 AND 2 (MEAN ± SD)

Variables	Match 1		Match 2	
	First half	Second half	First half	Second half
<i>Distance (m)</i>				
Total distance	5569.9 ± 314.9	5483.5 ± 365.5	5502.3 ± 324.8	5461.0 ± 330.5
HI distance	413.3 ± 171.4	298.5 ± 174.3	405.5 ± 166.3	371.5 ± 157.6
Sprint	130.1 ± 71.1	138.5 ± 87.4	132.0 ± 81.0	122.9 ± 65.5
High-speed run	283.2 ± 100.3	260.4 ± 86.9	273.5 ± 85.3	248.6 ± 92.1
Moderate-speed run	898.2 ± 194.3	881.1 ± 156.8	897.1 ± 162.3	862.4 ± 209.9
Low-speed run	863.7 ± 122.4	798.1 ± 127.6*	824.7 ± 105.7	794.6 ± 122.6
Walk and jog	3394.8 ± 139.1	3405.4 ± 128.2	3374.8 ± 133.3	3432.4 ± 180.3
<i>Frequency (number)</i>				
Sprints	6.2 ± 3.6	6.3 ± 3.8	6.9 ± 3.9	5.9 ± 2.8
High-speed run	19.2 ± 7.2	18.0 ± 6.6	19.9 ± 6.9	17.5 ± 5.7*
<i>Duration (s)</i>				
Recovery time	124.1 ± 54.1	137.1 ± 57.2	122.6 ± 48.3	151.1 ± 91.9*
<i>Speed (km·h⁻¹)</i>				
Top speed	31.2 ± 3.3	30.9 ± 2.2	30.9 ± 2.4	30.4 ± 2.3
Average speed	7.0 ± 0.5	6.7 ± 0.5 [†]	7.1 ± 0.4	6.7 ± 0.4 [†]

Legend: *Significantly different than first half (p < 0.05). † Significantly different than first half (p < 0.01).

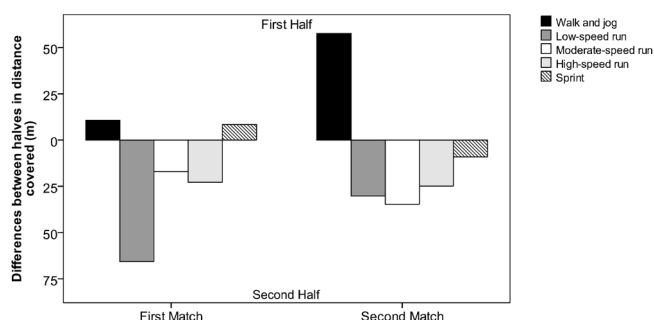


FIG. 1. BETWEEN HALVES DIFFERENCES IN PHYSICAL PERFORMANCE IN MATCH 1 AND 2.

TABLE 2. DIFFERENCES BETWEEN HALVES ON WORK-RATE PROFILES IN TWO CONSECUTIVE SOCCER MATCHES (MEAN ± SD)

Variables	Differences between halves	
	Match 1	Match 2
<i>Distance (m)</i>		
Total distance	-84.4 ± 354.0	-41.3 ± 318.8
HI distance	-14.3 ± 208.2	-34.0 ± 193.1
Sprint	8.4 ± 105.2	-9.1 ± 92.9
High-speed run	-22.7 ± 103.0	-24.9 ± 100.2
Moderate-speed run	-17.1 ± 188.1	-34.7 ± 181.1
Low-speed run	-65.6 ± 170.8	-30.1 ± 141.2
Walk and jog	10.6 ± 165.4	57.5 ± 218
<i>Frequency (number)</i>		
Sprints	0.7 ± 4.3	-1.0 ± 4.1
High-speed run	-1.2 ± 7.1	-2.4 ± 7.3
<i>Duration (s)</i>		
Recovery time	13.0 ± 58.9	28.4 ± 87.4
<i>Speed (km·h⁻¹)</i>		
Top speed	-0.2 ± 3.4	-0.5 ± 3.2
Average speed	-0.3 ± 0.4	-0.4 ± 0.3

DISCUSSION

The aim of this investigation was to provide a detailed analysis of the activity profiles of elite professional soccer players over an intense period of matches. Physical performance was assessed by analyzing differences between halves and matches on work-rate profiles.

Existing research investigating fatigue during soccer match-play has generally been focused to date to the influence of fatigue within matches and over different phases of the season. However, the effects of a congested calendar on physical performance of professional soccer players have been slightly studied.

Conversely to previous research [3,11,15,16,23], the current investigation showed no significant second-half decrement for total distance covered, and it did not show a fall in work-rate of high intensity work towards the end of a game. Nevertheless, players seem to spare energy during the second half by increasing distance covered in walking and jogging and by decreasing the distance in medium intensity. Moreover, no difference between halves was observed for top speed.

Caution is necessary in comparing recent data with reported results from literature, because different technologies and categorizations were employed. Our results are similar to those previously reported by Barros et al. [4], Di Salvo et al. [9,10] and Zubillaga et al. [25]. In these studies technologies and intensity categories were the same to those used in the current investigation.

Decline in physical performance appears to occur in relation to recovery time, number of high-speed runs and average speed. The average recovery time increased across the course of half 1 to 2 by 13 and 29 s, respectively. In the second match this difference was significant (p<0.05). These results are similar to the findings of Bradley et al. [6]. The average speed during the second half of

matches was significantly lower ($p < 0.01$) than in the first half. Finally, more high-speed runs were performed by players in the first half compared to the second half. In the second match this difference was significant ($p < 0.05$). It has been suggested that physical performance in elite soccer may be influenced by match contextual factors. Thus, Bloomfield et al. [5] and Lago et al. [14] found that elite soccer players performed less high-intensity activity when winning than when were losing. In fact, given that winning is a comfortable status for a team, it is possible that players assume in a match a ball contention strategy, keeping the game slower, which results in lower speeds [5].

When comparing the same top-class players in two consecutive matches, overall observation of the data suggested that the activity profiles were not statistically influenced by the short recovery periods between games.

Some of the results of this study, although not displaying statistical changes, may still have a bearing on match situations. For example, a higher difference between halves was found in the distance covered by players at submaximal and maximal intensities (high-speed run and sprint) during the second match of the week than in the first match (-34.0 ± 193.1 v -14.3 ± 208.2 m, respectively). Moreover, a higher difference between halves was found in the top speed and average speed during the second match compared to the first match (-0.5 ± 3.2 v -0.2 ± 3.4 and -0.4 ± 0.3 v -0.3 ± 0.4 km·h⁻¹, respectively). Given that margins for physical performance in elite level sports are so small, these observations cannot be ignored.

Difference in the recovery time between halves tended to be longer in the second match compared to the first half (28.4 ± 87.4 v 13.0 ± 58.9 s, respectively). Nevertheless, this difference was non significant. A similar finding was observed by Odetoynbo et al. [18] and in hockey players who played three games in four days [24]. This alludes to the possibility that players may seek increased recovery times through slower activity profiles and that is more likely when required to play matches in quick succession. It could be that in elite levels the more experienced players adapt their movement behaviour in the knowledge that they will be required to play successive matches with short rest periods between games.

Many coaches maintain that an athlete's level of preparation is also elevated by participation in competitions. Participation in competitions does assist athletes to reach a high state of readiness for the next competition. During such competitions, the athletes have the opportunity of testing all training factors in the most specific way. Perhaps, to a certain extent, a top team can cope with a busy match schedule. However, it should not be expected that a degree of training and correct peaking can be achieved through competition only. To consider the competition as the only means of improvement lessens the whole philosophy of training and, consequently, disturbs the main cycle of activity: training → competition → regeneration [21]. Future studies should determine the ideal duration of the competitive phase in professional soccer. As far as the frequency and the number of matches played are concerned, the time required for recovery between matches should be considered.

The major limitations of this study were the relatively low number of matches and players examined and that players played for only one club. Therefore, the patterns observed might be a reflection of this particular team. Moreover, the potential impact of contextual factors such as match location (i.e. playing at home or away), match status (i.e. whether the team was winning, losing or drawing at the moment ...) and the relative demands imposed by differing opposition over the matches has not been considered. Finally, measurements of peripheral or central fatigue in the tested players have not been included in the study given that no data were available.

CONCLUSIONS

In summary, in this study the activity profiles of Spain-based professional soccer players were considered when two matches were played in 5 days. Overall, results suggest that the activity profiles of elite soccer players were not influenced by the short recovery between matches. However, further research is warranted to address others factors that may influence the variation in physical performance over an intense period of matches. Work could be extended to examine the effects of match type (domestic cup competitions v league games), the influence of specific team formation (systems of play), and the potential impact of situational variables.

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