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This is the author's manuscript

Original Citation:

Availability:

This version is available <http://hdl.handle.net/2318/127171> since

Published version:

DOI:10.1519/JSC.0b013e3182679382

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(Article begins on next page)

This is the author's final version of the contribution published as:

[inserire: Vigne G; Gaudino C; Dellal A; Chamari K; Rogowski I; Alloatti G; Wong DP; Owen A; Hautier C, Physical outcome in a successful Italian Serie-A soccer Team over 3 consecutive seasons, JOURNAL OF STRENGTH AND CONDITIONING RESEARCH, volume 27, anno 2013, pagg. 1400-1406, DOI: 10.1519/JSC.0b013e3182679382]

The publisher's version is available at:

[\[http://dx.doi.org/10.1519/JSC.0b013e3182679382\]](http://dx.doi.org/10.1519/JSC.0b013e3182679382)

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Link to this full text:

[inserire l'handle completa, preceduta da <http://hdl.handle.net/2318/127171>]

Keywords: elite football, seasonal variations, match play, time-motion characteristics, ball possession

Physical Outcome in a Successful Italian Serie A Soccer Team Over Three Consecutive Seasons

Vigne, Gregory¹; Dellal, Alexandre^{1,2,3}; Gaudino, Claudio^{1,4}; Chamari, Karim³; Rogowski, Isabelle¹; Alloatti, Guissepe⁴; Wong, P. Del⁵; Owen, Adam^{1,6}; Hautier, Christophe¹

Author Information

¹Center for Research and Innovation of Sport, University of Lyon, Lyon, France

²Santy Orthopedic Clinic, Sport Science and Research Department, Lyon, France

³Tunisian Research Laboratory "Sport Performance Optimisation" - National Center of Medicine and Science in Sport (CNMSS) - El Menzah, Tunisia

⁴SUISM, Physiology - Biology, Animal and Human Department, University of Torino, Torino, Italy

⁵Technological and Higher Education Institute of Hong Kong, Department of Health and Physical Education, Hong Kong

⁶Sports Science Department, Rangers Football Club, Glasgow, Scotland

Address correspondence to Dellal Alexandre,

alexandredellal@gmail.com

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Abstract

Abstract: Vigne, G, Dellal, A, Gaudino, C, Chemari, k, Rogowski, I, Alloatti, G, Wong, PD, Owen, A, and Hautier, C. Physical outcome in a successful Italian Serie A soccer team over three consecutive seasons. *J Strength Cond Res* 27(5): 1400–1406, 2013—The aim of this study was to examine the physical performance of a successful Italian Serie A team of more than 3 consecutive seasons. Twenty-five players participated in the study and were classified into 3 playing positions: defenders ($n = 9$), midfielders ($n = 11$), and forwards ($n = 5$). Activities match were studied by an analysis of multiple match camera SICS throughout the competition Italian Serie A matches played at home ($n = 90$) for 3 consecutive seasons (first: 2004/2005; second: 2005/2006; and third: 2006/2007). Total team ball possession and time-motion characteristics were examined. Results showed that total ball possession (52.1–54.9%) and the number of points accumulated at home (40/48) improved in the past 3 seasons, whereas the final rankings at home were stable. The total distances covered by minutes of play were significantly different between the 3 seasons (118.32 ± 6.69 m·min⁻¹ to 111.96 ± 8.05 m·min⁻¹). Distance running and high-intensity activities were similar in the 3 seasons, whereas the distance covered in moderate-intensity running decreased in the third ($p < 0.05$). Variations between playing positions were found during the 3 consecutive seasons, with midfielders covering greater distances than defenders ($p < 0.05$) and forwards ($p < 0.01$).

This study showed how for 3 consecutive seasons a Serie A team of successful players reduced their distances performed at submaximal speeds, and increased ball possession, while maintaining the high-intensity activities and the number of points at home. It is suggested that this is because of a better understanding of roles and tactics team organization and to act collectively and individually on these

parameters to reduce energy expenditure during the game to maintain a high-level performance throughout the season.

Introduction

Soccer has been widely analyzed both by coaches and scientists throughout the previous 20 years to fully understand and define the precise activity of soccer players during elite competitive match play. In recent times, multiple cameras within semiautomatic systems are continually used to provide information about the tactical, technical, and physical implications within competitive match play for each player concomitantly (9–12,23). It was reported that male adult soccer players covered a distance ranging from 10 to 13 km during a game including ~3.2 km of walking, ~0.7 km of high-intensity activity, and ~0.25–0.4 km of sprinting (3,5,9,10,12,23,26). In the same context, the physical profile of elite Italian soccer players has been described by Vigne et al. (28) who suggested that players perform ~39% of walking (≤ 5 km·h⁻¹), ~30% of low-intensity running (>5 to 13 km·h⁻¹), ~13% of moderate-intensity running (>13 to 16 km·h⁻¹), ~8% of high-intensity running (>16 to 19 km·h⁻¹), and ~10% of very high-intensity running (>19 km·h⁻¹). Thatcher and Batterham (27) have added that players run backward for approximately 1.3 km during match play, which represents approximately 3.7% of the total activity; however, this type of action has recently been left out of the literature despite its importance in the movement characteristics of the game. Furthermore, studies have revealed essential differences of time-motion characteristics and technical activity when analyzing the different positional roles during games (9,10,12). It has been shown that midfielders covered the highest total distance when compared with other playing positions, whereas forwards elicited the highest values for sprinting and walking activity (1,2,9,10,28). Physical and technical outcomes of competitive match play are well known according to the playing positions, but to the best of our knowledge, no study has attempted to follow the player's activities within official games during consecutive seasons. Rampinini et al. (23) revealed the variation in physical performance during a single season and concluded that the high-intensity activity varied significantly throughout the course of that season. Gregson et al. (13) concurred with this variation of high-intensity activity throughout the season, describing how this variability also existed when 2 games were played with limited recovery time between the 2 fixtures. Moreover, Bradley et al. (4) tried to analyze the effects of tactical components (i.e., playing formation) on the physical and technical demands in English Premier League matches. The results revealed how the use of different playing formations can impose different physical and technical demands on players. For example, forwards performed approximately 30% greater high-intensity running when their team played in a 4-3-3 playing formation in comparison with the 4-4-2 and 4-5-1 formations. However, as suggested by Lago-Penas and Dellal (16), the tactical implications depend on multiple factors. Indeed, these authors examined the total ball possession during 380 matches involving Spanish League first division during the 2008–2009 season and have demonstrated that the possession variable alone does not influence the final positional rank of the team for the majority of the league but did however show a trend for the 5 top teams. In this context, the question of the relationship between tactical variable, total ball possession, and physical

demands within elite games has not been investigated yet. Nevertheless, with regard to physical outcome, several authors have stressed the importance of sprints and very high-intensity runs with respect to the outcome of a soccer game (Dellal et al. 2011) (9). Moreover, with respect to ball possession, keeping a relatively consistent team composition and playing formation could eventually help in increasing the ball possession, thus increasing the likelihood of success at elite level along with impeding the opponents to impose their play (16).

Consequently, the aim of the present retrospective study was to determine the motion characteristics and total team ball possession during 3 consecutive seasons in an elite Italian Serie A soccer team, using a consistent playing formation and having won the league for the 3 consecutive studied seasons. We hypothesized that the distances covered by the players during the games and the team's ball possession stayed constant over time and in a relatively high range to insure such a successful outcome.

Methods

Experimental Approach to the Problem

The physical activities of elite soccer players during official games are well known. However, the physical demands and total ball possessions during elite level games over consecutive seasons has not been investigated. To take into account the performance of the team, the number of points accumulated and the final rankings at home were examined. Therefore, in this within-player repeated-measures retrospective study, players' physical activities and team's total ball possessions were examined during all the official games played at home during 3 consecutive seasons (first season: 2004–2005; second season: 2005–2006; and third season: 2006–2007), in which the team also took part in the UEFA European Champions League. Players ($n = 25$) who did not participate in the 3 complete seasons or sustained a major injury were excluded for the statistical analyses, and therefore, a total of 10 players were examined (defenders: $n = 4$; midfielders: $n = 3$; forwards: $n = 3$). During the study, the turnover of the squad was lower than 50% (less than 16 new players a year); however, it represented only 10% over the course of the 3 seasons (<3 players). All players followed the same nutritional guidelines consisting mainly of a high carbohydrate meal that was consumed 3 hours before the kickoff of all competitive fixtures. The medical staff allowed specific hydration strategies before, during, and after each games sessions. All the training sessions' workload and recovery methods were used between games and were the same for all players across the 3 seasons. The same fitness and assistant coaches always used a similar standardized warm-up before each official game for all players. The playing formation used (4-4-2) and the technical coaching staff remained constant over this study period. This allowed ensuring that the coaches' tactical instructions to the players both individually and collectively were consistent.

Subjects

Twenty-five elite Italian soccer players competing within the Italian Serie A league and who were at the time competing at UEFA Champions League level took part in the investigation. Players participating in the study (age 27.4 ± 4.0 years; body mass 82.8 ± 8.0 kg; height 181.5 ± 7.7 cm) were classified in 3 playing positions:

defenders: $n = 4$; midfielders: $n = 3$; forwards: $n = 3$. Players completed 5–7 training sessions per week plus 1 or 2 official matches (UEFA Champions League, Italian Serie A, Italian cup, and Italian Supercup).

Goalkeepers were excluded from this study because they did not participate in the same physical training program as the remainder of the squad. The study was conducted according to the ethical standards in sport and exercise science research and was in accordance with the Declaration of Helsinki, 1964.

The local university ethics committee approved the protocol, and all subjects gave written informed consent.

Time-Motion Characteristics and Total Team Ball Possession

Data were collected from a total of 90 matches (at home) played over the 3 seasons using the same multiple camera match analysis SICS system (SICS, Bassano del Grappa, Italy) with six 25-Hz sample frequency cameras. The 6 fixed cameras were positioned all around the pitch and subsequently calibrated and synchronized. All players were simultaneously monitored, and the total distance covered in different speed categories was determined as in the study of Osgnach et al. (22). Five speed thresholds were used to evaluate the total distances covered: walking (≤ 5 km·h⁻¹), low-intensity running (>5 to 13 km·h⁻¹; LIR), moderate-intensity running (>13 to 16 km·h⁻¹; MIR), high-intensity running (>16 to 19 km·h⁻¹; HIR), and very high-intensity running (>19 km·h⁻¹; VHIR). These speed categories are similar to those reported in other previous studies using the same analysis system (22,24,28). The reliability of the video match analysis system SICS was demonstrated by Rampinini et al. (24) who showed a typical error of 1.0% for total distance covered and a typical error as coefficient of variation for HIR of 3.2% (95% confidence interval [CI] = 1.9–9.2%), whereas a previous pilot study showed an accuracy of 3.6% for HIR ($n = 5$; 95% CI = 2.6–10.3%). Values of distances covered were expressed according to “the minute of play” to allow a fixable comparison (Burgess et al. 2006). In accordance to this, the total duration of the total team ball possession was examined during each game and has been expressed as a percentage of the playing time.

Statistical Analyses

Times-motion characteristics and total team ball possession values are expressed as mean \pm SD, including area of a 95% confidence ellipse and range. Before using parametric statistical test procedures, the assumptions of normality and sphericity (Mauchly test) were verified. Two-way analysis of variance (ANOVA) for repeated measures were used with playing positions (3 levels: defenders, midfielders, and forwards), time-motion characteristics (different running thresholds), and season effect (first, second, and third) as factors to test the 2 hypotheses. In addition, 1-way ANOVA for repeated measures were used to analyze the effect of different periods of the season on the time-motion characteristics. Significant main effects of each factor were followed-up with post hoc Bonferroni-corrected multiple comparisons. For all the statistical tests, the significance threshold was set at $p \leq 0.05$. All the tests were performed using SPSS software, version 11.0 (SPSS, Inc., Chicago, IL, USA). Effect size (Cohen's d) was calculated to determine the practical

difference. Effect size (ES) values of 0 to <0.20, 0.20 to <0.50, 0.50 to <0.80, and ≥ 0.80 were considered to represent trivial, small, medium, and large differences, respectively (8).

Results

The physical profile of each player according to playing positions is presented in [Table 1](#) and [Figure 1](#). The total distances covered per minute of match play were significantly different between seasons. The variation of the proportion of distances covered presented no significant differences for all speed categories. Over the 3 seasons, distance covered per minute of play did not vary significantly for walking and VHIR. However, the analysis showed significant decreases in distance covered per minute of play in LIR between first and second seasons ($p < 0.01$; small ES = 0.21) and between the second and third seasons ($p < 0.05$; small ES = 0.32). The distances covered in MIR ($p < 0.01$, small ES = 0.30) and HIR ($p < 0.05$, small ES = 0.32) also showed a significant decrease between the second and third seasons, whereas no significant difference was found between the first and second seasons. The decrease of the total distance covered per minute of play (especially for LIR, MIR, and HIR) allowed the players to cover approximately 6–7 m less per minute of presence on the pitch, and thus the total distance covered was reduced by 5%. No seasonal differences were observed during the different periods (start or end of season) of the different seasons for all the time-motion characteristics.

Midfielders covered greater total distance as compared with defenders ($p < 0.05$; large ES = 1.72) and forwards ($p < 0.01$; large ES = 0.92) ([Table 1](#)). No differences were observed in walking and in VHIR ([Figure 2](#)). Nevertheless, midfielders covered higher total distance than forwards in LIR ($p < 0.01$; large ES = 0.75) and in MIR ($p < 0.05$; large ES = 0.73), whereas defenders covered greater distance than forwards in MIR ($p < 0.05$; large ES = 1.80) and in HIR ($p < 0.05$; large ES = 1.75) during the 3 seasons ([Table 1](#) and [Figure 2](#)).

The variation and range of the physical profile according to the playing positions during the 3 consecutive seasons showed no interaction season/playing positions, and thus, no significant differences all across the 3 seasons whether it is for defenders, midfielders, or forwards.

Results showed a significant improvement of the total team ball possession percentage from the first to the third season (52.1 vs. 54.9%, $p < 0.05$ with 95% CI = 48.7–58.8% and 47.5–59.1%, respectively) during all the games played at home. No significant differences were found according to the different periods of the season. In addition, the total points won at home significantly increased from the first to the third season (40 vs. 48) along with the final team rank for at home ranking that stayed in the range of excellent performance (second vs. first).

Discussion

This study reveals significant changes concerning the players' physical outcome within an elite successful Serie A team over 3 consecutive seasons for the home games. If the distances covered per minute by walking or VHIRs did not vary over the seasons, there was a significant decrease in the distances covered at intermediate intensities (LIR, MIR, and HIR). Along with this, the team's ball

possession increased significantly while improving number of points and keeping an excellent team ranking. Analyzing the soccer players' physical outcome by the quantification of distance covered at specific running speeds has been widely used in the recent years (4,7,9,10,21,24,26,28).

Nevertheless, as the absolute distance covered could be flawed by the playing time (duration of the game or the player being substituted during the game or just entering to substitute another player), we chose to express the distance relatively to time (6), that is, distance covered per minute.

Recently, Osgnach et al. (22) showed that the game analysis performed in this study, that is, analyzing the distances covered at different speeds, underestimates the energy cost of accelerations and decelerations performed by the players. Nevertheless, even if this issue clearly suggests that this study results has to be interpreted with caution, most of the last decade match analysis studies relied on such a descriptive analysis. For such, the present results will be compared with similar studies keeping in mind the fact that the present analysis does not take into account the energy costs of accelerations/decelerations and changes of direction. The reduction of distance covered at intermediate zone speeds allowed reducing the physical demands placed upon the players. Therefore, it may increase the energy reserve (especially glycogen) and thus delay fatigue during the match according to the findings of previous studies (18). This might have been a contributing factor to the observed increase of points collected over the 3 seasons. In this context, the decrease in total distance covered per minute of play from the first to the third season (especially for LIR, MIR, and HIR) equates to the players covering approximately 6–7 m less per minute during the match, resulting in a reduction of the total distance covered approximately by 5%. At elite performance level and considering the number of games during the seasons (between 47 and 55 games), this adaptation could be a decisive advantage during consecutive games and especially considering the end of season efforts. It could also be interesting during several periods, especially at the beginning of the UEFA Champions League during which match fixture is congested (e.g., 7 games in 21 days). However, it was reported that 2 consecutive games in 3 days did not affect the number of sprints and HIR activity (25). This study shows that no changes appear in VHIR activity throughout the course of the 3 consecutive seasons. The lower distances performed in LIR, MIR, and HIR are probably because of a better organization of the team or an improved understanding of the playing formation because of the stability of tactical strategy. In this context, high-intensity physical efforts performed at intensities above the anaerobic threshold highly tax the glycogen muscle stocks. The depletion of the glycogen stocks has been shown to be one of the main explanatory factors of the decrease of performance toward the end of soccer games (18,19,20,24). However, the distance covered in VHIR was not significantly altered during the 3 seasons probably because of the fact that this running activity (>19 km·h⁻¹; VHIR) is an effort that generally affects the outcome of a match in elite soccer because it has an influence on the final score of a match (14). Therefore, even if improving their energy management by significantly reducing the distances performed at intermediate speeds, players of this study did not alter their distances covered at high intensity, allowing them to keep a good performance through the 3 consecutive studied seasons.

Some parameters could also explain the decrease in physical demands imposed upon the players (7,14,15,17,24), especially the total ball possession that continued to improve throughout the analyzed period (20). Recent studies also revealed that the total ball possession in the offensive phase (16), score and status of the game (23), and/or localization of the game (14,15,17) had several influences on the time-motion characteristics in elite soccer players.

Lago (14) showed that strategies in soccer are influenced by match variables (i.e., match location, quality of opposition, and match status), and teams alter their playing style during the match accordingly. All these parameters could have an effect on the physical demands during the match, and it is essential to consider these variables in addition to the tactical playing formation consistency. Several studies (18,19) have revealed that players presented signs of fatigue at the end of a match, especially a decrease of the physical performance (sprinting and VHIR) in the last 15 minutes of an elite soccer match. However, in this study, it could be suggested that some of the decrease of the physical demands within the match was not only due to fatigue but also influenced by players having a better tactical organization and/or understanding of the playing formation. It should be noted, however, that fatigue during competitive match play could be avoided by improving the tactical awareness of both the individual players and the team collectively. Additionally, it appears that the physical demands during elite-level games may be an indicator to the final rank and level of a team, as indicated by Rampinini et al. (24) who revealed that teams ranked within the bottom 5 Italian Serie A presented significantly greater total distance covered than the top 5 teams.

This implies that more successful teams exert less physical effort in competitive match play probably because of a higher tactical awareness and technical ability allowing higher ball possession. Authors from these specific investigations suggested how players from the bottom teams covered greater distances (+4%), especially in HIR (>14 to 19 km·h⁻¹, +11%) and VHIR (>19 km·h⁻¹, +9%), than the top 5 team players' counterparts in defensive phases.

Moreover, in offensive phases, top 5 teams' players covered 18% higher distances especially in VHIR (+16%). The team involved within this investigation finished as winner of the Italian Serie A, and as such, results from Rampinini et al. (24) suggest that players from the 5th ranking covered greater distance with ball possession and therefore, it is in agreement with the results of this study. In this context, the tactical consistency of playing formation could improve the fluidity of playing movements and the coordination between players as indicated by the results of this study showing no seasonal variation in tactical strategy. Essentially, coaching should focus on the quality of passing the ball during offensive phases but not always on the total ball possession because it was showed that the team having longer ball possession was the team generally who lost in Spanish Liga (16) except for the top 5 teams. The team examined in this study belongs to the top 3 teams of the Serie A, and Furthermore, although physical demands varied from the first to the third season, the analysis of this study showed similar differences between the different playing positions during all the 3 seasons. Indeed, this study results confirm those from previous studies (9,23,25,27) revealing that midfielders cover greater total distance within a game than other players, whereas defenders covered greater distance than forwards. A stable playing formation could not ensure the physical

demands stability because coaches could provide different tactical instructions according to the match location, the score evolution, the match status, the opposition, and the competition (Serie A vs. UEFA Champions League). In this context, Bradley et al. (4) have shown that variation of the tactical instructions alters the physical (especially, sprinting, HIR, and VHIR) and technical demands, with, for example, an increase of approximately 30% of HIR for forwards. In this context, it is possible that the tactical instructions should not have the same effect on all the playing positions. Interestingly, despite the significant decrease of the total distances covered by players throughout the 3 seasons, the differences of the physical activity profile according to the playing positions persisted in opposition with the results from Bradley et al. (4). Although the total distances covered between 13 and 19 km·h⁻¹ decreased for every playing positions (Table 1), no differences of total distances covered was found during the 3 seasons for each playing positions. Thus, the main information of this article concerning the stability (VHIR, final ranking in Serie A), the decrease (LIR, MIR, and HIR), and the increase (team ball possession and number of points win at home) of the players' activities over the 3 seasons were not dependent of the playing position. Therefore, this last information could justify the fact that it was the whole team activity that induced these physical and technical performances evolutions over the 3 studied seasons.

Practical Applications

This retrospective study investigated a successful team through 3 consecutive Italian Serie A seasons. The physical distance covered in walking, LIR, MIR, and HIR decreased from season 1 to season 3, whereas there was stability in the distance covered in VHIR and sprinting. This trend was observed for the whole team and for the different positional roles. Technically, whereas some of the distance covered decreased, the team increased its ball possession through the studied seasons. The consistency of the playing formation and tactical strategy used could be a factor explaining these interesting variations of physical and collective technical performances. The coach's choice of tactical stability could improve the tactical positions and/or replacement of players and therefore improve the economy of the energy expenditure favoring a constant repetition of sprinting and VHIR. Consequently, it could be recommended to the coaches whenever it is possible to use a stable tactical organization to allow their players to optimally use their physical and technical capacities during all the repeated games through seasons.

Acknowledgments

The authors would like to thank the medical soccer team staff and Roberta Macchi for their collaboration. The authors have no conflicts of interest that are directly relevant to the content of this article. This study was not supported by any financial aid. Results of this study do not constitute endorsement of the product by the authors or the National Strength and Conditioning Association.

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