Title: Comparison of physical and technical performance in European professional soccer match-play: The FA Premier League and La Liga

Running head: Match performance in elite soccer

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Abstract

The aim of this study was to compare match-performance in professional soccer players across two major European championships: Spanish Liga (LIGA) and FA Premier League (FAPL). Data were collected using a computerised match analysis system. A total of 5938 analyses were recorded during the 2006-2007 season. The players were classified into 6 positional roles: central defenders (CD), full-backs (FB), central defensive midfielders (CDM), wide-midfielders (WM), central attacking midfielders (CAM), and forwards (F). Match performance variables analysed included: a) physical activity: total distance covered, distances covered at high-intensities both with and without possession of the ball; b) technical actions: heading and ground duels, passing, time in possession and ball touches. Comparison of the total distance covered between FAPL and LIGA players generally showed no difference across individual playing positions but players in the former generally covered greater distances in sprinting. In contrast, the latter covered a higher total distance in sprinting when their team was in possession (values for playing positions from $P<0.05$ to $P<0.001$) while FAPL players had an equal total sprint distance irrespective of possession. LIGA players won significantly more heading duels ($P<0.05$), performed more successful ($P<0.05$) passes and took more ball touches per possession than FAPL F (2.16 ± 0.54 vs. 2.01 ± 0.55, $P<0.001$, respectively). FAPL WM had ~ 20% more ball touches per possession than their LIGA counterparts (2.24 ± 0.54 vs. 2.03 ± 0.55, $P<0.001$, respectively). In conclusion, this study showed that FAPL and LIGA teams present differences in various physical and technical aspects of match-play suggesting that cultural differences may exist across professional soccer leagues.

Keywords: Football, Motion analysis, Technique, Sprinting, Notational analysis

Introduction

Over the last four decades, different methods have been developed to evaluate player performances during soccer match-play (Bangsbo *et al.*, 1991). Previously, subjective estimation methods were used to analyse movement in professional soccer match-play but these are being replaced by semi-automatic computerised player tracking technologies (Barros *et al.*, 2007; Bradley *et al.*, 2009: Di Salvo *et al.*, 2009). These contemporary systems allow collection of a larger range of performance data both more quickly and accurately than visual estimation methods (Drust *et al.*, 2007). They also provide a simultaneous analysis of the physical efforts, movement patterns and technical actions of players whilst allowing a comparison of performance with and without the ball, which may not be possible when using visual estimation (Carling *et al.*, 2008).

The physical profile of the contemporary player in professional match-play has been well described especially in relation to individual playing positions. Research has generally shown that central defenders cover the least distances whereas midfielders run the greatest distances respectively (Mohr *et al.*, 2003; Rampinini *et al.*, 2007). Where high-intensity efforts are concerned, wide-midfielders cover more distance and have less-recovery time between these efforts compared to other positions (Bradley *et al.*, 2009; Di Salvo *et al.*, 2009). However, the majority of this research has simply quantified the physical activity profiles of players in one specific championship and a direct comparison of performance between professional leagues has rarely been achieved (Dellal *et al.*, 2009; Rienzi et al., 2000). Indeed, an objective comparison of player performance across different leagues using the results of previously published motion analyses studies is difficult due to the use of different data collection methods and threshold values for categories of movement intensity (Barros *et al.*, 2007; Di Salvo *et al.*, 2009). The use of the same motion analysis system to compare physical activity profiles between leagues would maximize both objectivity, accuracy and practical

usefulness as the calculation methods and definition of movements would be the same (Drust *et al*., 2007). However, obtaining sufficient comparative data can be difficult as clubs across different Championships may not use the same analysis system and are/or unwilling to share data.

Previous studies done using semi-automatic video match analysis have provided valuable information on physical performance but have generally neglected the accompanying technical demands (Rampinini *et al.*, 2009; Taylor *et al.*, 2008). A direct comparison of both physical and technical performance between equivalent leagues would be important in determining whether game performance is general to all Leagues or if each league has its own specific playing characteristics. It could also aid teams in their understanding of opposition performance and when preparing to compete against other in the UEFA Champions League or Europa League. In a related study, a detailed analysis of physical profiles in professional soccer players across 4 European Leagues was carried out by Bloomfield et al. (2005). Results showed substantial variations in stature, body mass and body mass index which led the authors to speculate that there are different physical demands respective to each League. The provision of objective data from match analysis on physical and technical performance would help to identify if these differences exist and subsequently aid in tailoring position specific training regimes that are suitable for each respective league.

Consequently, the aim of this investigation was to provide a comparative analysis of physical and technical demands of professional soccer match-play across two European Leagues: The English FA Premier League (FAPL) and the Spanish Liga (LIGA). This information will aid in furthering understanding of the general physical and technical requirements of professional soccer as well as those respective to two major European Leagues.

Methods

A total of 5938 observations of match performance were analysed in the Spanish Liga (LIGA) (*n*=1896) and in the FA Premier League (FAPL) (*n*=4704) respectively. Data were collected over the 2006-2007 season using the same multiple-camera match analysis system (Amisco Pro®, Sport-Universal, Nice, France) among 600 matches. In each stadium, 8 stable cameras were positioned and subsequently calibrated and synchronised. Signals and angles obtained by the encoders were sequentially converted into digital data and recorded on 6 computers for post-game analysis. The movements of every player over the course of matches were tracked using a sampling rate of 25 Hz. Operators experienced in video match-analysis simultaneously coded each player action involving the ball. Physical and technical performance from the raw data file was determined automatically by computerised analysis of player movements and actions using match-analysis software (AMISCO Viewer®, Sport-Universal Process, Nice, France). The workings, accuracy and reliability of the AMISCO Pro® system in measuring player movements and coding game events in professional soccer competition have been described in more detail elsewhere (Di Salvo et al, 2007; Carling et al., 2008; Zubilaga, 2006, Zubillaga, Gorospe, Hernadez-Mendo et al., 2008).

The performance profiles of players according to their individual positional role were determined. The number of performance observations (*n*) for 6 positional roles were as follows: central defenders (CD, *n*=2328), full-backs (FB, *n*=344), central defensive midfielders (CDM, *n* =1972), wide-midfielders (WM, *n* =150), central attacking midfielders (CAM, *n* =158) and forwards (F, *n* =986).

The total distance covered by players was measured. Two thresholds were used to evaluate the distances run in two categories of running speeds at high-intensities: 21-24 $km \cdot h^{-1}$ (high-intensity running, HIR) and >24.1 $km \cdot h^{-1}$ (sprinting). These speed categories are similar to those reported in other studies using the same analysis system (Carling &

Bloomfield, in press; Di Salvo et al., 2007). The physical efforts of players were calculated according to whether their team was in (attacking play) or out of (defensive play) possession of the ball.

The technical parameters monitored included: number and percentage of successful passes, number of forward passes, individual time spent in possession of the ball, mean number of ball touches by individual players for each possession, and number and percentage of successful heading and ground duels (one-on-one situations such as heading and tackling actions in which players were competing for possession).

All values are expressed as means ± standard deviation. The normality distribution of the data was checked using the Kolmogorov-Smirnov test and the statistical analysis variance homogeneity was provided by the Hartley test. A two-way analysis of variance (ANOVA) with repeated measures was used to compare the distance covered according to two factors: playing positions with six levels (CD, FB, CDM, WM, CAM and F) and the distances covered at two running intensities with two levels (21-24 $km \cdot h^{-1}$ and > 24.1 $km \cdot h^{-1}$). Concerning technical performance, a one-way ANOVA was used to compare the technical aspects according to the playing positions with six levels (CD, FB, CDM, WM, CAM and F). Independent-sample t-tests were used to explore differences between FAPL and LIGA players. Significant main effects of each factor were followed-up with post hoc Bonferroni-corrected multiple comparisons. Statistical significance was set at $P<0.05$.

Results

Physical performance

Total distance covered

Comparison of the total distance covered across playing positions showed no difference between FAPL and LIGA players except for CAM ($P<0.05$). Post hoc analyses

showed that CD, FB and F (in ascending order and respecting the same pattern in LIGA and FAPL players) were the positional roles that covered the least total distance (Table I). Lower values (P<0.05) were obtained in CD, FB and F compared to CDM, who covered the greatest total distance.

*****Table I about here*****

High-intensity running (21-24 km·h^{-1})

Table I presents data on distance covered in high-intensity running (HIR). In both leagues, CD performed the lowest amount of total distance in HIR (P<0.001) but greater values were recorded in FAPL CD compared to LIGA counterparts (P<0.05). LIGA F, CDM and CAM covered lower distances in HIR than FAPL players in the same positional roles (respectively P<0.05 for the F and P<0.001 for the CAM and the CDM). WM and FB in the FAPL ran a larger percentage of the total distance covered at high-intensities compared to LIGA peers (respectively P<0.05 and P<0.01) whereas FAPL CDM and CAM presented a lower percentage of the distance run at high-intensities than those in the LIGA (2.5% vs. 2.9% of HIR for CDM, P < 0.001; 2.5% vs. 3.1% for CAM, P < 0.001, respectively).

In defensive play, CD, FB, CDM and WM LIGA players ran a significantly greater total distance in HIR than in attacking play (P<0.001 for CD, FB and CDM, P<0.01 for WM) (Table I). The efforts made during defensive and attacking play demonstrated similar patterns across players irrespective of positional role or championship, except for WM and CAM. FAPL WM ran greater HIR distances when their team was in ball possession whereas the opposite was observed for LIGA WM. In addition, CAM in the FAPL covered similar distances in HIR in defensive and attacking play whereas a higher total distance covered in attacking play (P<0.001) was observed in LIGA CAM.

Sprinting (>24.1 km·h^{-1})

Analysis of the distance covered in sprinting showed a similar trend in both leagues in that CD covered the least distance in sprint whereas F sprinted the greatest distance (P<0.001). However, players across all playing positions in the FAPL league covered greater distances in sprint running than LIGA counterparts (Table I). Of the total distance covered, FAPL FB, CDM, CAM and F players ran a larger percentage in sprinting in comparison with the LIGA players (respectively P<0.05 for FB and F, P<0.001 for CAM and CDM). Sprint activities ranged from 1.8% to 2.6% of the total distance covered. LIGA players covered a higher total sprint distance in possession compared to out of possession (P<0.001 for CD, FB, CAM, WM, F and P<0.05 for CDM). However, contrasting results were reported in FAPL players as they covered a similar total distance in sprint running irrespective of ball possession (FB, CDM and CAM) (Table I). Indeed, FB, CDM, CAM and F FAPL players included a larger part of sprint activities in respect to the total distance covered in comparison with LIGA players (respectively P<0.05 for FB and F; P<0.001 for CAM and CDM).

Technical performance

Defenders (FB and CD) across both leagues won the highest proportion of heading and ground duels (Table II) (P<0.001). CAM and F presented the lowest percentage in heading duels won (P<0.001) but LIGA F won more heading duels than FAPL F (P<0.001). The different positions across the midfield (CDM, WM and CAM) presented no difference in the success percentage in ground duels. When comparing the different playing positions across the FAPL and LIGA, the results did not demonstrate any difference in the percentage of ground duels won.

The percentage of successful passes ranged from 70% to 81% (Table II) with no difference between the two leagues across playing positions, except for LIGA F who

successfully performed more passes than FAPL F (P<0.05). In both leagues, CD had the lowest total time spent in individual ball possession (P<0.001). LIGA CAM spent the most time in individual ball possession (P<0.01 vs. FAPL CAM, and P<0.001 vs. the other positions) whereas in the FAPL, highest values were reported in CAM and WM (P<0.001). The number of ball contacts per possession was similar in CD, FB, CDM and CAM for both the LIGA and FAPL leagues but differed in WM and F. FAPL WM had ~20% more ball contacts per possession than LIGA counterparts (P<0.001) while LIGA F had a higher number of ball contacts than FAPL F (P<0.001).

Discussion

The various demands of elite soccer performance have been frequently described in the scientific literature. However, there is a lack of studies attempting to address cultural differences in physical match performance especially between various professional leagues while using the same method of analysis and definitions of movement speed. In addition, evaluation of physical performance should also take into account the technical demands of match-play. The aim of this investigation was therefore to compare physical and technical performance in competitive match-play, using a large-scale sample, between two major European soccer championships. The results demonstrate that specific technical and physical demands exist in both respective leagues and notably across individual positional roles. On the basis of these findings, it is hoped that the information will be valuable in contributing to the prescription of individualised training and preparation strategies.

Results from the present investigation showed that FAPL and LIGA players covered total distances ranging from 10496 m to 11779 m, which are generally within the range of those reported in players across other professional leagues (Carling *et al*., 2008; Di Salvo *et al*., 2009), indicating that a certain degree of aerobic endurance is essential in professional

soccer in England and Spain. The comparison across all playing positions generally identified no overall difference between Leagues in total distance covered although central attacking midfielders in the FAPL performed around 6.6% (775m) more distance than their LIGA counterparts. Therefore, the total distance covered by players may not be considered an important discriminator of performance across different Leagues. These findings partly contrast with research by Rienzi *et al.* (2000) who presented evidence that the overall distance covered by South American professional players was about 1000m less than by players in the FAPL Premier League. It was suggested that the higher sustained pace by FAPL players could explain this disparity across the populations although the authors did not distinguish between playing positions as was done in this study.

One noteworthy finding in this study was the significant differences in total distance run across midfield roles. In other investigations, central-midfielders were shown to cover higher overall distances than wide-midfielders (Di Salvo *et al.*, 2007). However, this study was the first to differentiate central midfield players into specific defensive and attacking roles. The result showing that central defensive midfielders (CDM) ran substantially greater overall distances compared to central attacking midfielders (CAM), especially in the FAPL, is therefore noteworthy. The tactical duties of CDM are different to that of CAM and the present results would suggest that the former latter is subjected to greater overall exertion and may need higher levels of fitness. The greater distances covered by the present CDM in the FAPL may be related to the playing styles and/or team formations commonly employed in this League. A study linking physical efforts and positional roles with these factors is thus warranted. Nevertheless, on the basis of these findings, the present authors suggest that data from future analyses of match performance should be interpreted according to the precise tactical role of the midfield player.

High-intensity running efforts are a crucial element in elite soccer performance (Di

Salvo *et al*., 2009). In the present study, HIR and sprint activities accounted for 3.9% and 5.3% of the total distance covered whereas in other professional leagues the high-intensity activity profile of players during match-play range from 6.1% up to 13.5% of total distance covered (Barros *et al*., 2007; Bradley *et al*., 2009; Rampinini *et al*., 2007). However, the comparative analysis revealed that FAPL players performed a substantially greater total distance in high-intensity activities than LIGA players irrespective of playing position. This result is in contrast with the observations of Bradley *et al*. (2009) when comparing their results in FAPL players with those from studies on other elite playing populations. Similar distances in high-intensity efforts were observed in FAPL players compared to those reported in equivalent Italian and Spanish Leagues (Bradley *et al.*, 2009; Rampinini *et al.*, 2007). Differences in the data collection methods employed could explain the discrepancy between studies. It may also be that the present results uphold the common belief that the FAPL game is traditionally played at a very fast pace compared to in other countries (Rienzi *et al.*, 2000). Nevertheless, further investigations are necessary to determine whether other elements of high-intensity performance such as mean sprint distance or duration and recovery time between efforts also differ between players from elite leagues.

In both Leagues, forwards were shown to cover the greatest distances in high-intensity work whereas CD and CDM covered the least distances respectively. Differences across positions are most likely a direct consequence of the tactical role of these positions within the team (Mohr *et al.*, 2003). This result is in contrast with general consensus that WM cover the most distance in high-intensity work (Carling *et al.*, 2008) although similar distances were recently reported in FAPL WM (Di Salvo *et al.*, 2009). While different methods of observation and variations in the classification of movements may once again account for the differences between studies, other factors such as the opposition, environmental factors or importance of games may have played a part. Nevertheless,

differences in physical performance across playing positions suggest that specific high-intensity conditioning regimes may be more beneficial for certain individuals within the team formation. Intermittent exercises, repeated-sprint drills and small-sided games are commonly used to improve aerobic performance and aid recovery time between sprints (Dellal *et al.*, 2008; Dupont *et al.*, 2004).

The differentiation between high-intensity activity with or without the ball possession enables the relative effectiveness of high-intensity efforts in relation to crucial match actions to be evaluated (Di Salvo *et al.*, 2009). The analysis of these efforts according to ball possession showed that physical activity in both leagues was substantially different across midfield playing positions. In the LIGA for example, CAM covered the most distance in high-intensity running when their team was in possession whereas this was the case for WM in the FAPL. This result suggests that position-specific high-intensity training in midfield players should be tailored not only to the individual tactical role of the player but also be adjusted according to the specific demands of the League in which the player performs. However, similar physical activity patterns were reported in other positions across both leagues (e.g. central-defenders, forwards) in both attacking and defending play implying that there are elements of physical performance common to certain positions in both leagues.

The technical analysis of match-play showed similar characteristics in passing performance in LIGA and FAPL players. Players in both of these leagues need to achieve a success rate between 70% and 81% in passing the ball (Table I). However, LIGA F attained better success rates in passing than FAPL F who also recorded the lowest success across all positions. Further research is necessary to understand the reasons for this disparity and to eventually inform ways in which this element of match performance can be improved.

Forwards in both leagues played a substantially lower number of passes towards the opponent's goal compared to the other positions. This disparity may be due to the specific

role of centre-forwards as these players often have their back to goal during link-up play. Similarly, CD, CDM and CAM across both leagues also demonstrated comparable patterns in terms of the total duration in possession and number of ball contacts. In contrast, FAPL FB and WM had substantially more ball possessions than their LIGA counterparts while LIGA F touched the ball more per possession than FAPL F despite spending a similar time in possession. LIGA CAM spent the greatest total time in possession whereas this was the case for WM in the FAPL league. These results suggest that the technical demands in ball possession differ significantly across certain playing positions in these two countries.

Finally, the analysis of the won and loss percentage in heading and ground duels showed that certain playing positions in each country (notably defenders) were generally more successful in these actions than other positional roles (Table I). This result probably reflects the specific training done to respond to the demands of playing in defensive positions. In addition, it could be also because the modern attacking players are generally shorter in height than defenders (Wong *et al.*, 2008). Somewhat surprisingly however, FAPL F lost a greater percentage of heading duels than LIGA F. This may be due to the better heading ability of FAPL defenders as the requirement for success in these actions is inherent to counter the direct playing style using long aerial passes frequently observed in the FAPL game (Carling, Williams & Reilly, 2005).

Conclusion

The findings from this study have allowed the identification of both similarities and differences in various aspects of physical and technical performance between two major European soccer leagues with variations dependant upon playing position. This information has enabled a more thorough understanding of the physical and technical requirements for playing in the LIGA and the FAPL and may have direct consequences for specific training

regimens and talent identification schemes. These cultural differences in performance may also have an impact on transfers as they suggest that players moving between countries need to adapt both physically as well as technically to the particular style of these leagues. Future studies examining further physical, technical and tactical aspects of performance and across a wider range of professional leagues are warranted.

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