Mach running performance in Brazilian professional soccer players: comparisons between successful and unsuccessful teams

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ABSTRACT

This study aimed to compare the match running performance between bottom- and top-ranked teams in professional soccer players. In addition, this study verified the independent and interactive effects of playing position and contextual factors on running outputs between these teams. Forty-eight professional male outfield soccer players participated in this study (top-ranked team, $n=24$; bottom-ranked team, $n=24$). The distance- and accelerometry-based measures were recorded during 69 matches using a global position system (10 Hz) integrated with an accelerometer (400 Hz). The top-ranked team covered greater total distance and high-acceleration than the bottom-ranked team in home and away matches, mainly for external defenders and midfielders ($p < 0.05$, effect size [ES]=moderate). The matches against top-level opponents required high values of running outputs only for the top-ranked team ($p < 0.05$, ES=small). In general, the match outcome (loss vs. draw vs. win) was not influenced by running performance for both bottom- and top-ranked teams ($p > 0.05$; ES=small), with exception for Player Load (bottom-ranked team: win > draw = loss; $p < 0.05$, ES=small). These findings should be taken into account when the coaches and practitioners interpret the match running outputs and when evaluating the effects of training intervention on these performance indicators.

Keywords: sports science; match analysis; contextual factors; performance; team sports.

INTRODUCTION

Researchers and practitioners' interest in the physical performance of soccer players during the match-play using distance-based measures (e.g., distance covered at different speeds) has grown substantially over the last five decades, leading to a myriad of studies and systematic and scientific evidence-based approaches to physical conditioning (14, 15, 28). In addition, global positioning systems (GPS) units are commonly equipped with accelerometers or inertial sensor units (IMUs), which makes it possible to obtain distance- and accelerometry-based data (e.g., acceleration/deceleration, Player Load) simultaneously (13, 19). However, there are some issues related to the use and interpretation of measures derived from GPS (20, 22). For example, some measures (e.g., total distance covered and distance in high-speed running) can be highly dependent on positional role, tactical contexts, players' physical fitness, competitive standard, and contextual factors, among other aspects (6, 13, 30). On the other hand, the investigation of accelerometry-derived measures in response to the aforementioned independent variables should be better investigated, considering the fact that many teams still use semiautomatic camera systems during official matches (12), and it can provide only limited information about competition mechanical load.

The extensive coverage of this research agenda on match running performance has forcibly shaped contemporary opinions with researchers and practitioners frequently emphasizing the position and context and their links with match outcomes (3, 14, 32). Classic studies reported that players' fitness levels and competitive physical performance at professional standards were superior to those observed in peers at lower-competitive standards (2, 36), suggesting that the match physical component discriminates the best teams and players from their less competitive counterparts. However, other studies in professional Leagues in England (9, 24), Italy (34), and Brazil (6) demonstrated that lower distances were covered in higher (e.g., English Premier League) compared to lower standard divisions (e.g., Championship), with substantial variations across some specific playing positions (23). However, there is a need to improve the current holistic approach to data analysis of top- and the bottom-ranked teams of the same season by evaluating interactions between match running performance and other factors, including the playing positions and contextual variables (e.g., match location, quality of opposition, match outcome). This analysis could provide comprehensive information on the factors that can affect running demands during the match-play in successful and unsuccessful teams.

Therefore, this study aimed to compare the match running performance between bottom-ranked and top-ranked teams during a high-level professional league competition. In addition, this study verified the independent and interactive effects of playing position and contextual factors on running outputs between these teams. We expected that a top-ranked team present greater physical demands than the bottom-ranked counterparts do. In addition, we expected that playing position and contextual factors impact the running performance.

METHODS

Design

This study was conducted under non-experimental conditions in which the research problem was embedded (11). The players' running performance was quantified during the matches over the 2020 season of the Brazilian National 2nd Division League. This League was disputed by 20 soccer clubs, of which the top four had access to 1st Division of 2021 and the last four were relegated to 3rd Division of 2021. Originally, the League was scheduled to start on May 2 of 2020, and to end on 28 November of 2020. However, due to the COVID-19 pandemic, its beginning was rescheduled for August 7 of 2020, and the new closure on January 29, 2021.

The present study analyzed the season of one successful team (top-four ranking and access to 1st Division of 2021; n=31 matches; n=166 individual observations) and one unsuccessful team (last-four ranking and relegated to 3rd Division of 2021; n=38 matches; n=228 individual observations). Five analyses were performed: i) *general results*, comparisons of the running outputs between top-and bottom-ranked teams (1st halves vs. 2nd halves vs. whole matches); ii) independent and interactive effects of *playing positions* (i.e., central defenders, external defenders, midfielders, forwards) and teams' ranking on running performance; iii) independent and interactive effects of *match location* (i.e., home, away) and teams' ranking on running performance; iv) independent and interactive effects of *quality of opposition* (i.e., bottom-level [16th to 20th in the current ranking], intermediate-level [5th to 15th in the current ranking], top-level [1st to 4th in the current ranking]) and teams' ranking on running performance; v) independent and interactive effects of *match outcome* (i.e., loss, draw, win) and teams' ranking on running performance.

Participants

Forty-eight professional male outfield soccer players participated in this study, including 24 players of top-ranked team (age 28±5 yrs; height 180±5 cm; body mass 78±8 kg; central defenders = 7;

external defenders = 5; midfielders = 8; forwards=5) and 24 players of bottom-ranked team (age 25 ± 5 yrs; height 179 ± 8 cm; body mass 79 ± 9 kg; central defenders = 6; external defenders = 5; midfielders = 7; forwards=6). Inclusion required participation in ≥ 90 minutes of play. The study was approved by the local Human Research Ethics Committee (School of Physical Education and Sport of Ribeirão Preto, University of São Paulo; protocol no. 61884716.9.0000.5659).

Dependent measures

The distance- and accelerometry-based measures were recorded in real-time during the matches using a wearable 10-Hz global position system (GPS) integrated with a 400-Hz Tri-Axial accelerometer and 10-Hz Tri-Axial magnetometer (Playertek, Catapult Innovations, Australia). The devices were fitted to the upper back of each player using adjustable harnesses and were activated 15 min before the data collection, in accordance with the manufacturer's instructions to optimize the acquisition of satellite signals. The players used the same device throughout the season to avoid inter-unit error (29). The following metrics were obtained: i) total distance covered (TD, m); ii) total distance covered under high-speed running (HSR, $> 18 \text{ km}\cdot\text{h}^{-1}$, m); iii) number of sprints ($> 25 \text{ km}\cdot\text{h}^{-1}$); iv) total distance covered under high-acceleration (Acc, $\geq 3 \text{ m}\cdot\text{s}^{-2}$, m); v) total distance covered under high-deceleration (Dec, $\leq -3 \text{ m}\cdot\text{s}^{-2}$, m); vi) Player Load (expressed as the square root of the sum of the squared instantaneous rate of change in acceleration in each of the three vectors—X, Y, and Z axes(8)) divided by 100; arbitrary units (AU)). The speed and accelerometry thresholds used are similar to those reported in previous studies (17, 26, 27).

Independent measures

Four independent variables were considered for data analysis: i) *playing positions* for each player for each match were determined by a Brazilian Soccer Confederation qualified coach and heatmap obtained of the GPS analysis (central defenders [n=136 individual observations], external defenders [n=96 individual observations], midfielders [n=100 individual observations], forwards [n=61 individual observations]; ii) *match location* (home [n=205 individual observations], away [n=188 individual observations]; iii) *quality of opposition* (bottom-level [n=71 individual observations]; intermediate-level [n=250 individual observations]; top-level [n=72 individual observations]; iv) *match outcome* (loss [n=163 individual observations], draw [n=107 individual observations], win [n=123 individual observations]).

Statistical Analysis

The Kolmogorov–Smirnov (general results) revealed that match running performance data were not normally distributed for some variables ($p < 0.05$). Thus, to avoid textual confusion, all the data are described by the median (interquartile range). The comparisons of running outputs between bottom- and top-ranked teams (general results) were assessed using the Mann-Whitney test. The ANOVA two-way was used to compare the interactive effects of independent measures on running performance: i) playing position according to ranking-teams; ii) match location according to ranking-teams; iii) quality of opposition according to team's ranking; iv) match outcome according to ranking-teams. The significance level was set at $p < 0.05$. Data were analyzed using the SPSS for Windows statistical software package version 22.0 (SPSS Inc., Chicago, IL, USA). Additionally, effect sizes (ES) for non-parametric data (general results) were calculated for pairwise comparisons ($ES = z / \sqrt{n}$) and classified as negligible (<0.1), small ($0.1-0.29$), medium ($0.3-0.49$), and large (>0.5) (25). The ES for parametric data (playing positions, match location, quality of opponents, match outcome) were assessed using partial eta squared (η^2), and classified as: $> .01$ (small), $> .06$ (moderate), and $> .15$ (large) (21).

Results

General

The top-ranked team presented greater TD ($p < 0.001$; $ES = 0.22$, small), high-acceleration ($p = 0.04$; $ES = 0.10$, small), and Player Load ($p = 0.004$; $ES = 0.14$, small) during the 1st halves compared to bottom-ranked team. In the 2nd halves and whole matches, top-ranked team covered higher TD ($p < 0.001-0.01$; $ES = 0.13-0.18$, small) and high-acceleration ($p < 0.001-0.002$; $ES = 0.16-0.17$, small) than bottom-ranked team (Table 1).

Playing positions

External defenders ($p = 0.004$; $\eta^2 = 0.022$, small), midfielders ($p < 0.001$; $\eta^2 = 0.064$, moderate), and forwards ($p = 0.001$; $\eta^2 = 0.028$, small) of the top-ranked team covered greater TD than bottom-ranked team (Figure 1A). External defenders of top-ranked team also performed greater number of sprints ($p = 0.03$; $\eta^2 = 0.012$, small; Figure 1C), Player Load ($p < 0.001$; $\eta^2 = 0.071$, moderate; Figure 1D), and high-deceleration ($p = 0.002$; $\eta^2 = 0.026$, small; Figure 1F) compared to bottom-ranked team.

Midfielders of the top-ranked team also showed greater HSR ($p = 0.002$; $\eta^2 = 0.024$, small; Figure 1B), number of sprints ($p = 0.003$; $\eta^2 = 0.023$, small; Figure 1C), Player Load ($p = 0.003$; $\eta^2 = 0.024$, small), high-acceleration ($p < 0.001$; $\eta^2 = 0.070$, moderate; Figure 1E), and high-deceleration ($p < 0.001$; $\eta^2 = 0.052$, small; Figure 1F) than bottom-ranked team. In contrast, central defenders of the bottom-ranked team presented higher TD ($p = 0.002$; $\eta^2 = 0.024$, small; Figure 1A), HSR ($p = 0.004$; $\eta^2 = 0.022$, small; Figure 1B), and Player Load ($p < 0.001$; $\eta^2 = 0.052$, small; Figure 1D) than top-ranked team.

Match location

Independent analysis between home and away matches showed no significant effects for bottom- and top-ranked teams ($p > 0.05$; Table 2). Interactive effects showed that home matches played by top-ranked team resulted in higher TD ($p = 0.02$; $\eta^2 = 0.015$, small) and high-deceleration ($p = 0.01$; $\eta^2 = 0.017$, small) compared to home matches played by bottom-ranked team. In addition, away matches played by top-ranked team showed greater TD ($p = 0.001$; $\eta^2 = 0.026$, small), Player Load ($p = 0.02$; $\eta^2 = 0.014$, small), and high-acceleration ($p = 0.04$; $\eta^2 = 0.011$, small) than away matches played by bottom-ranked team.

Quality of opposition

Independent analysis showed that top-ranked team presented greater Player Load in matches against top-level opponents compared to intermediate-level ($p = 0.001$; $\eta^2 = 0.054$, small) and bottom-level ($p = 0.003$; $\eta^2 = 0.006$, small). In addition, the top-ranked team covered greater distance in high-acceleration ($p = 0.03$; $\eta^2 = 0.040$, small) and performed more sprints ($p = 0.02$; $\eta^2 = 0.032$, small) in matches against top-level opponents compared to bottom-level (Table 3).

Interactive analysis demonstrated that the top-ranked team covered greater TD than the bottom-ranked team in matches against top-level ($p < 0.001$; $\eta^2 = 0.036$, small) and intermediate-level opponents ($p = 0.009$; $\eta^2 = 0.018$, small). Top-ranked team also presented higher values of Player Load ($p < 0.001$; $\eta^2 = 0.054$, small), high-acceleration ($p < 0.001$; $\eta^2 = 0.040$, small), and high-deceleration ($p < 0.001$; $\eta^2 = 0.037$, small) than bottom-ranked team in matches against top-level opponents (Table 3).

Match outcome

In general, independent analysis across loss, draw, and win matches showed no significant effects ($p > 0.05$; Table 4), with the exception of Player Load. When the bottom-ranked team won the matches, we verified greater values of this metric compared to draw ($p = 0.01$; $\eta^2 = 0.021$, small) and loss ($p = 0.02$; $\eta^2 = 0.015$, small).

Interactive analysis demonstrated that top-ranked team covered greater TD ($p = 0.004$; $\eta^2 = 0.022$, small), high-acceleration ($p = 0.007$; $\eta^2 = 0.019$, small), and high-deceleration ($p = 0.005$; $\eta^2 = 0.021$, small) than bottom-ranked team in loss matches.

Table 1. Comparisons of match running performance between bottom- vs. top-ranked teams during the 2020 season of the Brazilian National 2nd Division League.

Variables	1 st Halves		2 nd Halves		Whole Matches	
	Bottom-ranked Team	Top-ranked Team	Bottom-ranked Team	Top-ranked Team	Bottom-ranked Team	Top-ranked Team
TD (m)	4944.5 (567.5)	5200.0 (770.0)*	4918.5 (622.5)	5160.0 (770.0)*	9892.0 (1119.5)	10330.0 (1430.0)*
HSR (m)	496.0 (266.2)	519.0 (859.0)	473.5 (267.7)	480.0 (322.0)	984.5 (518.5)	1057.0 (660.0)
Number of Sprints	16.0 (9.0)	17.0 (10.0)	15.5 (9.0)	16.0 (9.0)	32.0 (18.0)	34.0 (21.0)
Player Load (AU)	214.0 (27.7)	220.0 (42.0)*	214.0 (32.5)	222.0 (46.0)	429.0 (55.5)	444.0 (86.0)
High-acceleration (m)	45.5 (15.0)	48.0 (19.0)*	42.0 (13.0)	46.0 (17.0)*	87.0 (23.0)	97.0 (32.0)*
High-deceleration (m)	52.0 (14.0)	53.0 (22.0)	48.0 (15.0)	51.0 (18.0)	99.0 (25.7)	104.0 (37.0)

Note: The data are described by the median (interquartile range). *Top-ranked Team > Bottom-ranked Team ($p < 0.05$). TD = Total distance covered; HIR = High speed running ($> 18 \text{ km}\cdot\text{h}^{-1}$); High-acceleration ($> 3 \text{ m}\cdot\text{s}^{-2}$); High-deceleration ($< -3 \text{ m}\cdot\text{s}^{-2}$); Number of sprints ($> 25 \text{ km}\cdot\text{h}^{-1}$).

Figure 1. Comparisons of match running performance according to playing positions between bottom- vs. top-ranked teams during the 2020 season of the Brazilian National 2nd Division League. Note: The data are described by the median (interquartile range) of the whole matches. * $p < 0.05$. TD = Total distance covered; HIR = High-speed running ($> 18 \text{ km}\cdot\text{h}^{-1}$); High-acceleration ($> 3 \text{ m}\cdot\text{s}^{-2}$); High-deceleration ($< -3 \text{ m}\cdot\text{s}^{-2}$); Number of sprints ($> 25 \text{ km}\cdot\text{h}^{-1}$).

Table 2. Comparisons of match running performance according to match location between bottom- vs. top-ranked teams during the 2020 season of the Brazilian National 2nd Division League.

Variables	Bottom-ranked Team		Top-ranked Team	
	Home	Away	Home	Away
TD (m)	9916.0 (1257.5)	9829.5 (1123.0)	10440.0 (1310.0)*	10290.0 (1567.5)*
HSR (m)	1007.5 (502.2)	982.0 (527.2)	1081.0 (715.0)	1001.0 (624.0)
Number of Sprints	33.0 (17.0)	31.5 (18.5)	34.0 (20.0)	33.0 (19.7)
Player Load (AU)	433.0 (61.0)	424.0 (49.7)	442.0 (89.0)	444.0 (75.7)*
High-acceleration (m)	86.0 (24.5)	88.0 (23.0)	95.0 (33.0)	97.5 (29.0)*
High-deceleration (m)	98.0 (25.7)	100.0 (25.7)	105.0 (35.0)*	103.0 (36.2)

Note: The data are described by the median (interquartile range) of the whole matches. *Top-ranked Team > Bottom-ranked Team ($p < 0.05$); $p < 0.05$. TD = Total distance covered; HIR = High-speed running ($> 18 \text{ km}\cdot\text{h}^{-1}$); High-acceleration ($> 3 \text{ m}\cdot\text{s}^{-2}$); High-deceleration ($< -3 \text{ m}\cdot\text{s}^{-2}$); Number of sprints ($> 25 \text{ km}\cdot\text{h}^{-1}$).

Table 3. Comparisons of match running performance according to quality of opposition between bottom- vs. top-ranked teams during the 2020 season of the Brazilian National 2nd Division League.

Variables	Bottom-ranked Team			Top-ranked Team		
	vs. Bottom-level	vs. Intermediate-level	vs. Top-level	vs. Bottom-level	vs. Intermediate-level	vs. Top-level
TD (m)	10075.0 (979.5)	9941.0 (1190.5)	9643.5 (1025.0)	10120.0 (1300.0)	10340.0 (1567.5)[∅]	10755.0 (1305.0)[∅]
HSR (m)	991.0 (549.5)	1004.0 (541.5)	921.5 (480.5)	968.0 (664.5)	1056.0 (637.0)	1201.0 (711.5)
Number of Sprints	33.0 (16.5)	32.0 (18.0)	31.0 (16.5)	29.0 (19.5)	34.0 (20.7)	40.0 (16.5)**
Player Load (AU)	432.0 (86.0)	429.0 (42.0)	425.5 (58.5)	426.0 (72.0)	441.0 (80.0)	486.0 (72.7)*,**,∅
High-acceleration (m)	91.0 (29.5)	88.0 (23.5)	83.5 (24.5)	90.0 (37.5)	95.0 (30.0)	107.5 (30.5)**,[∅]
High-deceleration (m)	98.0 (26.5)	101.0 (26.0)	95.0 (24.2)	102.0 (41.5)	102.0 (36.5)	117.0 (33.0) [∅]

Note: The data are described by the median (interquartile range) of the whole matches. * vs. Top-level > vs. Intermediate-level ($p < 0.05$); ** vs. Top-level > vs. Bottom-level ($p < 0.05$). [∅] = Top-ranked Team > Bottom-ranked Team ($p < 0.05$). TD = Total distance covered; HIR = High-speed running ($> 18 \text{ km} \cdot \text{h}^{-1}$); High-acceleration ($> 3 \text{ m} \cdot \text{s}^{-2}$); High-deceleration ($< -3 \text{ m} \cdot \text{s}^{-2}$); Number of sprints ($> 25 \text{ km} \cdot \text{h}^{-1}$).

Table 4. Comparisons of match running performance according to match outcome between bottom- vs. top-ranked teams during the 2020 season of the Brazilian National 2nd Division League.

Variables	Bottom-ranked Team			Top-ranked Team		
	Loss	Draw	Win	Loss	Draw	Win
TD (m)	9657.5 (1176.0)	10070.5 (1067.2)	10053.0 (1080.0)	10330.0 (1600.0)^ø	10250.0 (1040.0)	10370.0 (1520.0)
HSR (m)	975.0 (519.5)	987.0 (451.2)	1056.0 (590.2)	1069.0 (640.0)	1068.0 (660.5)	1031.0 (609.0)
Number of Sprints	31.5 (17.0)	33.0 (17.0)	33.5 (19.7)	37.0 (25.0)	35.0 (18.5)	30.0 (19.5)
Player Load (AU)	429.5 (47.5)	419.5 (47.7)	447.0 (56.0)*,**	442.0 (95.0)	445.0 (80.5)	435.0 (104.5)
High-acceleration (m)	85.5 (23.5)	86.5 (19.2)	90.5 (33.2)	100.0 (35.0)^ø	98.0 (29.0)	92.0 (30.0)
High-deceleration (m)	98.5 (24.5)	100.5 (25.7)	100.5 (31.2)	104.0 (40.0)^ø	105.0 (33.5)	100.0 (42.0)

Note: The data are described by the median (interquartile range) of the whole matches. * vs. Win > Draw ($p < 0.05$); ** Win > vs. Loss ($p < 0.05$). ^ø = Top-ranked Team > Bottom-ranked Team ($p < 0.05$). TD = Total distance covered; HIR = High-speed running ($> 18 \text{ km} \cdot \text{h}^{-1}$); High-acceleration ($> 3 \text{ m} \cdot \text{s}^{-2}$); High-deceleration ($< -3 \text{ m} \cdot \text{s}^{-2}$); Number of sprints ($> 25 \text{ km} \cdot \text{h}^{-1}$).

Discussion

This study aimed to compare the match running performance between successful (top-ranked) and unsuccessful (bottom-ranked) professional soccer teams. Additionally, we verified the independent and interactive effects of playing positions and contextual factors on locomotor and accelerometer-derived outputs. Our initial hypotheses were partly confirmed. First, the top-ranked team covered greater TD and high-acceleration than the bottom-ranked team in home and away matches, mainly due to external defenders and midfielders (moderate effect size). Central defenders presented contrasting results (bottom-ranked team > top-ranked team; small effect size). Second, the matches against top-level opponents required high values of GPS-derived outputs only for the top-ranked team. Third, in general, the match outcome was not influenced by running performance for both bottom- and top-ranked teams. However, the top-ranked team presented greater running demands than the bottom-ranked team in loss matches. These results can aid coaches and practitioners to understand the set of physical variables that better discriminates successful and unsuccessful professional soccer teams, including aspects from the playing position and context that matters.

Match running performance was previously investigated in several countries (28). In general, players covered ~11 km (~9% in HSR; > 19.1 km·h⁻¹) during the matches of different Leagues, including Serie A – Italy (33), Ekstraklasa – Poland (1), League 1 – France (16), Eliteserien – Norway (22), La Liga – Spain (18), or Premier League – England (10). Here, the top-ranked team covered greater total distances than the bottom-ranked team (top: ~10.3 km, ~10% in HSR; bottom: ~9.9 km, ~10% in HSR), although were reported small effect sizes. Also, both teams presented running outputs similar to the Brazilian elite-level (1st Division: ~10 km [~11% in HSR; > 19 km·h⁻¹]; Barros, Misuta, Menezes, Figueroa, Moura, Cunha, Anido and Leite (7)). Specifically related to HSR, top- and bottom-ranked teams analyzed in this study presented similar values (~1000 m) between them and compared to elite-level national leagues around the world (~800 m; HSR considered > 19.1 km·h⁻¹) (28). In relation to high-acceleration, the current study showed higher values in the top- (~100 m) than in the bottom-ranked team (~90 m), with small difference. These values were inferior to those found in elite-level Norway players (~300 m) (22). However, this difference can be attributed to acceleration-zones classification (here: > 3 m·s⁻²; Dalen, Jørgen, Gertjan, Havard and Ulrik (22): every

acceleration $> 2 \text{ m}\cdot\text{s}^2$ for at least half a second). Furthermore, caution is required when comparing/interpreting match running performance and mechanical load measured by different systems (12).

Two previous studies conducted in the top professional Leagues in England (23) and Italy (34) demonstrated that lower-ranked teams covered significantly greater distances in high-speed movement activities than upper-ranked teams. In Brazil, players covered greater TD and number of sprints in bottom- compared to top-division Leagues (6). Another study showed greater running outputs captured from players in the highest (Premier League) compared to second highest standards of English soccer (Championship) (24), with small effect sizes. Here, the top-ranked team covered greater TD and high-acceleration than the bottom-ranked team in home and away matches. These differences were position-dependent.

The analysis of playing positions on running performance has received extensive coverage (6, 9, 14). In general, external defenders/midfielders and forwards presented the highest absolute values of TD and HSR (35). However, few studies compared the influence of playing positions between top- and bottom-ranked teams (23). In the current study, the top-ranked team presented greater running performance mainly for external defenders and midfielders (moderate effect size). In English professional soccer, external defenders of top-ranked teams also completed greater HSR with team in possession (large effect size) than middle- and bottom-ranked teams (23). Therefore, despite the previous evidence of small effect size in the comparisons of running performance between top- and bottom-ranked teams (grouped players), moderate-to-large effects were computed when considered playing positions. This information suggests that mainly external defenders and midfielders should receive specific conditioning programs to deal with the greater match running demands in top-ranked teams.

Research examining contextual factors such as match location, quality of opposition, and match outcome demonstrates these have an impact on the running demands of players (10, 30, 32). In general, home matches played against top-ranked teams and with a win resulted in greater running outputs (3, 5, 33). In addition, elite-level players usually performed less HSR when winning than when they were losing (31). Here, these contextual factors did not promote independent significant effects on running performance in both top- and bottom-ranked teams, in line with previous study during the 2019 season of the Brazilian National 2nd Division League (26). In addition, the current study observed that independent of the match location, top-ranked team covered greater

distances than bottom-ranked team, although with small effect sizes. However, the matches against top-level opponents required high values of running outputs only for the top-ranked team, possibly indicating that need to remain among the top-four required more physical effort from the players. Curiously, the top-ranked team presented greater running demands than the bottom-ranked team in loss matches (small effect size). Overall technical-tactical effectiveness probably have a greater impact on match outcome and team's final League ranking (14). For example, during the 2018 FIFA World Cup, the players of the champion team (France) and one of the teams with the worst performance (Panama) had a similar match running performance ($TD = \sim 10 \text{ km}$; $\sim 10\% > 20 \text{ km} \cdot \text{h}^{-1}$). In contrast, French players presented higher levels of interconnectivity between close teammates (greater cooperation) (4).

This study has some limitations that should be recognized. The major limitation was the lack of analysis of technical-tactical performance indicators (e.g., notational analysis, collective dynamics, tactical behavior). In addition, the design was conducted only in one season. Further studies should investigate the characteristics of successful and unsuccessful teams in multiple seasons and with a holistic data approach (e.g., physical and technical-tactical). However, this study advances in some aspects from previous literature about this topic. For example, we considered independent and interactive effects of a myriad of independent measures (i.e., playing positions, match location, quality of opposition, match outcome). Furthermore, the design allowed that top- and bottom-ranked teams were analyzed in the same season with the same GPS system. Finally, to the best of our knowledge, this is the first study that provides information regarding match running performance of successful and unsuccessful teams in Brazilian soccer.

Conclusion

In summary, the current study provides important new information for coaches and practitioners of professional soccer. This study demonstrated that changes in running performance during match-play are related to several factors, such as the team's ranking, the playing positions, the match location, and the quality of opposition. Specifically, mainly external defenders and midfielders of the top-ranked team completed greater running distances than their counterparts of the bottom-ranked team, both in home and away matches. Our results also showed that the quality of opposition influenced only the top-ranked team, which matches against top-level opponents required high values of running performance. This should be taken into account when the coaches

and practitioners interpret the match running outputs and when evaluating the effects of training intervention on these performance indicators. In addition, strategy and technical-tactical aspects probably have a greater impact on results and final ranking than running performance. Therefore, inferences about the cause-effect between match running demands and competitive standard/match outcome should be viewed with caution.

Contributions

Conceptualization, R.A., E.R., A.P., T.S.M.; methodology, R.A., E.R., A.P., G.G., M.N., T.S.M.; formal analysis, R.A., L.G.G., M.G., G.G., M.N. investigation, R.A., L.G.G., M.G., F.Y.N., G.G., M.N.; writing—original draft preparation, R.A. F.Y.N.; writing—review and editing, all authors. All authors have read and agreed to the final version of the manuscript.

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