High Speed Running and Sprinting Profiles of Elite Soccer Players

by
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Real Madrid was named as the best club of the 20th century by the International Federation of Football History and Statistics. The aim of this study was to compare if players from Real Madrid covered shorter distances than players from the opposing team. One hundred and forty-nine matches including league, cup and UEFA Champions League matches played by the Real Madrid were monitored during the 2001-2002 to the 2006-2007 seasons. Data from both teams (Real Madrid and the opponent) were recorded. Altogether, 2082 physical performance profiles were examined, 1052 from the Real Madrid and 1031 from the opposing team (Central Defenders (CD) = 536, External Defenders (ED) = 491, Central Midfielders (CM) = 544, External Midfielders (EM) = 233, and Forwards (F) = 278). Match performance data were collected using a computerized multiple-camera tracking system (Amisco Pro®, Nice, France). A repeated measures analysis of variance (ANOVA) was performed for distances covered at different intensities (sprinting (>24.0 km/h) and high-speed running (21.1-24.0 km/h) and the number of sprints (21.1-24.0 km/h and >24.0 km/h) during games for each player sectioned under their positional roles. Players from Real Madrid covered shorter distances in high-speed running and sprint than players from the opposing team (p < 0.01). While ED did not show differences in their physical performance, CD (p < 0.05), CM (p < 0.01), EM (p < 0.01) and F (p > 0.01) from Real Madrid covered shorter distances in high-intensity running and sprint and performed less sprints than their counterparts. Finally, no differences were found in the high-intensity running and sprint distances performed by players from Real Madrid depending on the quality of the opposition.

Key words: performance analysis, time-motion analysis, football association.

Introduction

Studies continue to investigate the physical and technical performances of elite soccer players during official games across congested periods (Bradley et al., 2009; Rampinini et al., 2007; Rey et al., 2010) in accordance with positional roles (Bradley et al., 2009; Di Salvo et al., 2007; Rampinini et al., 2007) or depending on the match conditions.

In particular, Rampinini et al. (2007) observed that the work rate of professional soccer players was significantly influenced by the activity profile of their opponents. According to

their results, the total distance covered and the amount of high-intensity running during matches were higher against `better´ opponent teams than against `weaker´ opponent teams. Other studies suggest that the poorer the quality of the opponent, the shorter the distance covered by the reference team (Bloomfield, 2005; Lago et al., 2010). These findings suggest that players can increase or decrease their work rate according to both demands of individual matches and the quality of the opposition. Consequently, distances covered by players from top teams could be

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shorter than those of their opponents: the higher the quality of the teams, the shorter the distance covered by their players.

The opponent level has been considered from different methodological perspectives. For example, teams and players have been categorized as "successful" and "unsuccessful" according to their standings within a particular tournament or classified as "strong" or "weak" based on symmetric division of end-of-season classification (Taylor et al., 2008). Lago et al. (2010) defined the quality of opposition as the differences in the end-of-season ranking between opposing teams. Recently, team performance has been classified using cluster analysis procedures, which improved the classification by using more valid cut-off values.

However, the impact of the quality of the teams on physical performances in soccer is still inconclusive. This may be due to the fact that previous studies have not investigated teams of excellence, i.e., teams that usually win the domestic league and international competitions such as the European Cup or the Intercontinental Cup.

Therefore, the aim of this study was to examine the physical performance of Real Madrid during the 2001-2002 to 2006-2007 seasons (six seasons) and to compare if there were differences between teams depending on their quality. Real Madrid was named as the best club of the 20th century by the International Federation of Football History and Statistics (IFFHS) and won during the explored period 1 European Cup, 1 Intercontinental Cup, 1 European Super Cup, 2 Spanish Leagues and 1 Spanish Super Cup. According to the research framework, it was hypothesized that the players from Real Madrid covered shorter distances in High-Intensity Running and Sprint than players from the opposing team.

Methods

Participants

One hundred and forty-nine matches including league, cup and UEFA Champions League matches played by the Real Madrid were monitored during the 2001-2002 to the 2006-2007 seasons (six seasons). Data from both teams (Real Madrid and the opponent) were recorded. The players included in the study met two basic

criteria: (1) completion of the entire match (at least three matches within the whole sample), and (2) because the physical loading of goalkeepers differs from that of field players, they were not included in the study. Altogether, 2082 physical performance profiles were examined, 1051 from the Real Madrid and 1031 from the opposing teams (Central Defenders (CD) = 536, External Defenders (ED) = 491, Central Midfielders (CM) = 544, External Midfielders (EM) = 233, and Forwards (F) = 278). The matches analysed resulted in 94 wins, 21 draws, and 26 losses. Opponents of Real Madrid were divided into four categories depending on their end-of-season ranking in the Spanish *La Liga*: Very Strong (teams ranked from 1 to 5), Strong (6-10), Intermediate (11-15) and Weak (16-20). Opponents participating in the Champions League were considered Very Strong teams. The study followed the ethics code of the World Medical Association and the standards for research's recommendation of the Declaration of Helsinki. The protocol was approved by the ethics committee of the Facultad de Ciencias de la Actividad Física y del Deporte (Universidad Politécnica de Madrid, Madrid, Spain). To ensure the team and player's confidentiality, all performance data were anonymised before analysis.

Measures

Physical indicators were coded into the following activities: 21.1-24.0 km/h (high-intensity running, HIR), >24.0 km/h (Sprint), and the number of high-speed runs (21.1-24.0 km/h) and sprints (>24.0 km/h).

Procedures

Match performance data were collected using a computerized multiple-camera tracking system (Amisco Pro®, Nice, France). Player's movements were captured during matches by cameras positioned at the roof level and analyzed using proprietary software to produce a dataset of each player's physical performance. The validity and reliability of this tracking system had been quantified to verify the capture process and data accuracy (Zubillaga et al., 2007). For previous applications of the Amisco system, see Castellano et al. (2014).

Statistical analyses

A repeated measures analysis of variance (ANOVA) was performed for distances covered at

different intensities (sprinting and high-speed running) and the number of high-speeds runs (21.1-24.0 km/h) and sprints (>24.0 km/h) during matches for each player sectioned under their positional roles (External Defender, Central Defender, External Midfielder, Central Midfielder, and Forward). The *Bonferroni* test was carried out where it was necessary to establish the pairwise comparisons between groups. Effect sizes were also calculated to describe any trends apparent in the data using the eta squared (η2). Effect size interpretation was based on the following criteria: 0-0.1 = weak, 0.1-0.3 = modest, 0.3-0.5 = moderate, >0.5 = strong (Bliese and Halverson, 1998). All statistical analyses were performed using IBM SPSS and statistical significance was set at $p < 0.05$.

Results

The physical indicators across playing positions for Real Madrid and the opposing team are summarized in Tables 1 and 2. Players from Real Madrid covered shorter distances ($p < 0.05$) in HIR than players from the opposing team (Table 1). While ED did not show differences in their physical performance, CD ($p < 0.05$), CM ($p < 0.01$), EM ($p < 0.01$) and F ($p > 0.01$) from Real Madrid covered shorter distances in HIR than their counterparts (180 v. 192, 257 v. 284, 354 v. 382 and 269 v. 297, respectively).

Similarly, the Real Madrid players covered shorter distances in Sprint ($p < 0.05$) than players from the opposing team (Table 2). While CD and CM did not show differences in their physical performance, EM ($p < 0.05$) and F ($p > 0.01$) Real Madrid players covered shorter distances in Sprint than their counterparts (320 v. 361, 235 v. 306, respectively). However, ED from Real Madrid covered higher distances than their counterparts (374 v. 320, $p < 0.05$).

Concerning the number of high-speed runs (21.1.-24.0 km/h), CM ($p < 0.01$; $\eta^2 = 0.031$), EM ($p < 0.05$; $\eta^2 = 0.041$) and F ($p < 0.05$; $\eta^2 = 0.024$) from Real Madrid performed less efforts than the opposing team (10.7 v. 21.1, 25.0 v. 28.1 and 19.9 v. 22.0). Additionally, there were no differences for ED and F players (Figure 1).

Finally, ED ($p < 0.05$; $\eta^2 = 0.012$), CM ($p < 0.05$; $\eta^2 = 0.008$), EM ($p < 0.05$; $\eta^2 = 0.034$) and F ($p < 0.01$; $\eta^2 = 0.064$) from Real Madrid executed a lower number of sprints (<24.0 km/h) than their counterparts from the opposing team (16.1 v. 14.9, 9.1 v. 10.0, 14.8 v. 17.2, 11.7 v. 14.6). Also, no differences were found for CD players (Figure 2).

No differences were revealed in the HIR and Sprint distances performed by players from Real Madrid depending on the quality of the opposition. Similarly, the number on high-intensity runs and sprints did not vary depending on the strength of the opposing team.

Table 1

Differences in the distance covered between Real Madrid and the opposing team in High-Intensity Running (21.1-24.0 km/h) depending on the player's position

	Real Madrid	Opposing Team	η^2
Playing Position			
External Defenders (ED)	340 (± 90)	341 (± 100)	.000
Central Defenders (CD)	180 † (± 65)	192 (± 74)	.007
Central Midfielders (CM)	253 ‡ (± 87)	284 (± 96)	.029
External Midfielders (EM)	354 ‡ (± 88)	382 (± 109)	.019
Forwards (F)	269 ‡ (± 86)	297 (± 103)	.022
Mean	269† (± 104)	285 (± 114)	.011

‡Significantly shorter than the opposing team ($p < 0.01$).
†Significantly shorter than the opposing team ($p < 0.05$).

Table 2

Differences in the distance covered between Real Madrid and the opposing team in Sprint (>24.0 km/h) depending on the player's position.

	Real Madrid	Opposing Team	η^2
Playing Position			
External Defenders (ED)	374 ↑ (± 144)	320 (± 143)	.034
Central Defenders (CD)	161 (± 91)	164 (± 87)	.000
Central Midfielders (CM)	179 (± 95)	196 (± 113)	.006
External Midfielders (EM)	320 † (± 132)	361 (± 158)	.020
Forwards (F)	235 ‡ (± 99)	306 (± 138)	.081
Mean	245‡ (± 141)	248 (± 145)	.004

Significantly higher than the opposing team (p < 0.05).
‡Significantly shorter than the opposing team (p < 0.01).
†Significantly shorter than the opposing team (p < 0.05).

↑

Table 3

Differences in the distance covered between Real Madrid and the opposing team in High-Intensity Running (21.1-24.0 km/h) and Sprint (>24.0 km/h) depending on the quality of the opponent.

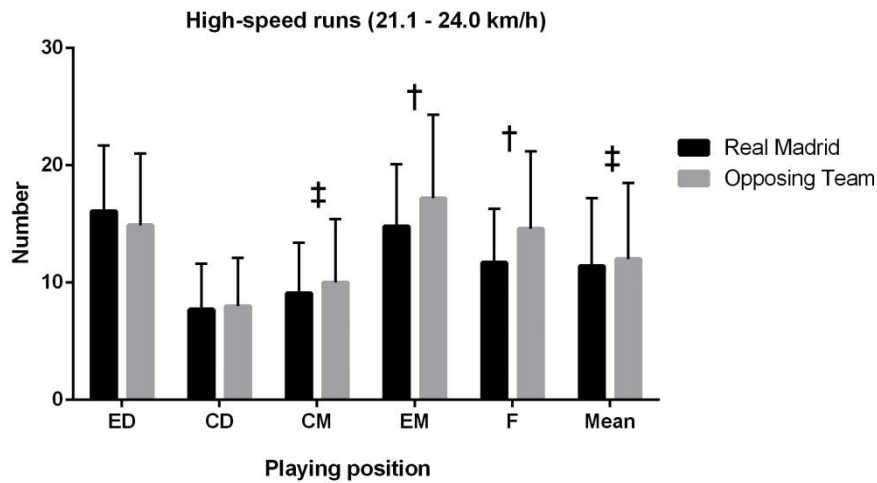| Quality of the Opponent	Very Strong	Strong	Intermediate	Weak	η^2
High-Intensity Running distance (21.1-24.0 km/h)	270 (± 106)	265 (± 101)	271 (± 105)	270 (± 103)	.000
Sprint distance (>24.0 km/h)	243 (± 143)	265 (± 101)	248 (± 131)	241 (± 142)	.000
Number of High-Intensity Runs (21.1-24.0 km/h)	11 (± 6)	11 (± 85)	12 (±6)	11 (± 6)	.001
Number of sprints (>24.0 km/h)	20 (± 8)	20 (± 7)	20 (± 7)	19 (± 7)	.001

Figure 1

Differences in the number of high-speed runs (21.1-24.0 km/h) between Real Madrid and the opposing team depending on the player's position
‡Significantly shorter than the opposing team (p < 0.01); †Significantly shorter than the opposing team (p < 0.05). Playing positions: ED = External Defender; CD = Central Defender; CM = Central Midfielder; EM = External Midfielder; and F = Forward.
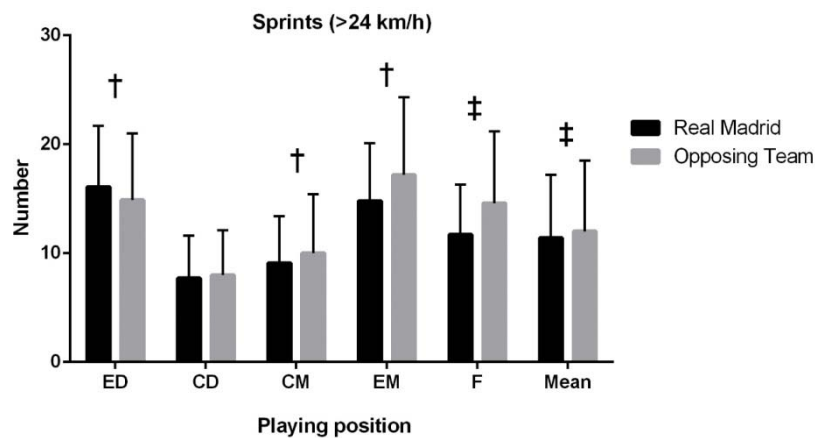

Figure 2

Differences in the number of sprints (>24.0 km/h) between Real Madrid and the opposing team depending on the player's position
‡Significantly shorter than the opposing team (p < 0.01); †Significantly shorter than the opposing team (p < 0.05). Playing positions: ED = External Defender; CD = Central Defender; CM = Central Midfielder; EM = External Midfielder; and F = Forward.

Discussion

The main aim of this study was to examine the effects of the quality of the opposition on high-speed running and sprinting performance in elite soccer. Although previous studies have shown that the work rate of professional soccer players was significantly influenced by the activity profile of the opponents (Lago, 2009; Lago and Martin, 2007; Taylor et al., 2008), these findings are still inconclusive given that most of these works were based on small sample sizes or did not examine teams of excellence, i.e., teams that usually win the domestic league and international competitions.

The major finding was that players from Real Madrid covered shorter distances in HIR and Sprint and executed less sprints than players from the opposing team. These findings may be explained by two different reasons. Firstly, it has been demonstrated that soccer players perform significantly less high-intensity activity when winning than when losing or when the score is balanced (Bloomfield et al., 2005; Castellano et al., 2011; Shaw and O´Donoghue, 2004; O´Donoghue and Tenga, 2001). In particular, the Real Madrid team won during the explored period approximately 70% of the total matches played. These results suggest that as the team spent too much time winning and scored first the players did not always use their maximal physical capacity during the match. In fact, given that winning is a comfortable state for a team, it is possible that players assumed a ball retention strategy and slowing down the game resulted in shorter speeds (Bloomfield et al., 2005b; Lago et al., 2010). On the other hand, when losing, players try to reach their maximal activity in order to win or draw the match. However, this scenario is not usually played by the teams of excellence. Other studies have considered match status in relation to the tactical aspects of performance. James et al. (2002) and Lago and Martin (2007) found that teams had longer periods of possession in matches when they were losing than when they were winning. When ahead, teams decreased their possession, suggesting that they preferred to play counter-attacking or direct play (that is, move the ball quickly to within scoring range, often using long passes or long balls downfield). However when behind, they increased their possession, suggesting they preferred to "control"

the game by dictating play. In addition, Lago (2009) demonstrated that time spent in possession of the ball in different zones of the pitch (defensive third, middle third, attacking third) was influenced by match status: when teams were losing, possession of the ball was less in the defensive zone and more in the attacking zone than when winning or drawing. Secondly, it has been demonstrated that soccer players modify their activities according to the match conditions and the demands of the play. Probably, players from Real Madrid were more technically and tactically advanced compared to their opponents and this fact allowed them to cover less distance during a match.

Concerning the impact of the quality of opposition on high-speed running and sprinting profiles, no differences were found in the distances covered by players from Real Madrid depending on the strength of the opposing team. These results are not in agreement with other studies. For example, Rampinini et al. (2007) observed that the work rate of professional soccer players was significantly influenced by the activity profile of opponents. The total distance covered and the amount of high-intensity running during matches were higher against `better´ opponent teams than against `weaker´ opponent teams. Other studies suggest that the poorer the quality of the opponent, the shorter the distance covered by the reference team (Bloomfield, 2005; Lago et al., 2010). The current results may be due to the fact that Real Madrid was able to impose and maintain their pattern of play despite the alteration in variables over the match (e.g., quality of opposition, evolving score) and between matches (e.g., playing at home or away). For example, it has been demonstrated that top teams show lower CVs for ball possession per match compared to those who finished lower in the ranking (Lago and Dellal, 2010). Different teams appear to employ different strategies when ahead, level or behind, reflecting the individual styles of coaching and management, the budget, characteristics of the players, team formation and philosophy of play based on the tradition of the club.

One of the most robust findings within the research literature is the relationship between the playing position and match running performance in elite players (Bangsbo, 1994; Di

Salvo et al., 2007; Lago et al., 2009; Mohr et al., 2003). Our data supports the well-established finding that external defenders and external midfielders cover greater high-intensity distances than the other playing positions (Carling et al., 2010; Di Salvo et al., 2007).

Additional research using a larger sample of clubs of excellence and across different countries should be performed. Future studies should analyse how performance varies in the same group of players during different periods of the season and from season to season. Moreover, an analysis of the potential variations in physiological responses to match-play across a similar prolonged period of fixture congestion is also warranted. Data on objective markers of fatigue such as plasma creatine kinase concentration, combined with subjective measures of performance, could provide additional information on the individual and team response to fixture congestion. Future studies should include additional situational variables, such as match location or match status. Our findings should be interpreted with caution, as generalisations are difficult in time-motion studies.

In conclusion, players from Real Madrid covered shorter distances in high-speed running and sprint and executed less sprints than players from the opposing team. In addition, no differences were found in the distances covered by players from Real Madrid depending on the strength of the opposing team. These findings may be explained by the fact that Real Madrid was able to impose and maintain their pattern of play despite the alteration in variables over the match. Finally, the performance profiles for playing positions and match running were similar to the ones reported in the literature indicating the standardization of playing roles in soccer.

References

Bangsbo J. The physiology of soccer: With special reference to intense intermittent exercise. *Acta Physiol Scand*, 1994; 619: 151

Bloomfield JR, Polman RCJ, O'Donoghue PG. Effects of score-line on intensity of play in midfield and forward players in the FA Premier League. *J Sports Sci*, 2005; 23: 191-192

Bradley PS, Sheldon W, Wooster B, Olsen P, Boanas P, Krustup P. High-intensity running in English FA Premier League soccer matches. *J Sports Sci*, 2009; 27: 159-168

Bliese PD, Halverson RR. Group Size and Measures of Group-Level Properties: An Examination of Eta-Squared and ICC Values. *J Manag*, 1998; 24: 157-172

Carling C. Analysis of physical activity profiles when running with the ball in a professional soccer team. *J Sports Sci*, 2010; 28: 319-326

Castellano J, Blanco-Villaseñor A, Alvarez D. Contextual variables and time-motion analysis in soccer. *Int J Sport Med*, 2011; 32: 415-421

Castellano J, Alvarez-Pastor D, Bradley PS. Evaluation of research using computerised tracking systems (Amisco® and Prozone®) to analyse physical performance in elite soccer: A systematic review. *Sport Med*, 2014; 44: 701-712

Di Salvo V, Baron R, Tschan H, Calderon F, Bachl N, Pigozzi F. Performance characteristics according to playing position in elite soccer. *Int J Sports Med*, 2007; 28: 222-227

James N, Mellalieu SD, Holley C. Analysis of strategies in soccer as a function of European and domestic competition. *Int J Per An Sport*, 2002; 2: 85-103

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: 1463-1469

Lago C, Dellal A. Ball Possession Strategies in Elite Soccer According to the Evolution of the Match-

Score: the Influence of Situational Variables. *J Hum Kinet,* 2010; 25: 93-100

Lago C, Martin R. Determinants of possession of the ball in soccer. *J Sports Sci,* 2007; 25: 969-974

Lago-Peñas C, Rey E, Lago-Ballesteros J, Casais L, Dominguez E. Analysis of work-rate in soccer according to playing positions. *Int J Perf Anal Sport*, 2010; 9: 218-227

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: 519-528

O'Donoghue P, Tenga A. The effect of score-line on work rate in elite soccer. *J Sports Sci*, 2001; 19: 25-26

Rampinini E, Coutts AJ, Castagna C, Sassi R, Impellizeri F. Variation in top level soccer match performance. *Int J Sports Med*, 2007; 28: 1018-1024

Rey E, Lago-Peñas C, Lago-Ballesteros J, Casais L. Dellal A. The effects of a congested fixture period on the activity of elite soccer players. *Biol Sport*, 2010; 27: 181-185

Shaw J, O'Donoghue P. The effect of score-line on work rate in amateur soccer. In: O'Donoghue P, Hughes, MD, editors. *Notational analysis of sport* VI. Cardiff: UWIC, 84-91; 2004

Taylor JB, Mellalieu SD, James N, Shearer D. The influence of match location, qualify of opposition and match status on technical performance in professional association football. *J Sports Sci*, 2008; 26: 885-895

Zubillaga A, Gorospe G, Mendo AH, Blanco-Villaseñor A. Match analysis of 2005-2006 Champions League final with Amisco System. *J Sports Sci Med*, 2007; 6: 10-20

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