Influence of match location, competitive level and match outcome on running performance in professional soccer players

Influências do mando de jogo, nível competitivo e resultado da partida sobre o desempenho físico em jogadores profissionais de futebol

ABSTRACT

Introduction: The context of soccer matches (e.g., match location, competitive level, match outcome) can impact the players' physical performance. Aim: To investigate the effects of the match location, competitive level and match outcome on match running performance in professional Brazilian players. Methods: The performance data were monitored in 16 male soccer players of the same team during the following championships: 1st Division of the Capixaba Championship 2020 (n = 8 matches; n = 64 individual observations) and; 1st and 2nd Phases of the Brazil Cup 2020 (n = 2 matches; n = 16 individual observations). The match running performance was calculated using Global Positioning System: 1) total distance covered; 2) total distance covered in high-intensity; 3) total distance covered in high-acceleration. The t-test for independent measurements was used to compare the home vs away, national vs. state, and win vs. loss matches. The magnitude of the effects (ES) was calculated using Cohen's “d”. Multiple linear regression was used to estimate the relative contribution of independent variables to the variation of dependent variables. Results: The matches played at “home” resulted in greater physical demands compared to “away” (p < 0,001−0,01, ES = moderate−very large). Matches at the national level required greater running demands than matches at the state level (p < 0,001, ES = very large). Winning matches were more physically demanding compared to losing matches (p < 0,001−0,002, ES = very large). Conclusion: Coaches can use this information to prescribe training sessions that are more representative of the match context.

Keywords: task performance and analysis; geographic information systems; exercise; sports nutrition sciences.
Introduction

The match analysis is often used in team sports (e.g., soccer) to obtain objective information about the players’ and teams’ performance and can assist coaches in planning training sessions more in line with match demands. In addition, information of match running performance (e.g., total distance covered at high-speed running) is important physical performance indicator [1-3]. A classic study about the evolution of match physical demands showed that the total distance covered at high-speed running and the number of passes increased 50% across seven seasons of the England Premier League (season 2006-07 to season 2012-13) [4]. This growth can affect the behavior of ball possession during the matches, as a greater number of successful passes can result in higher possession values [5].

In Brazil context, there are few studies that characterized match running performance in professional soccer players [6]. In 2007, Barros, Misuta [7] verified that the players cover ~10000 ± 1024 meters during the games, being 1,128 ± 361 meters in high intensity (≥ 19.0 km/h) in games of the 1st Division of the Brazilian Championship. Twelve years later, Vieira et al. [8] observed similar values for total distance covered (10147 ± 971 meters); however, the authors demonstrated an increase of ~71% in high-speed distances during 1st Division of the São Paulo State Championship. This increase in match intensity can impact the match outcome. Faude et al. [9] showed that 83% of goals during the German National League were preceded by some high-intensity action. In Brazil, two studies observed that matches that resulted in a victory during the 3rd and 4th Divisions of the Brazilian National Championship had greater actions in high-intensity compared to games with defeat [6,10]. Furthermore, previous studies demonstrated that match location (i.e., home vs. away) and competitive level (i.e., different divisions) can influence players’ performance [11,12].

Regarding the match location, studies have shown that home matches resulted in greater physical and technical-tactical performance compared to away matches [13,14]. For example, higher values of total distance covered in high-speed running and teams’ ball possession were verified in home vs. away matches [3,13,15]. These results can be explained by the familiar environment of playing at home and a more solid playing style [16,17]. Regarding the competitive level, the results in the scientific literature are divergent. In Europe (i.e., Union of European Football Associations (UEFA) and Italian League), high-level players covered greater distances in high-speed running compared to low-level players [18,19]. In contrast, Aquino et al. [11] showed higher values of high-speed actions in lower divisions (e.g., 4th Division of the Brazilian National Championship) vs. Upper division (i.e., 1st Division of the São Paulo State Championship).

Despite the existence of previous studies in Brazilian soccer demonstrating the effects of contextual variables on the physical and technical-tactical performance of professional players [6,10,11,20], the data are restricted to teams from São Paulo, which does not guarantee “nomothetic” observational designs [21]. Therefore, more
studies are needed at different competitive levels (state and national championships). This information can be crucial for sports coaches and scientists in understanding the real physical and technical-tactical demands according to the match context in Brazilian soccer. Thus, the aim of this study was to investigate the effects of match location (home vs. away), competitive level (state vs. national) and match outcome (won vs. loss) on match running performance during the 1st Division of the Capixaba Championship (edition 2020) and the Continental Cup in Brazil (edition 2020).

Methods

Participants and match sample

Match running performance data (80 individual observations) were monitored in 16 professional outfield male soccer players (mean ± standard deviation: age: 25 ± 10 years; height: 177.1 ± 9.2 cm; body mass: 82.3 ± 7.5 kg) of the same team during two competitions: 1st Division of the 2020 Capixaba Championship (n = 8 matches; n = 64 individual observations), 1st and 2nd Phases of the 2020 Continental Cup in Brazil (n = 2 matches; n = 16 observations). As an inclusion criterion, only data from players who participated in ≥ 80 minutes were analyzed. In the present study, a previous sample calculation was not performed, as it is a follow-up of the entire season of the analyzed team. However, based on the study of Aquino et al. [6] and based on the results found in the present study for the comparisons of the total distance covered between the win (10019.6 ± 832.1 m) vs. loss matches (8322.4 ± 1238.6 m), there is a real power = 0.82, with an effect size of 1.60 and an α = 0.05 for the match sample size. This study complies with the Code of Ethics of the World Medical Association (approved by the Swansea University Ethics Advisory Board), approved by the Research Ethics Committee of the University of São Paulo at School of Physical Education and Sport of Ribeirão Preto (protocol 108137/2015) and was carried out in accordance with the Declaration of Helsinki. Written informed consent was obtained from all players prior to the proceedings.

Measures

Dependent variables: Global Positioning System (GPS) devices were used (QS-TARZ - 5 Hz, Taipei, Taiwan) [6]. GPS technology has been widely used to measure running performance in team sports and its accuracy and reliability have been previously determined [22,23]. Although the low acquisition frequency of the devices used in this study (5 Hz) could potentially underestimate the total distance covered at high speed running compared to computerized optical tracking [24], the quality control analyzes that we performed showed good reliability (coefficient of variation ± 5%). All players used the same unit throughout the competition season [25].

The GPS devices were attached between the upper scapulae approximately at the T3-4 junction and were activated 15 minutes before the matches. After the matches, data were downloaded using the software (QStarz International Co., GPS
View, version 1.2.24) and exported to CSV format for further analysis in the Matlab®
environment (The Math Works Inc Natick, USA). Using specific scripts [10], the geo-
graphic coordinates were converted into Cartesian coordinates (x, y) and smoothed
by a Butterworth digital filter (third order; cutoff frequency = 0.4 Hz) for later calcu-
lation of the total distance covered (TD; meters), total distance covered in high speed
running (HSR; ≥ 18 km/h; meters) and total distance covered in high acceleration (> 2m/s²; meters). The third-order Butterworth filter with a cut-off frequency of 0.4 Hz
was used to smooth the positional data according to a quality control assessment of
the GPS units in a pilot study and in previous research.

**Independent variables:** three independent variables were considered [10,11]:
1) match location (“home” vs. “away”); 2) competitive level (state vs. national cham-
pionship) and; 3) match outcome (loss vs. win). Regarding the match location, du-
during the 1st Division of the 2020 Capixaba Championship, 1st and 2nd Phases of the
2020 Continental Cup in Brazil, 10 matches were monitored, including seven home
matches (n = 56 observations) and three away matches (n = 24 observations). Regard-
ing the competitive level, data were collected from eight matches at the state level
(n = 64 observations) and two games at the national level (n = 16 observations). Over
the two competitions analyzed, the reference team in this study had nine wins (n = 72
observations) and one loss (n = 8 observations).

**Statistical analysis**

The normality and homogeneity of variance of the data were confirmed by
the Kolmogorov-Smirnov and Levene tests, respectively. Therefore, the results were
analyzed and presented as mean and standard deviation (SD). To compare the depen-
dent variables (total distance, high-speed running, and high-acceleration) according
to match location, competitive level and match outcome, the t-test for independent
measures was used. The magnitude of the effect (Effect Size [ES]) was calculated
using Cohen’s “d” [26]. The values of “d” were considered as: d < 0.1 (trivial), 0.1 < d <
0.2 (small), 0.2 < d < 0.5 (moderate), 0.5 < d < 0.8 (large), d > 0.8 (very large). Multiple
linear regression (stepwise method) was used to estimate the relative contribution
of the independent variables (match location, competitive level, and match outcome)
to the variation of the dependent variables. Data for regression analysis assumed
homoscedasticity, independence, normal distribution, and no multicollinearity be-
tween the independent variables. The level of significance was set at 5% (p < 0.05).
Analyzes were performed using the software IBM SPSS Statistics, for Windows, ver-
ion 22.0 (IBM Corporation).

**Results**

Table I shows the effects of contextual variables on the match running per-
formance over the season. Home matches resulted in greater physical demands com-
pared to away matches (p < 0.001-0.01, ES = moderate-very large). Win matches pre-
presented higher physical demands than loss matches (p < 0.001-0.002, ES = very large). Furthermore, national level matches presented greater physical demands compared to state level matches (p < 0.001, ES = very large).

Multiple linear regression analysis showed that all regression coefficients were significant (p < 0.05). Regarding the relative contribution of each independent variable, we verified that 29%, 8% and 6% of the total variance of the total distance covered was explained by the match location, competitive level, and match outcome, respectively. In relation to the total distance covered in high-speed running, 22% and 8% of its total variance was explained by the competitive level and the match outcome, respectively. Finally, 46% and 6% of the total variance of the high acceleration was explained by the competitive level and match location, respectively.

Table I - Effects of contextual variables on physical performance in professional soccer players (mean ± standard deviation)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Match running performance</th>
<th>Total distance covered (m)</th>
<th>p</th>
<th>ES</th>
<th>High-speed running (m)</th>
<th>p</th>
<th>ES</th>
<th>High acceleration (m)</th>
<th>p</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Match location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home (n = 7 matches)</td>
<td>10212.3 ± 802.41</td>
<td>&lt; 0.001</td>
<td>0.21</td>
<td></td>
<td>869.5 ± 109.7</td>
<td>0.01</td>
<td>0.62</td>
<td>399.9 ± 81.4</td>
<td>&lt; 0.001</td>
<td>1.22</td>
</tr>
<tr>
<td>Away (n = 3 matches)</td>
<td>9004.3 ± 948.9</td>
<td></td>
<td></td>
<td></td>
<td>801.3 ± 108.1</td>
<td></td>
<td></td>
<td>318.9 ± 46.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Match outcome</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Win (n = 9 matches)</td>
<td>10019.6 ± 832.1</td>
<td>&lt; 0.001</td>
<td>1.60</td>
<td></td>
<td>862.3 ± 107.4</td>
<td>0.001</td>
<td>1.30</td>
<td>384.7 ± 78.6</td>
<td>0.002</td>
<td>1.32</td>
</tr>
<tr>
<td>Loss (n = 1 matches)</td>
<td>8322.4 ± 1238.6</td>
<td></td>
<td></td>
<td></td>
<td>730.3 ± 95.9</td>
<td></td>
<td></td>
<td>293.1 ± 58.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competitive level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National (n = 2 matches)</td>
<td>10745.4 ± 450.8</td>
<td>&lt; 0.001</td>
<td>1.45</td>
<td></td>
<td>957.9 ± 67.0</td>
<td>&lt; 0.001</td>
<td>1.82</td>
<td>486.2 ± 28.0</td>
<td>&lt; 0.001</td>
<td>3.00</td>
</tr>
<tr>
<td>State (n = 8 matches)</td>
<td>9625.9 ± 988.4</td>
<td></td>
<td></td>
<td></td>
<td>821.8 ± 105.7</td>
<td></td>
<td></td>
<td>347.9 ± 65.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ES = Effect Size; High-speed running = total distance covered above 18 km/h; High acceleration = total distance covered above 2 m/s²

Discussion

The aim of the present study was to examine the effects of match location (home vs. away home), competitive level (state vs. national) and match (loss vs. win) on the match running performance in a professional Brazilian soccer team. In addition, the relative contributions of each independent were analyzed. The results showed that home, winning, and national level matches presented greater running
demands compared to their counterparts. Furthermore, we verified that the match location and the competition level have greater relative contributions to the variations in the total distance ($R^2 = 29\%$) and in the total distance covered in high acceleration ($R^2 = 46\%$), respectively.

Few studies have analyzed the independent and interactive effects of match contextual variables on running performance in professional players in Brazilian soccer [15,17,27]. Our data for the total distance covered (i.e., TD = 9849.9 ± 1010.3 m) are similar to the values found in professional soccer players from Serie A of the Brazilian National Championship in the 2007 season (TD = 10012 ± 1924 m) [7] and the 1st Division of the São Paulo Championship in the 2016/2017 season (TD= 10147 ± 971m) [8]. However, we verified lower values for the distance covered at high speed running (HSR = 849.1 ± 113 m) compared to matches of the 1st Division of the São Paulo Championship in the 2015/2016 season (HSR = 1924.9 m) [8].

Research about the influence of match location on players’ performance has received extensive coverage in the last two decades [13,15,28]. Previous studies showed that teams change their playing style and match strategies according to the match location [3,5,28,29]. Therefore, the match location was considered an important factor that influence offensive and defensive performance in soccer [30,31]. For example, Thomas et al. [32] showed that the home advantage occurred in 60.7% of the 4426 matches in the English Football Premiership. Lago and Martín [5] showed that teams playing at home have more possession than visiting teams, using data from 170 matches from the Spanish Football League (season 2003-4). The same behavior was found by several other studies [27,33,34], in line with our findings. In this study, home matches presented greater running outputs than away matches. Previous research in sports psychology has listed some factors that may explain this behavior, such as spectators effects [35,36], familiarity with the location and absence of travel [37]. In addition, the tactical strategy adopted by the team at home (i.e., controlling the match with ball possession strategy) may explain this advantage [5]. In fact, players must adapt physiologically and psychologically to different match scenarios. For example, Pollard [16] showed that players are more familiar with the installation and environment when playing at home, which can result in more positive physiological and psychological states [38].

Another important variable to explain the results refers to the competitive level. In this study, when the analyzed team played the national championship, we observed greater TD and match intensity (higher values of high-speed running and high acceleration). Similar findings were reported by Rampinini, Coutts [19], in a study of players from a semi-finalist UEFA Champions League club. This behavior seems to be more physically demanding due to the need to “surprise” and “uncontrol” the opposing team’s playing style, making it difficult for opponents to retrieve the ball, which indicates that players must be physically prepared to play against strong opponents. Although there are studies showing that matches against weak opponents have a higher percentage of possession than matches against strong opponents. This
demonstrates that stronger teams dominate possession against their weaker opponents and, therefore, print less intensity of play [3,15,34]. This can be explained by the system and style of play adopted by the team, preferring to “control” the game by maintaining possession of the ball. This style is known as positional attack, in which the team has a slower game, usually using short passes and seeking to create spaces between the opposing defensive lines [3].

Regarding the match outcome, there are two possible reasons to explain the lower match intensity when the analyzed team lost. First, Lago [3], in a case study of the Espanyol Fútbol Club (season 2005-2006), showed that ball possession was greater when the team was losing vs. winning. This can be explained by the change in the team formation and playing style adopted by the team, preferring to “control” the game by positional attack. Under these conditions, it is suggested that players present low running intensity, as demonstrated in the present study, in which the variables that determine the intensity of the game (high-speed and high acceleration) were significantly lower when the team lost. In addition, Moura et al. [39] showed reduced values of team surface area without vs. with ball possession in professional Brazilian soccer. Therefore, as reduced tactical performance is expected to occur simultaneously with reduced physical performance [40], an excessively defensive strategy, such as when the team mainly adopts a more compact style of play and/or without possession of the ball for a long time, can reduce the running demands.

Overall, this study supports the criticisms of Mackenzie and Cushion [30], that highlight the importance of considering the contextual factors of the match in the analysis of soccer performance. Coaches can use this information to prepare their teams for the specific competitive situation in which they will play [15]. Therefore, coaches must be aware that the physical demands of the match are influenced by match location, competitive level, and match outcome. This information allows the creation of strategies to maximize the athletes’ physical performance during the matches.

It is important to highlight that this study has some limitations. First, the fact that the influence of the contextual variables of the match was followed by only one team limits the generalizability of the data. Second, there is a lack of information in this study about possible influences of other variables related to the match context, such as team formation (1-4-4-2, 1-4-3-3), and technical-tactical performance indicators. However, several studies have evaluated the influence of contextual variables on technical-tactical performance [14,27,41,42]. Third, the match sample size for each independent variable were different and this can be considered a limitation of this study. However, previous studies with the same observational design often show this sampling difference, largely due to real observation throughout the season, which makes it difficult to balance the number of matches for each context analyzed [3,6,10-13].
Conclusion

The findings of this study are new and provide pertinent information about physical requirements during soccer season. The analyzed players covered greater total distance, distance in high-speed running (> 18 km/h) and distance in high acceleration (> 2 m/s²) in home location, national level and when win the matches. Coaches can use this information to prescribe more representative training sessions, and to adapt post-match recovery strategies in relation to the physical requirements during the matches. Further studies in Brazilian soccer can consider tactical-technical indicators and include other contextual variables (e.g., coach change, travel).

Conflict of interest
No conflict of interest with relevant potential.

Financing source
Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP; processos: 2019/17729-0; 2014/1616 4-5) e Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) – Código de financiamento 001.

Author’s contributions
Conception and design of the research: Sagaz CS, Aresi LZ, Azevedo AM, Souza H, Aquino R. Data collection, statistical analysis and writing of the manuscript: Sagaz CS, Aresi LZ, Bedo B, Mesquita F, Santiago PRP, Gonçalves E, Azevedo AM, Souza H, Aquino R. Critical review of the manuscript: Sagaz CS, Aresi LZ, Gonçalves E, Aquino R. Publication of the document: Sagaz CS, Aresi LZ, Aquino R.

Acknowledgement
Our thanks to the Vitória Football Club (Espírito Santo State). In addition, our thanks to the Prof. Dr. Danilo Sales Bocalini and Prof. Dr. Ubirajara de Oliveira for the suggestions.

References
8. Vieira LHP, Aquino R, Moura FA, de Barros RM, Arpini VM, Oliveira LP, et al. Team dynamics, running, and skill-related performances of Brazilian U11 to professional soccer players during official


This is an open access article distributed under the terms of the Creative Commons Attribution License, which allows for unrestricted use, distribution and reproduction in any medium, as long as the original work is properly cited.