Match Running Performance of Brazilian Professional Soccer Players according to Tournament Types

Lucas de Albuquerque Freire[1], Michele A. Brito[1], Pablo Merino Muñoz[1], Diego Ignacio Valenzuela Pérez[2], Hugo Cerda Kohler[1], Esteban A. Aedo-Muñoz[3], Maamer Slimani[4], Ciro José Brito[5], Nicola L. Bragazzi[6], Hela Znazen[7], Bianca Miarka[1]

Affiliations: [1]Federal University of Rio de Janeiro, Rio de Janeiro, Brazil, [2]Universidad Santo Tomás, Escuela de Kinesiología, Facultad de Salud, Santo Tomás, Chile, [3]University of Santiago, Santiago, Chile, [4]University of Genoa, Genoa, Italy, [5]Juiz de Fora Federal University, São Pedro, Juiz de For a, Brazil, [6]York University, Toronto, ON, Canada, [7]Taif University, Al Hawiyah, Taif, Saudi Arabia

Correspondence: D.I.V. Pérez, Escuela de Kinesiologia - Facultad de Salud, Universidad Santo Tomás, Santiago Chile, Av. Ejército Libetador, 146, Centro – Santiago, Chile. Email: diegovalenzuela@santotomas.cl

Abstract

The present study aimed to report different level games in terms of their external game loads, using data collected from GPS performance indicators in Brazilian soccer teams. We used measures of 464 performances of professional soccer athletes during the National Tournament (NT=265), State Tournament (ST=89), National Cup (NC=44), and the International Tournament (IT=66). The performance analysis included the assessment of Total (meters) and Relative (meters/minutes) distances; running (>14km/h), and sprinting (>18km/h) distance; the number of sprints (>18km/h and >24km/h); accelerations (above three m/s2), deceleration (less than three m/s2) and jumps (>30 cm); Total and Relative load – per minute. There were differences (p<0.05) in terms of relative distance between NT and ST (102.2 ±9.5 vs. 98.1± 10.3) and between ST and NC (98.1± 10.3 vs. 103.4 ±9.6). In sprints >18km/h NT differed from ST (60.4 ±5.9 vs 52.7 ±19.9). In sprints >24km/h differences could be found between NT and ST (10.7 ±5.9 vs 8.7 ±5.4). In Total Load NT differed with respect to ST (908.6 ±141.5 vs. 852.7 ±138.5) In Relative Load differences were reported between NT and ST (10 ±1.2 vs. 9.3 ±1.4) and IT (10 ±1.2 vs. 9.4 ±1.4), and between ST and NC (9.3 ±1.4 vs. 10.0 ±1.4). Finally, concerning deceleration, NT differed when compared to ST (36.1 ±9.9 vs. 32 ±11) as well as ST differed from IT (32 ±11 vs. 37.5 ±9.7). The present results make it possible to create specific training games according to tournament level associated with the predominant activities performed during the competition.

Keywords: *external load, football, time motion, aerobic, anaerobic*

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Introduction

Soccer is a sport of intermittent nature, which mixes technical and tactical skills, high intensity actions such as sprinting, jumping and changes in direction with short rest periods, with players getting to travel between 9 to 14 km per match, in different speed bands (Dolci et al., 2020; Turner & Stewart, 2014)., In the last decades, physical demands have been significantly increasing (Bradley et al., 2016; Bush et al., 2015), par-

Conflict of interest: None declared.

alleling the interest of researchers and practitioners towards match fitness performance outcomes. The latter has, indeed, grown tremendously, in particular, using distance-based measures (e.g., distance traveled at different velocities) to improve physical conditioning strategies (Aquino et al., 2021; Hands & Janse de Jonge, 2020).

A large amount of research has been conducted to identify the major determinants underlying conditional or physical demands during a soccer match. These include the location (local or visiting) (Oliva-lozano et al., 2021), match status and goal difference (Buchheit et al., 2018), tactical systems adopted (Aquino et al., 2020), category (age-group) (Papaevangelou et al., 2012), division (Gomez-Piqueras et al., 2019), and ranking (Aquino et al., 2021), among others.

However, few studies have analyzed the differences in these demands between tournament types (state, national and international) (Andersson et al., 2010; Bradley et al., 2010), where, according to the existing literature, the tournament system (league or play-off) could have an impact, even though with contrasting findings being reported. One study that analyzed the external load of 100 and 10 female players during national/domestic and international tournaments, respectively (Bradley et al., 2010), found that players ran similar high intensity distances. On the contrary, another study (Andersson et al., 2010) found that female players ran distances at higher intensities when playing international versus domestic games.

Moreover, several studies have analyzed differences in performance outcomes according to the level (division) in leagues of different countries such as Germany (Hoppe et al., 2015), Italy (Rampinini et al., 2009), United Kingdom (Di Salvo et al., 2013), Spain (Gomez-Piqueras et al., 2019) and Brazil (Aquino et al., 2017), and have found different results according to the league, warranting the replication of this kind of analysis with the different leagues of the world.

Other studies have analyzed further factors that may influence external match load such as congested periods and have analyzed matches from different tournaments as a whole (Castellano et al., 2020; Gabbett et al., 2013), which could affect results by an increase in the variability of external load variables.

Knowledge of the external load differences between various types of tournaments is of paramount importance in that it could help coaches and technical staff plan the load of the competition micro-cycles according to the tournament in which players participate. Therefore, the present study aimed to assess different level games in terms of their external game loads, using data collected from GPS performance indicators in Brazilian soccer teams. We hypothesized that there is a significant difference in performance demands between games at different competitive levels.

Methods
Participants
464 performances of Brazilian professional soccer athletes (height: 1.81±0.29 cm; weight: 73.77±13.25kg; age: 23.8 ± 6.34 years-old; 56 attackers, 103 wingers, 195 midfields and 110 defenders) during the National Tournament (NT=265), called Brasileirão Série A, State Tournament (ST=89), called Carioca, National Cup (NC=44), called Copa do Brasil, and during an International Tournament (IT=66), called Copa Libertadores da América, were used in the present study. These performances were collected from professional athletes who competed in national, state, and international representative championships

once per week and were regularly training (technical and tactical) 4-7 times a week during the evaluation period. All measures occurred between February and September 2018. Concerning inclusion criteria, we included complete data of players that showed all the results in each of the tests used in the present study, aged over 18 years, without cognitive alterations, without recent surgeries and without injuries and with more than two years in the professional soccer level. Exclusion criteria were the following: players who were unable to complete 75% of the game or who had limitations during the study, mainly for health reasons, duly certified by doctors. Also, the participants were instructed not to intake alcohol or drugs for at least 24 hours before the games and measures and were maintaining normal diets. Before proceeding with data collection, all participants attended a briefing meeting and signed an informed consent document to ensure the understanding of the testing parameters and the risks and benefits associated with the study. In addition, a letter of consent was sent and duly signed by the Brazilian's Club. This study was submitted to and approved by the Local Committee of Ethics in Research (protocol 051979/2017), following the rules of resolution of the National Health Council and according to the WMA Declaration of Helsinki.

Procedures and measures
During each trial, subjects wore a GPS device (Catapult Innovations, Scoresby, Australia) (Jennings et al., 2010). Performance analysis of professional soccer players were monitored using a portable 5-Hz GPS unit (Catapult, Melbourne, Australia) during games. The GPS device was positioned via an elasticized shoulder harness to sit between the scapulae of the bowler at the base of the cervical spine (Petersen et al., 2009). The GPS unit was activated and GPS satellite lock was established for at least 15 min before the player taking the field as per the manufacturer's recommendations (Petersen et al., 2009). After each session, the recorded information was downloaded using Caput Sprint software (Catapult Innovations, Melbourne, Australia) for analysis. Once downloaded, competition data was edited and split into two 45min halves (Abbott et al., 2018).

Only subjects completing more than 75% of the match were included within the analysis process. The mean number of satellites, and the horizontal dilution of position were recorded during data collection (Abbott et al., 2018). Performance analysis followed the standardized protocol (Abbott et al., 2018). Total distance (meters) - distance travelled during all the game; Relative distance (meters/minutes) - Total distance by minute; percentage of distance traveled movement speed and running (>14km/h), and sprinting (>18km/h) distance; number of sprints (>18km/h and >24km/h); maximum speed (km/h); number of accelerations (above 3 m/s2) and deceleration (less than 3 m/s2); jumps (with more than 30 cm), Explosive efforts - accelerations, deceleration and jumps frequency; Total Load - and Relative load – per minute were the performance indicators assessed during professional soccer games with ~90min of durations (Abbott et al., 2018). Total and relative (load/min) Loads were calculated using an established algorithm and considering forward, lateral, and upwards acceleration, and time in the PlayerTek system (Catapult Innovations, Melbourne, Australia).

Statistical Analysis
Descriptive statistics was presented as means and standard deviations. Data normal distribution was checked

through the Kolmogorov-Smirnov test. Regarding inferential statistical analysis, repeated measures analysis of variance (ANOVA) with Bonferroni post-hoc tests were used to compare the total and relative time for each variable amongst groups. Partial Eta squared ($\eta^2 p$) values were calculated to evaluate the ANOVA effect size. All analyses were performed utilizing SPSS software (version 20.0; SPSS, Inc., Chicago, IL, USA).

Results

The descriptive analysis of performance indicators of different soccer tournament levels with computed statistical inferences is shown in Table 1. There were differences (p<0.05) in terms of relative distance (F=5.35 and $\eta^2 p$=0.034) between NT and ST (102.2 ±9.5 vs. 98.1± 10.3) and between ST and NC (98.1± 10.3 vs. 103.4 ±9.6). In runs >18km/h (F=3.3 and $\eta^2 p$=0.021) differences could be reported between NT and ST (60.4 ±5.9 vs 52.7 ±19.9). In sprints >24km/h (F=3.13 and $\eta^2 p$=0.02) NT differed with respect to ST (10.7 ±5.9 vs 8.7 ±5.4). In Total Load (F=3.94 and $\eta^2 p$=0.025) NT differed from ST (908.6 ±141.5 vs. 852.7 ±138.5) In terms of Relative Load (F=8.33 and $\eta^2 p$=0.052), differences could be found between NT and ST (10 ±1.2 vs. 9.3 ±1.4) and IT (10 ±1.2 vs. 9.4 ±1.4), and between ST and NC (9.3 ±1.4 vs. 10.0 ±1.4). Finally, deceleration (F=4.63 and $\eta^2 p$=0.029) differed based on tournament, with differences recorded between NT and ST (36.1 ±9.9 vs. 32 ±11) and between ST and IT (32 ±11 vs. 37.5 ±9.7).

Table 1. Descriptive and inferential analysis of performance indicators by soccer tournament levels

Variable/groups		Mean	SD	F	Sig.	Pn2	NT	ST	NC	IT
Total Distance (m)	NT	9337.5	1281.0	1.39	.242	.009				
	ST	9032.4	1164.3							
	NC	9342.4	1205.0							
	IT	9210.7	1332.4							
	Total	9261.4	1261.7							
RelativeDistance (m/min)	NT	102.2	9.5	5.35	≤.001	.034		.005		
	ST	98.1	10.3				.005		.023	
	NC	103.4	9.6					.023		
	IT	99.2	11.2							
	Total	101.1	10.0							
% of sprints>14km/h	NT	19.4	5.2	.81	.485	.005				
	ST	18.6	5.2							
	NC	18.4	5.6							
	IT	19.1	4.8							
	Total	19.1	5.2							
% of sprints>18km/h	NT	8.6	2.9	1.95	.120	.013				
	ST	7.9	2.8							
	NC	7.8	2.8							
	IT	8.3	2.8							
	Total	8.3	2.9							
sprints>18km/h (frequency)	NT	60.4	20.1	3.30	.020	.021		.011		
	ST	52.7	19.9				.011			
	NC	57.6	20.4							
	IT	58.7	20.3							
	Total	58.4	20.3							
Total Distance (m) > 18km/h	NT	812.2	314.0	2.40	.067	.015				
	ST	722.2	294.1							
	NC	735.3	275.4							
	IT	770.3	292.5							
	Total	781.7	305.2							
Sprints>24km/h (frequency)	NT	10.7	5.9	3.13	.025	.020		.028		
	ST	8.7	5.4				.028			
	NC	9.1	5.5							
	IT	10.0	6.3							
	Total	10.1	5.9							

(continued from previous page)

Variable/groups		Mean	SD	F	Sig.	Pn2	NT	ST	NC	IT
Total Distance (m) > 24km/h	NT	158.8	97.3	1.96	.119	.013				
	ST	133.5	91.5							
	NC	137.4	88.1							
	IT	143.6	103.9							
	Total	149.8	96.7							
Maximum speed (km/h)	NT	29.8	2.0	.96	.408	.006				
	ST	29.4	2.3							
	NC	29.9	2.4							
	IT	29.7	2.3							
	Total	29.7	2.1							
Total Load (Score)	NT	908.6	141.5	3.94	.009	.025		.008		
	ST	852.7	138.5				.008			
	NC	900.9	128.6							
	IT	874.1	149.2							
	Total	892.2	142.3							
Relative Load (score/ min)	NT	10.0	1.2	8.33	≤.001	.052		≤.001		.019
	ST	9.3	1.4				≤.001		.017	
	NC	10.0	1.4					.017		
	IT	9.4	1.4				.019			
	Total	9.8	1.3							
Acceleration (frequency)	NT	31.5	9.2	2.22	.085	.014				
	ST	28.9	7.6							
	NC	31.9	9.4							
	IT	31.8	9.8							
	Total	31.1	9.0							
Deceleration (frequency)	NT	36.1	9.9	4.63	.003	.029		.008		
	ST	32.0	11.0				.008			.006
	NC	36.0	11.7							
	IT	37.5	9.7					.006		
	Total	35.5	10.4							
Jumps (frequency)	NT	12.0	5.1	3.25	.022	.021				
	ST	13.1	6.2							
	NC	13.9	4.9							
	IT	13.8	5.6							
	Total	12.6	5.4							
Explosive efforts (frequency)	NT	124.9	36.0	2.44	.063	.016				
	ST	120.6	37.7							
	NC	133.0	37.8							
	IT	134.8	39.6							
	Total	126.3	37.2							
Game time (min)	NT	91.5	10.2	.62	.601	.004				
	ST	92.5	9.1							
	NC	90.7	10.1							
	IT	92.8	9.1							
	Total	91.8	9.8							

Discussion

The main results indicated higher relative displacement of National Tournament and National Cup than State Level, as National Tournament presented higher total, and relative load, deceleration, frequency of efforts above 18km/h and 24km/h than State Level. In addition, international soccer games presented higher deceleration and relative load than state-level games.

The results reported in the present study are consistent with the findings of other studies. For instance, Andersson et al. (2010) found that professional players ran longer distances at high intensity during international matches, mainly because increasing the level of competition may result in increasing the workload of the athletes (Mohr et al., 2008). Therefore, in NT, teams with better physical condition are more likely to participate, and their game strategies are characterized by imposing greater intensity. In this case, the top-ranked teams in the state championship are the ones that qualify for the national championship, and it has been found that a higher-ranked team runs greater distances in accelerations (>3m/s2) (Aquino et al., 2021).

However, in contrast to our results, Bradley et al. (2010) found no differences in match displacement between international and domestic matches, but this could be due to several reasons. First, the sample was not paired; 100 domestics vs. ten international league subjects were analysed. Moreover, factors such as playing position (Andersson et al., 2010) or intra-subject variability could affect the results.

Rienzi et al. (2000) compared the work profiles of professional players in matches for their national team (South America) and domestic league matches (England). They found that domestic league players ran a greater total distance than international players, but this could be because they compared different players, and their position could have affected the results, as well as the sample was not paired as in the Bradley et al.'s study (2010).

A limitation should be recognized concerning the GPS sampling frequency, which shows good reliability up to actions below 20 km/h (Johnston et al., 2013). As such, actions above this threshold could exhibit more noise or variability between matches. Also, the position of the players and their intra-individual variability could influence the results (Altmann et al., 2021). Therefore, it is suggested that future research should consider these factors when performing the analyses. On the other hand, future research that analyses factors influencing external match load should consider separately analysing matches from different tournaments.

From a practical point of view, knowledge of the differences in match performance could be useful to know the post-match recovery; in this case, players had a lower frequency of decelerations and runs >18km/h during ST and associations of this variable with post-match Creatine Kinase levels have been found (Freire et al., 2020).

In summary, the external load of Brazilian team players varies in terms of some variables depending on the type of tournament. The present results make it possible to create specific training games according to tournament level associated with the predominant activities performed during the competition. Based on the present study, coaches and fitness trainers of Brazilian teams could adapt their training programs according to the requirement of each tournament level. These findings should be used with caution when considering competitions in other countries, therefore future research should analyse competitions taking into account the country in which they take place.

References

Abbott, W., Brickley, G., & Smeeton, N. J. (2018). Positional differences in GPS outputs and perceived exertion during soccer training games and competition. *Journal of Strength and Conditioning Research*, 32(11), 3222-3231. doi: 10.1519/JSC.0000000000002387.

Andersson, H.Å., Randers, M. B., Heiner-Møller, A., Krustrup, P., & Mohr, M. (2010). Elite female soccer players perform more high-intensity running when playing in international games compared with domestic league games. *Journal of Strength and Conditioning Research,* 24(4), 912–919. https://doi.org/10.1519/JSC.0b013e3181d09f21

Aquino, R., Carling, C., Palucci Vieira, L. H., Martins, G., Jabor, G., Machado, J., Santiago, P., Garganta, J., & Puggina, E. (2020). Influence of Situational Variables, Team Formation, and Playing Position on Match Running Performance and Social Network Analysis in Brazilian Professional Soccer Players. *Journal of Strength and Conditioning Research*, 34(3), 808–817. https://doi.org/10.1519/JSC.0000000000002725

Aquino, R., Gonçalves, L. G., Galgaro, M., Maria, T. S., Rostaiser, E., Pastor, A., Nobari, H., Garcia, G. R., Viana, M., & Neto, M. (2021). Match running performance in Brazilian professional soccer players : comparisons between successful and unsuccessful teams. *BMC Sports Science, Medicine and Rehabilitation*, 1–10. https://doi.org/10.1186/s13102-021-00324-x

Aquino, R., Vieira, L. H. P., Carling, C., Martins, G. H. M., Alves, I. S., & Puggina, E. F. (2017). Effects of competitive standard, team formation and playing position on match running performance of Brazilian professional soccer players. *International Journal of Performance Analysis in Sport*, 17(5), 695–705. https://doi.org/10.1080/24748668.2017.1384976

Bradley, P. S., Archer, D. T., Hogg, B., Schuth, G., Bush, M., Carling, C., & Barnes, C. (2016). Tier-specific evolution of match performance characteristics in the English Premier League: it's getting tougher at the top. *Journal of Sports Sciences*, 34(10), 980–987. https://doi.org/10.1080/02640414.2015.1082614

Bradley, P. S., Di Mascio, M., Peart, D., Olsen, P., & Sheldon, B. (2010). High-intensity activity profiles of elite soccer players at different performance levels. *Journal of Strength and Conditioning Research*, 24(9), 2343–2351. https://doi.org/10.1519/JSC.0b013e3181aeb1b3

Buchheit, M., Modunotti, M., Stafford, K., Gregson, W., & Di Salvo, V. (2018). Match running performance in professional soccer players: effect of match status and goal difference. *Sport Performance & Science Reports*, 1(21), 1–3.

Bush, M., Barnes, C., Archer, D. T., Hogg, B., & Bradley, P. S. (2015). Evolution of match performance parameters for various playing positions in the English Premier League. *Human Movement Science*, 39, 1–11. https://doi.org/10.1016/j.humov.2014.10.003

Castellano, J., Martin-Garcia, A., & Casamichana, D. (2020). Most running demand passages of match play in youth soccer congestion period. *Biology of Sport,* 37(4), 367–373. https://doi.org/10.5114/BIOLSPORT.2020.96853

Di Salvo, V., Pigozzi, F., González-Haro, C., Laughlin, M. S., & De Witt, J. K. (2013). Match performance comparison in top English soccer leagues. *International Journal of Sports Medicine*, 34(6), 526–532. https://doi.org/10.1055/s-0032-1327660

Dolci, F., Hart, N. H., Kilding, A. E., Chivers, P., Piggott, B., & Spiteri, T. (2020). Physical and Energetic Demand of Soccer:

A Brief Review. *Strength and Conditioning Journal*, 42(3), 70–77. https://doi.org/10.1519/ssc.0000000000000533

Freire, L. de A., Tannure, M., Gonçalves, D., Aedo-Muñoz, E., Perez, D. I. V., Brito, C. J., & Miarka, B. (2020). Correlation between creatine kinase and match load in soccer: A case report. *Journal of Physical Education and Sport*, 20(3), 1279–1283. https://doi.org/10.7752/jpes.2020.03178

Gabbett, T. J., Wiig, H., & Spencer, M. (2013). Repeated high-intensity running and sprinting in Elite Women's soccer competition. *International Journal of Sports Physiology and Performance*, 8(2), 130–138. https://doi.org/10.1123/ijspp.8.2.130

Gomez-Piqueras, P., Gonzalez-Villora, S., Castellano, J., & Teoldo, I. (2019). Relation between the physical demands and success in professional soccer players. *Journal of Human Sport and Exercise*, 14(1), 1–11. https://doi.org/10.14198/jhse.2019.141.01

Hands, D. E., & Janse de Jonge, X. (2020). Current time-motion analyses of professional football matches in top-level domestic leagues: a systematic review. International Journal of *Performance Analysis in Sport*, 20(5), 747–765. https://doi.org/10.1080/24748668.2020.1780872

Hoppe, M. W., Slomka, M., Baumgart, C., Weber, H., & Freiwald, J. (2015). Match running performance and success across a season in German Bundesliga soccer teams. *International Journal of Sports Medicine*, 36(7), 563–566. https://doi.org/10.1055/s-0034-1398578

Jennings, D., Cormack, S., Coutts, A. J., Boyd, L., & Aughey, R. J. (2010). The validity and reliability of GPS units for measuring distance in team sport specific running patterns. *International journal of sports physiology and performance*, 5(3), 328–341. https://doi.org/10.1123/ijspp.5.3.328

Mohr, M., Krustrup, P., Andersson, H., Kirkendal, D., & Bangsbo, J. (2008). Match activities of elite women soccer players at different performance levels. *Journal of Strength and Conditioning Research*, 22(2), 341–349. https://doi.org/10.1519/JSC.0b013e318165fef6

Oliva-lozano, J. M., Rojas-valverde, D., Gómez-carmona, C. D., Fortes, V., & Pino-ortega, J. (2021). Impact of contextual variables on the representative external load profile of Spanish professional soccer match-play : A full season study. *European Journal of Sport Science*, 21(4), 497–506. https://doi.org/10.1080/17461391.2020.1751305

Papaevangelou, E., Metaxas, T., Riganas, C., Mandroukas, A., & Vamvakoudis, E. (2012). Evaluation of soccer performance in professional, semi-professional and amateur players of the same club. *Journal of Physical Education and Sport*, 12(3), 362–370. https://doi.org/10.7752/jpes.2012.03054

Petersen, C., Pyne, D., Portus, M., & Dawson, B. (2009). Validity and reliability of GPS units to monitor cricket-specific movement patterns. *International Journal of Sports Physiology and Performance*, 4(3), 381–393. https://doi.org/10.1123/ijspp.4.3.381

Rampinini, E., Impellizzeri, F. M., Castagna, C., Coutts, A. J., & Wisløff, U. (2009). Technical performance during soccer matches of the Italian Serie A league: Effect of fatigue and competitive level. *Journal of Science and Medicine in Sport*, 12(1), 227–233. https://doi.org/10.1016/j.jsams.2007.10.002

Rienzi, E., Drust, B., Reilly, T., Carter, J. E. L., & Martin, A. (2000). Investigation of anthropometric and work-rate profiles of elite South American international soccer players. *Journal of Sports Medicine and Physical Fitness*, 40(2), 162–169.

Turner, A. N., & Stewart, P. F. (2014). Strength and conditioning for soccer players. S*trength and Conditioning Journal*, 36(4), 1–13. https://doi.org/10.1519/SSC.0000000000000054