

Effect of the Game Time Schedule under the Physical Performance of Professional Soccer Players

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Abstract The physical performance of soccer players is multifactorial, among these, the game schedule seems to be a factor to be considered, after all, the time of the day in which the match is played, either daylight or nightfall, can influence directly on their performance. Therefore, this study aimed to investigate the influence of game time has on the physical performance of professional soccer players in relation to distance traveled and intensity of effort during game play. In order to do so, 24 professional players from a team of the 4th division of Brazilian soccer were evaluated, in which the observed matches (*referenced as n = 13 in the spreadsheet*) were performed in the afternoon (4:00 PM, *referenced as n = 8 in the spreadsheet*) and in the evening (9:00 PM *referenced as n = 5 in the spreadsheet*). All the players, except the goalkeeper, were equipped during matches with the *Global Positioning System*, and through the *QSports software®* were obtained the values of distance traveled and intensity relative to the distance traveled in the game, which is divided into three levels: 0 – 10 km/h (Low), 11 – 18 km/h (Average), and 19 – 26 km/h (High). Thus, the findings did not present any differences in relation to the distance traveled; however, in the matches held at 9:00 PM, the players ran a greater distance in average intensity than those at 4:00 PM. In conclusion, it is suggested that games performed after 9:00 PM influence the intensity in which the match is played, being covered greater distance in average intensity.

Keywords Soccer, Physical performance, Distance traveled, Chronobiology

1. Introduction

The overall performance of a soccer team is multifactorial, with physical performance being one of the most important factors for the outcome of a match, since the distance traveled by athletes in professional soccer games are on average 10 to 12 km, varying according to the player's tactical positioning [1-5].

That being said, evidence suggests that game timetable can influence physical performance. Studies related to chronobiology (study of rhythmic patterns in biological phenomena) show oscillations in the work rhythm of cells, tissues, organs, and therefore in the control of physiological systems at different times/periods of the day, a phenomenon known as circadian rhythm [6-8].

Due to circadian rhythm, variations related to physical performance can be between 10 to 30% in the anaerobic strength, flexibility and power capacities, being the maximum performance in the late afternoon and early

evening and the worse performance in the morning, following the temperature variation body [9, 10].

In order to do so, there seem to be two key components [2] of circadian rhythm influence, in which the first concerns the endogenous component, referring to changes in body temperature [11], cardiac function [7, 12], sleep-wake cycle [12] and the release of hormones: melatonin, cortisol, adrenaline, etc [7, 13], while the latter key component is related to the exogenous component, referring to factors such as motivation to perform the activity, as well as nutritional aspects [14] such as mealtime, for example.

Overall, studies that attempt to understand the influence of factors related to circadian rhythm, such as the times of day under the practice of physical activity, especially in collective sports, are scarce.

As a result of lack of research in this area, the present study aimed to investigate the influence of game time on the physical performance of professional soccer players in relation to distance traveled and intensity of effort. The main hypothesis is that, due to the organic changes already mentioned above, in matches played in the afternoon the distance covered and the intensity of the effort should be reduced in relation to the night period.

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2. Material & Methods

2.1. Sample

The sample is a team in the 4th division, composed of 24 male Brazilian professional soccer players competing in the state championship, average age being $27,1 \pm 3,17$ years old, weight $75,93 \pm 6,44$ kg, height $1,80 \pm 5,91$ cm, body mass index (BMI) $23,68 \pm 1$ kg/m², fat percentage of $11,07 \pm 1,19\%$ and VO_{2max} $44,73 \pm 4,38$ ml.kg.min⁻¹. The data collection formed part of the professional teams' routine in which players are frequently assessed across the season. Therefore, the normal ethics committee clearance was not required [15]. However, the athletes were informed of the experimental risks and benefits of this evaluation, and provided a verbal consent.

All observations took place at soccer fields with dimensions equal to $110m \times 78m$ and similar climatic conditions [16], as well as there was no interference on the sleep/awake cycle nor on the nutrition of the athletes, guaranteeing the external validity of this investigation.

2.2. Procedures

During the pre-competitive period, all athletes underwent a physical evaluation at the soccer club's compound and to measure the variables investigated (length of traveled distance, speed and speed per traveled distance) in real time. Those players who participated in the game, with the exception of the goalkeeper, were equipped with the *SportsRecorder Global Positioning System (GPS) 5Hz (QSTARZ® BT-Q1300ST)* attached with a chip. By doing so, through *QSports® software*, it was possible to measure the values of distance covered in the game and intensity relative to the distance covered, constituting the athlete's running speed. These measurements were divided into three levels of intensity: 0 – 10 km/h (Low), 11 – 18 km/h (Average), and 19 – 26 km/h (High).

The games were held in the state of Goiás, Brazil, where the predominant climate in the region is seasonal Tropical, dry winter and with temperature ranging from 23.5 °C to 24.5 °C during the months of January to April, not having significant variation during the periods of the day [16]. In this way, matches played in the afternoon started at 4:00 p.m. ($n = 8$), while games matches during the night started at 9:00 p.m. ($n = 5$).

2.3. Statistical Analysis

Data were expressed as mean and standard deviation. The normality and sphericity of the data were verified by means of the *Kolmogorov-Smirnov* test and the *Greenhouse-Geisser Epsilon*, respectively. Therefore, to verify the difference between the variables analyzed, between the positions and the different moments of the game, a multiple comparison ANOVA with *Bonferroni* adjustment was applied. It was adopted as significance level $p \leq 0.05$. All statistical procedures were performed using the Statistical Package for Social Sciences 22.0 (SPSS) software for

Windows.

3. Results

Table 1 shows the results of distance traveled in each period and in the complete match (TDG), grouped by tactical position and independent of this, according to the game time (4:00 PM and 9:00 PM). In this way, it was observed that the lateral ones presented greater distance covered in the second half ($p = 0.07$) and in the complete match ($p = 0.27$) in both evaluated games, when compared with the other positions.

In Table 2, the distance data covered in the game are distributed relative to the intensity and grouped by tactical and independent position. So, regardless of the tactical position, the players ran a greater distance in the matches performed at 9:00 PM compared to those at 4:00 PM ($p = 0.34$), however, when compared to the tactical positions, no differences were found.

4. Discussion

The main findings of the present study suggested that the time in which the games occurred did not influence the distance covered in the soccer game, however, in games played at 9:00 PM, the intensity in which the game is played is higher, since players have traveled more distance in intensity in relation to the game played at 4:00 PM. When compared by tactical position, the sides showed a greater distance in the second half of the games and in the complete game than the other positions in both play times.

Thus, it is suggested that the starting time is an important factor in the intensity in which the players perform, and it can be related to the influence that the circadian rhythm has on the performance of the sport. Fluctuation on this order are multi-factorial, taking in consideration oscillations on the external environment (temperature and humidity), and in the internal, such as (biologic rhythm) as well as life style. They can in some fashion influence the results on this subject [7].

The effort and performance that a football player performs depends on several factors, such as: team style [17], competitive level [3], type of competition [8], athletes physical condition [2], competition space [18], evolution of the modality, season of the competitions [19], methods of analysis [20], environmental conditions [21, 22] and the dynamics of the game itself [22]. Still, despite this complexity, there are no studies, until to now, that have investigated the influence of the time of a game under the physical performance of professional soccer players.

It should be noted, however, that this study has as main limitation the non-direct measurement of the ambient temperature in the days of the games. Roelands et al. [23] indicate that this is a factor that should be considered, since in a study with cyclists, in a comparison of the same test at different temperatures (18°C and 30°C), those that performed it under a higher temperature suffered a fall in

performance, so that a direct measure would remove any doubt in this regard. On the other hand, there are studies that indicate homogeneous temperature in the study period for the region in question [5].

In addition, this study opens an important path for re-research related to the physiology of soccer, as it is the first study to be carried out under the emphasis of chronobiology in soccer, as well as it is the first that does it with Brazilian professional soccer players. We point out the studies by Di Salvo *et al.* [2], who carried out a large-scale investigation aimed at characterizing the work-rhythm profile of elite soccer players. It was observed that in games of the same team during the Spanish Championship and the European League, the results showed that Offensive Midfielders covered greater distances than Defenders and that players run the longest distance in the first half of the game compared to the second.

Attempting to understand the influence of the opponent's level on the distance covered in the game, as well as the intensity relative to distance, Rampinini *et al.* [3], as well as, Di Salvo *et al.* [2] observed high-level matches in European football, and found results that indicate the influence of the opponent's level about the physical performance of the players. To the point where, when the opponent is stronger, the players end up covering more distance at higher speeds.

Thus, it should be noted that the distance values found in a complete game, regardless of the match time (Table 2), are lower than what is stated in the literature [2, 3]. However, the observed games are part of a competition that is losing importance in the Brazilian soccer calendar, a fact that can interfere in the motivation of the athletes for the games.

Table 1. Distance covered per game (m) at different times of the day (afternoon; evening). Data in mean and standard deviation (\pm)

All Positions	Time of Game (h)	Time in the field (min)	TDG (m) (1st half)	TDG (m) (2nd half)	TDG (m) Full Game
All	4:00 pm (n=38)	94,81 \pm 1,69	3964,11 \pm 441,05	3892,94 \pm 372,92	7853,78 \pm 747,18
	9:00 pm(n=40)	94,47 \pm 1,97	4041,72 \pm 468,88	4018,23 \pm 528,77	8059,95 \pm 950,22
Right and Left Wingers	4:00 pm (n=10)	95 \pm 1,41	4152,89 \pm 513,90	*4143,89 \pm 260,66 (p=0,007)	*8296,78 \pm 660,20 (p=0,027)
	9:00 pm (n=8)	95 \pm 1,94	4224,78 \pm 393,57	*4440,56 \pm 488,22 (p=0,007)	*8665,33 \pm 835,09 (p=0,027)
Defenders	4:00 pm (n=6)	95,2 \pm 1,64	3649 \pm 264,05	3748 \pm 491,3	7397 \pm 737,63
	9:00 pm (n=9)	94,5 \pm 2,22	3699,1 \pm 398,09	3676,5 \pm 502,98	7375,6 \pm 877,64
Defensive Midfielders	4:00 pm (n=8)	94,71 \pm 1,46	4012,5 \pm 449,41	3988,63 \pm 262,29	7988,63 \pm 665,88
	9:00 pm (n=16)	94,41 \pm 2,03	4214,35 \pm 432,8	4060,18 \pm 451,62	8274,53 \pm 819,19
Offensive Midfielders	4:00 pm (n=5)	94 \pm 1,87	4387,4 \pm 248,68	4119,9 \pm 230,56	8507,2 \pm 406,52
	9:00 pm (n=1)	97	4670	4559	9229
Strikers or Forwards	4:00 pm (n=9)	94,78 \pm 2,22	3672,22 \pm 179,23	3511,44 \pm 209,78	7181,67 \pm 345,75
	9:00 pm (n=6)	94,33 \pm 1,75	3744,33 \pm 364,26	3745,33 \pm 388,27	7489,67 \pm 719,95

TDG= total distance covered per game; n=number of observations. *=statistical differences when comparing same time games with other technical positions ($p \leq 0,05$).

Table 2. Distance covered (m) in different intensities (km/h). Data expressed in mean and standard deviation (\pm)

All Positions	Time of Game (h)	0-10 km/h (m)	11-18 km/h (m)	19-26 km/h (m)
All	4:00 pm n=38)	5911,05 \pm 388,92	*1690,51 \pm 479,47 (p=0,034)	303,29m \pm 449,33
	9:00 pm (n=40)	5958,76 \pm 291,74	*1885,76 \pm 291,74 (p=0,034)	250,96m \pm 152,67
Right and Left Wingers	4:00 pm (n=10)	5948,53 \pm 471,33m	1989,19 \pm 437,9	648,21 \pm 852,55
	9:00 pm (n=8)	6036,53 \pm 165,22	2265,57 \pm 566,88	403,62 \pm 142,86
Defenders	4:00 pm (n=6)	6062,73 \pm 323,05	1222,64 \pm 385,28	113,21 \pm 80,47
	9:00 pm (n=9)	5849,27 \pm 325,76	1460,03 \pm 547,08	162,48 \pm 69,04
Defensive Midfielders	4:00 pm (n=8)	6049,23 \pm 233,56	1767,15 \pm 512,75	172,38 \pm 61,11
	9:00 pm (n=16)	6074,78 \pm 123,71	1945,66 \pm 704,71	204,66 \pm 123,71
Offensive Midfielders	4:00 pm (n=5)	6142,48 \pm 357,42	2099,37 \pm 282,49	267 \pm 75,7
	9:00 pm (n=1)	6257,3	2796,4	175,4
Strikers or Forwards	4:00 pm (n=9)	5539,67 \pm 294,37	1417,01 \pm 269,69	224,97 \pm 112,77
	9:00 pm (n=6)	5646,9 \pm 222,31	1553,24 \pm 419,05	286,21 \pm 172,51

n=number of observations. *=statistical differences when comparing of games of same intensity played at different time independent of technical position ($p \leq 0,05$).

The results found also bring to attention an important discussion about the physical preparation of soccer players, and although literature shows studies that highlight the differences among the various tactical positions [2, 3, 5], even in the present study, it is verified that such differences are “diluted” when the main objective is to investigate the intensity of athletes' travels. In this manner, it is suggested that football should be understood as a complex sport and that needs to be planned integrally in order to favor the collective game and have different tactical positions integrate a proposal of game that has in view the objectives of a team with unity.

In addition, when organizing competitions, it is emphasized the need to take into account that the athletes are the main actors in this sport and should be treated likewise. The findings suggest that play time may influence the physical performance of the soccer player, and the literature shows that climatic conditions [24] may also influence this issue. Therefore, countries that have territory with continental dimensions and consequently the most adverse climatic conditions must understand that these aspects must be considered, as they influence the performance of the player and may in the long term, if they are misdirected, negatively influence the player, sports image by providing low-quality competitions.

It is known, however, that the main limitations of the present study are: the lack of direct measurement of the temperature during the matches, as well as the number of observations was low for some occasions, Midfielders, for example. Other factors such as function and characteristics of the observed player may have influenced these results. In addition, the fatigue was not analyzed.

Finally, it is suggested that more studies are carried out in soccer with emphasis on chronobiology, so that more tools to improve the performance of the athlete of this modality are created.

5. Conclusions

In this point, it is concluded that the time of day does not influence the distance covered in the soccer game, however, matches played after 9:00 pm can influence the intensity of the game, with athletes traveling more distance in average intensity. Therefore, it is important to emphasize the importance of considering which game time to choose for a more dynamic game with greater performance.

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