motricidade

REVIEW ARTICLE

https://doi.org/10.6063/motricidade.41554

Performance of GPS-tracked football players in response to game contextual variables: A systematic review

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ABSTRACT

This systematic review analysed the influence of contextual game variables on movement and intensity parameters recorded by Global Positioning System devices in professional football athletes. Following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, 1,401 studies (excluding duplicates) were found in the Medline via PubMed, Web of Science, and Scopus databases, resulting in 34 articles included, with 1,039 male professional football players analysed in 1,154 matches. Studies revealed that starters cover a greater total distance per minute compared to substitutes, who perform better in high-intensity activities. The need for points to secure safer standings or avoid relegation significantly influences effort and intensity. The average distance covered per minute is higher during ball-in-play periods, highlighting the importance of high-intensity moments. Game intensity tends to decrease in the second half, with intensity variations across different positions. These results emphasise the complexity of interactions between contextual variables and performance parameters. Practical applications include informing coaches to individualise training and recovery strategies by position and match context.

KEYWORDS: soccer; GPS devices; contextual game variables.

INTRODUCTION

Football is one of the most popular and widely practised sports worldwide, with millions of players and enthusiasts (Wallace & Norton, 2014). In addition to its cultural and social appeal, football involves variable intensity throughout the game, with moments of high physical demand interspersed with periods of relative recovery. Understanding the intensity of the game and the factors that influence it is fundamental for training, improving game strategies, and promoting a safe and healthy sport (Silva et al., 2019).

The intensity of football play has been the subject of study and analysis in different contexts, with a growing interest in understanding the variables related to the movement of players on the field and how these variables affect the intensity of the game (Cruz & Vidal, 2023; Domene, 2013; García-Aliaga et al., 2023; Nobari et al., 2022; Piñero et al., 2023). According to Djaoui et al. (2017), analysing player movement is essential to assess the physical load imposed during a football match, optimising training and sports performance.

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Conflict of interests: nothing to declare. Funding: nothing to declare.
Received: 6th May 2025. Accepted: 21st November 2025.
Edited by: Luís Branquinho, Polytechnic Institute of Portalegre, Portugal.

The modern football landscape has evolved considerably, with tactical changes, rule modifications, technological advances, and increased competition leading to greater speed, intensity, and physical demands (STATSports, 2020).

Football requires constant advances in knowledge and strategies to optimise player and team performance (Cruz & Vidal, 2023). GPS (Global Positioning System) tracking technology has advanced significantly, providing detailed insight into the intensity of the game and its effects on performance (Bortnik et al., 2022; Silva et al., 2021).

The analysis of match intensity and player movements, based on GPS data, has emerged as a fundamental field of research in top-level football. Analysing how match intensity affects team and player performance is important for developing more effective training strategies and improving performance (Jerkovic et al., 2022; Silva et al., 2019).

According to Silva et al. (2019), analysing match intensity from GPS data provides insights into the physical and tactical demands of top-level football, assisting the coaching staff in decision-making. It is worth noting that several contextual game variables, such as match location, team formation, and opponent quality, can influence performance (Aquino et al. 2020; Aquino, Martins, et al., 2017; Aquino, Vieira, et al., 2017; Paraskevas et al., 2020). However, there is a lack of systematic reviews analysing how these contextual variables affect GPS-collected performance metrics. This review aims to fill this gap by providing a comprehensive overview of how contextual variables influence football performance. This review differs from previous ones by focusing specifically on contextual variables in GPS studies of professional football.

Thus, the aim of this review is to analyse the influence of game contextual variables on the displacement parameters obtained by GPS devices in professional football players.

METHODS

A systematic search following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines was performed (Page et al., 2022). This review was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the number CRD42024532408. The protocol is publicly accessible, and no deviations occurred during the review process.

Search strategies

Searches were conducted in Medline (via PubMed), Web of Science, and Scopus from October 23 to November 23, 2023. Studies published up to the date of the search were included, without date filters. Title and abstract filters were applied across all databases. The Boolean search strategy combined controlled vocabulary (e.g., MeSH, DeCS) and free-text terms to maximise sensitivity and specificity. Query structures were adapted for each database to account for differences in indexing and Boolean syntax. For transparency and reproducibility, complete search strings are provided below and in the supplementary material.

The search strategy was formed using the following terms: "Game Intensity"; "external load"; "displacement"; "Locomotion"; "distance"; "sprint"; "Speed"; "acceleration"; "deceleration"; "global positioning system"; "GPS"; "micro-technology"; "microsensor"; "wearable technology"; "Football"; "Soccer"; "Football match"; "Soccer Match"; "Injuries"; "Warm up"; "Warming up". In the databases, Boolean operators "OR" between synonyms, "AND" between terms and "NOT" for unrelated terms were used to construct the search phrase, which was as follows: ((("Football"[Title/Abstract] OR "Soccer"[Title/Abstract] OR "football match"[Title/Abstract] OR "Soccer match"[Title/Abstract]) AND ("Game Intensity"[Title/Abstract] OR " external load"[Title/Abstract] OR "displacement"[Title/Abstract] OR "Locomotion"[Title/Abstract] OR "distance"[Title/Abstract] OR "sprint"[Title/Abstract] OR "Speed"[Title/Abstract] OR "acceleration"[Title/Abstract] OR "deceleration"[Title/Abstract])) AND ("GPS"[Title/Abstract] OR "Global Positioning System"[Title/Abstract])) NOT ("injuries"[Title/Abstract] OR [Title/Abstract] OR "Warming up"[Title/Abstract]).

Eligibility criteria

Only match-related contextual variables (e.g., location, result, formation, opponent level) were included; individual player characteristics were not considered contextual variables.

For inclusion in the study, the PECO (Population, Exposure, Control and Outcome) strategy was adopted, which included studies conducted with professional football players over 18 years of age who participated in official matches during their team's competitive season, with at least one contextual game variable (e.g., playing position, match location, match status, etc.), and monitored by GPS in which at least one metric (e.g., total distance covered, sprints and distance covered at high intensity, acceleration, etc.) was reported. Only observational cohort studies published in English, Portuguese, and Spanish were included.

Table 1 presents the PECO framework summarising Population, Exposure, Comparator, and Outcomes.

Duplicate references were first removed through a review in the EndNote online library, followed by manual methods. Two experienced reviewers independently screened titles and abstracts to determine initial eligibility using EndNote online

Table 1. Population, exposure, control and outcome framework.

Element	Description
Population (P)	Professional male football players (> 18 years) in official matches.
Exposure (E)	Contextual variables (e.g., playing position, match location, match status, opponent level, team formation).
Comparator (C)	Comparisons between different contextual conditions (e.g., home vs. away, wins vs. losses, positions, formations).
Outcomes (O)	GPS-derived metrics (e.g., total distance, high-intensity running, sprints, accelerations, decelerations).

library software. Author blinding was implemented to reduce bias during this process. Finally, the reviewers assessed the full texts of all articles for inclusion based on the eligibility criteria. Disagreements in eligibility decisions were resolved through discussion with a third reviewer when necessary.

Methodological quality and risk of bias

Methodological quality and risk of bias were assessed using the Newcastle-Ottawa Scale (Wells et al., n.d.), which was developed to assess internal quality in observational cohort and case-control studies. This scale also addresses the risk of bias across its three main categories: selection, comparability, and outcome. Each category contains specific items that, when assessed, help identify and minimise different types of bias. The NOS tool consists of 8 assessment items, grouped into 3 categories: selection, comparability, and outcome. Group selection contains 4 items and can earn up to 4 points, comparability contains 1 item that can earn up to 2 points, and outcome contains 3 items that can earn up to 3 points. Each item can be given a "star" that characterises a point, which can reach a total score of 9 points. The higher the score, the better the study methodology; scores below 5 indicate a high risk of bias (Veronese et al., 2015).

Data extraction

Data related to participant characteristics, such as the number of participants, age, height, body mass and body mass index, competition level, GPS device (manufacturer, model, recording frequency), number of games analyzed, player movement demands (e.g., total distance covered), as well as contextual variables (e.g., match location) and the results obtained were extracted independently by two researchers.

RESULTS

Figure 1 presents the flow diagram of the search strategy, the selection of included studies and the reasons for excluding studies. This diagram illustrates the systematic approach used to identify, screen, and include articles relevant to the review.

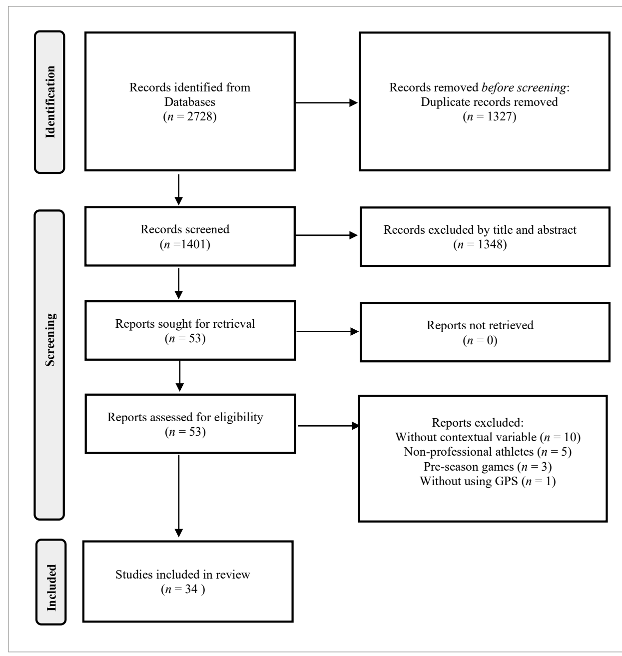

Figure 1. Flow diagram of the search strategy, selection of included studies and reasons for exclusion of studies.

Table 2 summarises the articles included in this systematic review. The data provide an overview of the various contexts and conditions in which displacement and intensity parameters were measured.

A total of 1,039 participants, all male professional football players, were included in the 34 articles that met the inclusion and exclusion criteria. The studies analysed the athletes' performances in football matches, totalling 1,154 football matches.

Table 3 summarises the GPS equipment used in the studies included in this systematic review. Each study provides details on the type and brand of equipment, as well as the GPS sampling frequency.

Different types of GPS devices were used, with a frequency range of 1–18 Hz; 10 Hz was the most common. The third step was to conduct a methodological assessment and evaluate the risk of bias in the included studies (Table 4).

The methodological quality, as assessed by the Newcastle-Ottawa Scale (NOS), indicated a high risk of bias in only

Table 2. Overview of the articles included in the research.

Title	Authors (year)	N	Sample characteristics	Competition	Number of games analyzed
Physical demands of playing position within English Premier League academy soccer	Abbott et al. (2018)	37	(19.9 ± 1.4 years) (height 180.3 ± 8.0 cm) (BM 78.9 ± 8.4 kg)	Premier League 2	44
Effects of competitive standard, team formation and playing position on match running performance of Brazilian professional soccer players	Aquino, Martins, et al. (2017)	36	(27.72 ± 3.94 years) (height 180.59 ± 6.25 cm) (BM 76.79 ± 7.35 kg)	1st division of São Paulo 2016; 3rd division of the Brazilian championship 2016; 4th division of the Brazilian championship 2015	52
Influence of match location, quality of opponents, and match status on movement patterns in Brazilian professional football players	Aquino, Vieira, et al. (2017)	-	(27.50 ± 4.79 years) (height 179.00 ± 6.38 cm) (BM 80.20 ± 7.33 kg)	4th division of the Brazilian championship 2015	16
Influence of situational variables, team formation, and playing position on match running performance and social network analysis in Brazilian professional soccer players	Aquino et al. (2020)	22	(27.9 ± 3.9 years) (height 180.1 ± 5.2 cm) (BM 79.3 ± 8.6 kg)	3rd division of the Brazilian championship 2017	18
Match running performance in Brazilian professional soccer players: Comparisons between successful and unsuccessful teams	Aquino et al. (2021)	48	(28 ± 5 years) (height 180 ± 5 cm) (BM 78 ± 8 kg)	2nd division of the Brazilian championship 2020	69
Contextual variables affect running performance in professional soccer players: A brief report	Augusto et al. (2021)	20	(27 ± 5 years) (height 180.5 ± 6.9 cm) (BM 74.8 ± 7.8 kg)	1st division of the Brazilian championship 2017	35
Contextual variables affect peak running performance in elite soccer players: A brief report	Augusto et al. (2022)	20	(25.7 ± 4.4 years) (height 180.1 ± 6.1 cm) (BM 75.4 ± 7.8 kg)	1st division of the Brazilia championship 2019	29
The mean and peak physical demands during transitional play and high pressure activities in elite football	Bortnik et al. (2022)	23	Not informed	Polish First Division (Ekstraklasa) 2020–2021	10
Analysis of professional soccer players in competitive match play based on submaximum intensity periods	Caro et al. (2022)	14	(23.86 ± 3.58 years) (height 1.79 ± 0.05 m) (BM 73.74 ± 5.92 kg)	Azerbaijan Premier League 2019–2020	15
Comparisons of recovery, external and internal load by playing position and match outcome in professional soccer	Conde et al. (2018)	23	(26.1 ± 3.8 years) (height 177.6 ± 5.1 cm) (BM 77.5 ± 5.0 kg)	1st division of the Brazilian Championship (year not informed)	9
Quantifying and modelling the game speed outputs of English Championship soccer players	Connor et al. (2022)	28	(25.3 ± 4.2 years) (height 1.82 ± 0.07 m) (BM 79.5 ± 6.3 kg)	Premier League 2019–2020	23
Modelling the decrement in running intensity within professional soccer players	Delaney et al. (2018)	24	(24.4 ± 5.4 years) (height 1.79 ± 0.06 m) (BM 75.2 ± 5.8 kg)	Australian A-League 2016	40
Influence of contextual factors on physical demands and technical-tactical actions regarding playing position in professional soccer players	Díez et al. (2021)	21	(25.10 ± 3.56 years) (height 180.25 ± 5.38 cm) (BM 75.56 ± 6.40 kg) (BMI 23.15 ± 1.20 kg/m2)	Spanish Second Division 2017–2018	65
Effects of congested match periods on acceleration and deceleration profiles in professional soccer	Djaoui et al. (2021)	24	(23 ± 4.5 years) (height 178 ± 6.1 cm) (BM 73 ± 8.2 kg)	Premier League 2016	31
Peak running speeds in professional male football: Influence of division and playing position	Fahey et al. (2023)	57	(25.9 ± 5.2 years) (height 1.8 ± 0.0 cm) (BM 79.4 ± 8.6 kg)	Premier League 2017–2018 English League One 2019–2020	60
A comparison of rolling averages versus discrete time epochs for assessing the worst-case scenario locomotor demands of professional soccer match-play	Fereday et al. (2020)	25	(25 ± 4 years) (height 1.80 ± 0.08 cm) (BM 75.0 ± 7.6 kg)	Premier League 2018–2019	28
Influence of contextual variables and the pressure to keep category on physical match performance in soccer players	García-Unanue et al. (2018)	10	Not informed	Spanish Second Division 2016–2017	14

Continue...

Table 2. Continuation.

Title	Authors (year)	N	Sample characteristics	Competition	Number of games analyzed
Effects of match location, quality of opposition, match outcome, and playing position on load parameters and players' prominence during official matches in professional soccer players	Gonçalves et al. (2021)	16	(26.3 ± 4.1 years) (height 180.0 ± 0.1 cm) (BM 77.3 ± 8.0 kg)	1st division of the São Paulo Championship 2018	14
Analysis of the associations between contextual variables and match running performance in Croatian First Division soccer	Jerkovic et al. (2022)	193	Not informed	Croatian National Championship 2018–2019; 2019–2020	29
The influence of short-term fixture congestion on position specific match running performance and external loading patterns in English professional soccer	Jones et al. (2019)	37	(23 ± 4 years) (height 181.8 ± 6.5 cm) (BM 79.1 ± 8.4 kg)	3rd division of the English championship 2015–2016; English National Cup 2016–2017	79
Influence of contextual factors on match running performance in elite soccer team	Kalapotharakos et al. (2020)	21	(25.2 ± 5.8 years) (height 1.81 ± 0.06 m) (BM 73.1 ± 16 kg)	1st division of the Greek Super League 2018–2019	28
A comparison of match demands using ball-in-play versus whole match data in professional soccer players of the English Championship	Mernagh et al. (2021)	20	(24 ± 4 years) (height 180.8 ± 8.0 cm) (BM 80.7 ± 10.3 kg)	Premier League 2018	8
Position-specific physical performance of professional players during full-season matches in a Greek Superleague elite team	Mitrotasios et al. (2022)	18	(27 ± 3.3 years) (BM 77.1 ± 6.9 kg) (height 180.5 ± 13 cm)	1st division of the Greek Super League 2018–2019	30
Analysis of the association between running performance and game performance indicators in professional soccer players	Modric et al. (2019)	101	(23.85 ± 2.88 years) (height 183.05 ± 8.88 cm) (BM 78.69 ± 7.17 kg)	Croatian National Championship 2018–2019	14
Position Specific Running Performances in Professional Football (Soccer): Influence of Diferent Tactical Formations	Modric et al. (2020)	20	(23.57 ± 2.84 years) (height 181.9 ± 5.17 cm) (BM 78.36 ± 4.18 kg)	Croatian National Championship 2018–2019	17
Comparison of running distance variables and body load in competitions based on their results: A full-season study of professional soccer players	Nobari et al. (2021)	13	(28.6 ± 2.7 years) (height 182.1 ± 8.6 cm) (BM 75.3 ± 8.2 kg) (BMI 22.6 ± 0.7 kg/m2)	1st division of Persia (irã) 2020	33
Comparison of GPS derived variables based on home versus away matches in the Asian professional soccer team	Nobari et al. (2022)	12	(28.6 ± 2.7 years) (height 182.1 ± 8.6 cm) (BMI 22.6 ± 0.7kg/m2)	1st division of Persia (irã) 2020	22
Analysis of positional differences in the Thai national football team players' performance using global positioning system tracking	Nuttouch et al. (2023)	16	(18 a 34 years)	Thailand National Football League (year not informed)	22
Relative individual sprint in most demanding passages of play in Spanish professional soccer matches	Piñero et al. (2023)	22	(25.8 ± 5 years) (BM 76.4 ± 6.5 kg) (height 1.81 ± 0.07 m)	1st division of the Spanish championship 2020–2021	19
The effect of high-intensity accelerations and decelerations on match outcome of an elite English League Two football team	Rhodes et al. (2021)	26	(23.68 ± 7.12 years) (height 183.4 ± 6.82 cm) (BM 80.70 ± 6.42 kg)	Premier League 2019–2020	45
Effects of match location, quality of opposition, and match outcome on match running performance in a Portuguese professional football team	Teixeira et al. (2021)	23	(32.02 ± 1.19 years) (height 182 ± 0.01 cm) (BM 74.74 ± 0.53 kg)	Portuguese Football League 2019–2020	18
Analysis of the running performance of elite soccer players depending on position in the 1-4-3-3 formation	Vardakis et al. (2020)	19	(25.4 ± 3.7 years) (height 179.4 ± 5.8 cm) (BM 76.1 ± 6 kg)	2nd division of the Greek championship 2016–2017	25
Profile of high-speed efforts considering the playing position of Chilean professional soccer players, recorded by a GPS device: A pilot study	Velásquez-González et al. (2023)	10	(27.30 ± 4.50 years) (height 177.11 ± 0.08 cm) (BM 75.19 ± 8.86 Kg)	1st division B of the Chilean championship 2019–2020	4
Running performance in Brazilian professional football players during a congested match schedule	Vieira et al. (2018)	40	(27.39 ± 3.99 years) (height 1.81 ± 0.06 m) (BM 77.01 ± 6.7 kg)	1st division of the Campeonato Paulista 2016 and 2017; 4th division of the Campeonato Brasileiro2015; 3rd division of the Campeonato Brasileiro 2016	59

N: sample number; BMI: body mass index; BM: body mass.

Table 3. Evaluation of GPS equipment used in the studies.

Authors (year)	Equipment characteristic
(Abbott et al., 2018)	OptimEye S5B, Versão 7.18; Catapult Innovations; GPS 10Hz
Aquino, Martins, et al. (2017)	QSTARZ - 1, Taipei, Taiwan; GPS 1Hz
Aquino, Vieira, et al. (2017)	QSTARZ, Taipei, Taiwan; GPS 5Hz
Aquino et al. (2020)	QSTARZ - 1, Taipei, Taiwan; GPS 1Hz
Aquino et al. (2021)	Playertek, Catapult Innovations, Austrália; GPS 10Hz
Augusto et al. (2021)	S5 Optimeye, Catapult Sports, Austrália; GPS 10Hz
Augusto et al. (2022)	Viper pod, STATSports, Belfast, Reino Unido; GPS 10Hz
Bortnik et al. (2022)	Vector S7, Catapult Sports, Melbourne, Austrália; GPS 10Hz
Caro et al. (2022)	STATSports APEX ProSeries; STATSports, Newry, Irlanda do Norte; GPS 10Hz
Conde et al. (2018)	S5 Optimeye, Catapult Sports, Austrália; GPS 10Hz
Connor et al. (2022)	STATSports, Apex, Irlanda do Norte; GPS 10Hz
Delaney et al. (2018)	S5 Optimeye, Catapult Sports, Austrália; GPS 10Hz
Díez et al. (2021)	STATSports APEX; STATSports, Newry, Irlanda do Norte; GPS 18Hz
Djaoui et al. (2021)	Viper, Statsport, Irlanda; GPS 10Hz; Acelerômetro 100HZ
Fahey et al. (2023)	S5 Optimeye, Catapult Sports, Austrália; GPS 10Hz
Fereday et al. (2020)	S5 Optimeye, Catapult Sports, Austrália; GPS 10 Hz
García-Unanue et al. (2018)	GPSport, Austrália; GPS 15 Hz
Gonçalves et al. (2021)	QSTARZ, Taipei, Taiwan; GPS 5 HZ
Jerkovic et al. (2022)	Catapult S5 and X4 devices, Melbourne, Austrália; GPS 10Hz
Jones et al. (2019)	Catapult S5 and X4 devices, Melbourne, Austrália; GPS 10Hz
Kalapotharakos et al. (2020)	Polar Team Pro, Polar Electro, Kempele, Finlândia; GPS 10 Hz
Mernagh et al. (2021)	APEX Pod, STATSports, Belfast, Reino Unido; GPS 18Hz
Mitrotasios et al. (2022)	APEX Pod, STATSports, Belfast, Reino Unido; GPS 10Hz
Modric et al. (2019)	S5 Optimeye, Catapult Sports, Austrália; GPS 10 Hz
Modric et al. (2020)	Vector S7, Catapult Sports, Melbourne, Austrália; GPS 10Hz
Nobari et al. (2021)	SPI High-Performance Unit HPU, GPSPORTS Systems Pty Ltd., Canberra, Austrália; GPS 15Hz
Nobari et al. (2022)	SPI High-Performance Unit, HPU; Austrália; GPS 15Hz
Nuttouch et al. (2023)	OH 10GPS/GLONASS Hz; GLONASS Hz
Piñero et al. (2023)	WIMU PRO, RealTrack System, Almería, Espanha; GPS 10Hz
Rhodes et al. (2021)	S5 Optimeye, Catapult Sports, Austrália; GPS 10 Hz
Teixeira et al. (2021)	STATSports Apex, Newry, Irlanda do Norte; GPS 10 Hz
Vardakis et al. (2020)	Lagalacolli System, Lagallacoli sport, Roma, Itália; GPS 15 Hz
Velásquez-González et al. (2023)	Playertek, Catapult, Melbourne, Austrália; GPS 10 Hz
Vieira et al. (2018)	QSTARZ - 1, Qstarz, Inc., Taipei, Taiwan; GPS 1 Hz

GPS: global positioning system; Hz: hertz (sampling frequency).

one study, though none of the studies achieved the maximum score.

Table 5 provides a detailed analysis of the displacement and intensity metrics collected by GPS devices, organised according to the contextual variables of football. The contextual variables analysed cover a wide range of factors that influence athlete performance and the results obtained.

The aim of this systematic review was to analyse studies that investigated the physical demands of football via GPS, considering contextual variables that influence the intensity of both athletes and teams during games. Most of the reviewed articles used Catapult Sports devices, such as the S5 Optimeye and Vector S7 models, operating at 10Hz, which provided adequate accuracy to record displacement and

Table 4. Methodological evaluation of the 34 articles included in the study.

Authors (year)	Selection				Comparability		Outcome			Scores
	1	2	3	4	1	2	1	2	3	
Abbott et al. (2018)	-	-	★	★	★	★	-	★	★	6/9
Aquino, Martins, et al. (2017)	-	-	★	★	★	★	-	★	★	6/9
Aquino, Vieira, et al. (2017)	-	-	★	★	★	★	-	★	★	6/9
Aquino et al. (2020)	-	-	★	★	★	★	-	★	★	6/9
Aquino et al. (2021)	-	★	★	★	★	★	-	★	★	7/9
Augusto et al. (2021)	-	-	★	★	★	★	-	★	★	6/9
Augusto et al. (2022)	-	-	★	★	★	★	-	★	★	6/9
Bortnik et al. (2022)	-	-	★	★	★	★	-	★	★	6/9
Caro et al. (2022)	-	-	★	★	★	-	-	★	★	5/9
Conde et al. (2018)	-	-	★	★	★	-	-	★	★	5/9
Connor et al. (2022)	-	-	★	★	★	★	-	★	★	6/9
Delaney et al. (2018)	-	-	★	★	★	★	-	★	★	6/9
Díez et al. (2021)	-	-	★	★	★	★	-	★	★	6/9
Djaoui et al. (2021)	-	-	★	★	★	★	-	★	★	6/9
Fahey et al. (2023)	-	★	★	★	★	★	-	★	★	7/9
Fereday et al. (2020)	-	-	★	★	★	★	-	★	★	6/9
García-Unanue et al. (2018)	-	-	★	★	★	★	-	★	★	6/9
Gonçalves et al. (2021)	-	-	★	★	★	★	-	★	★	6/9
Jerkovic et al. (2022)	-	-	★	★	★	★	-	★	★	6/9
Jones et al. (2019)	-	-	★	★	★	★	-	★	★	6/9
Kalapotharakos et al. (2020)	-	-	-	★	★	-	-	★	★	4/9
Mernagh et al. (2021)	-	-	★	★	★	★	-	★	★	6/9
Mitrotasios et al. (2022)	-	-	★	★	★	-	-	★	★	5/9
Modric et al. (2019)	-	-	★	★	★	★	-	★	★	6/9
Modric et al. (2020)	-	-	★	★	★	★	-	★	★	6-9
Nobari et al. (2021)	-	-	★	★	★	★	-	★	★	6/9
Nobari et al. (2022)	-	-	★	★	★	★	-	★	★	6/9
Nuttouch et al. (2023)	★	-	★	★	★	-	-	★	★	6/9
Piñero et al. (2023)	-	-	★	★	★	★	-	★	★	6/9
Rhodes et al. (2021)	-	-	★	★	★	★	-	★	★	6/9
Teixeira et al. (2021)	-	-	★	★	★	★	-	★	★	6/9
Vardakis et al. (2020)	-	-	★	★	★	★	-	★	★	6/9
Velásquez-González et al. (2023)	-	-	★	★	★	★	-	★	★	6/9
Vieira et al. (2018)	-	★	★	★	★	★	-	★	★	6/9

intensity variables. Other frequently used devices included the QSTARZ (1Hz to 5Hz) and the STATSports APEX (10Hz to 18Hz), with higher frequencies allowing for more detailed data collection. This section summarises the findings of 34 studies, highlighting convergences and divergences regarding game intensity separately according to contextual variables, as discussed below.

DISCUSSION

GPS metrics according to game position

Of the 34 studies included, 24 used player position as a parameter in the intensity analyses. The main findings grouped by playing position highlight convergences and divergences in the results.

Table 5. Displacement/intensity metrics collected by GPS analyzed according to football contextual variables.

GPS METRICS ACCORDING TO PLAYING POSITION		
Authors, year	GPS Metrics	Results
Abbott et al. (2018)	MRS (m/s); HSR (m); SPR (m); TD (m); MAD (m) HAD (m)	TD: CD (9,830 ± 428) < WA (10,918 ± 353), WD (10,747 ± 420), ST (10,320 ± 420), MD (11,570 ± 469); WD < ST; MD > WA, WD and ST; WA < ST. MRS: WA (8.6 ± 0.4); WD (8.4 ± 0.4); ST (7.6 ± 0.5); MD (7.5 ± 0.3); CD (7.4 ± 0.3) CD < WD and WA; WD > CD, MD and ST; MD < WD and WA; WA > CD, MD and ST; ST < WD and WA.
Aquino, Martins, et al. (2017)	TD (m), MRS (km/h), Smean (km/h) HIA (au) (≥ 15,0 km/h)	TD: CD (8256.4 ± 698.8) < WD: (9670.0 ± 739.5), MD: (9201.6 ± 1141.5), WA: (9583.8 ± 1432.8) and ST: (9050.7 ± 1030.5); WD > MD and ST. MRS: CD (27.1 ± 3.2), WD: (29.9 ± 2.2), MD: (26.8 ± 4.0), WA: (30.4 ± 2.3) and ST: (30.2 ± 3.7) CD < WD, ST and WA; WD > MD; WD < WA; WA and ST > MD. Smean: CD (4.4 ± 0.6) < WD (5.2 ± 0.5), MD (5.0 ± 0.7), WA (5.0 ± 0.8) and ST (4.9 ± 0.5); WD > MD and ST. HIA: CD (34.6° 14.5) < WD (66.0 ± 25.0), MD (52.4 ± 31.3), WA (66.1 ± 25.9) and ST (61.0 ± 23.3); WD > MD; WA > MD; WA < ST.
Aquino et al. (2020)	TD (m), Smean (km/h), MRS (km/h) HIA (au) (≥ 19 km/h), NS (au) (≥ 23,01 km/h) distances traveled in: JG (m) (4,91-11 km/h); LIR (m) (11,01–14 km/h); MIR (m) (14,01–19 km/h); HIR (m) (19,01–23 km/h); SPR (m) (≥ 23,01 km/h)	TD: CD (7,525.2 ± 922.2) < WD (9,602.5 ± 1,188.6), MD (9,216.1 ± 1,244.6), WA (9,576.1 ± 1981.2) and ST (8,693.7 ± 1,013.9). for JG the CD (2,968.1 ± 629.4) < WD (3,451.1 ± 536.4), MD (3,946.4 ± 613.6), WA (3,659.8 ± 809.1) and ST (3,411.8 ± 524.1); MD > WD and ST. LIR: CD (845°267.1) < WD (1,404.4 ± 353.6), MD (1,477.1 ± 444.8), WA (1,590.5 ± 518.6) and ST (1,202.8 ± 251); WA > ST. MIR: CD (627 ± 205.5) < WD (1,398.5 ± 457.5), MD (1,163.8 ± 424.8), WA (1,537.3 ± 504.5) and ST (1,129.6 ± 217.7); WA > MD and ST. HIR: CD (143.1 ± 69.7), WD (504.4 ± 194.2), MD (267.5 ± 158.5), WA (467.4 ± 196.2) and ST (390.1 ± 110.2); MD < WD and WA. SPR: CD (126.6 ± 138.5) < WD (338.7 ± 183.3), MD (147.4 ± 99.4), WA (259.7 ± 128.7) and ST (256.5 ± 102.2); MD < WD and WA. HIA: CD (269.8 ± 182.4) < WD (843.1 ± 354), MD (414.9 ± 234.5), WA (727.1 ± 294.2) and ST (646.6 ± 187); MD < WD, WA and ST. NS: CD (10.9 ± 8.6) < WD (49.1 ± 25.6), MD (17.5 ± 14.1), WA (30.1 ± 19.4) and ST (31.2 ± 13.4); WD > MD, WA and ST.
Aquino et al. (2021)	TD (m), HIR (m) (> 18km/h), NS (au) (> 25 km/h), HAD (m) (≥ 3 m/s²), DDI (m) (≤ –3 m/s²).	Playing position: WRT > PRT in TD for ST, MD and WD; PRT > WRT in TD for CD; WRT > PRT in NS for MD and WD; WRT > PRT in HIR and HAD for MD; WRT > PRT in DDI for MD and WA; PRT > WRT in HIA for CD.
Augusto et al. (2022)	TD (m); HIR (m) (≥ 19,8 km/h), HAD (m) (≥ 2 m/s²) DDI (m) (≤ –2m/s²); moving average for 1, 3 and 5 min presented by m/min in all variables	For 1 min: CD < WD, MD and ST in TD
Caro et al. (2022)	Metrics in (au) and (s) for: HIA (< 19.8km/h), NS (25.2km/h), AccD, Mmin, MetP, HMLD (<25.5W/kg).	AccD: WA < ST; MD > WD, CD, ST. M/min: for number and time of MetP and Mmin; WA > CD; WA > WD. MetP and Mmin: CD > WD; ST > CD and WD.
Conde et al. (2018)	TD (km) and relative (m/min), HIR (m) (> 20km/h), HIA (> 20km/h), MRS (km/h)	TD: WD (10.01 ± 6.96) > ST (7.68 ± 1.78). Relative TD: CD (95.76 ± 5.92) < WD (104.73 ± 7.17), MD (103.78 ± 5.87), WA (112.34 ± 9.27); ST (97.40 ± 8.96) <WA. HIR and HIA: WD (680.47 ± 194.11; 44.83 ± 12.90) > CD (411.53 ± 129.74; 27.47±7.57), MD (296.70 ± 122.90; 20.47 ± 6.57), WA (456.45 ± 136.22; 30.00 ± 7.60) and ST (472.87 ± 157.33; 30.74 ± 9.87); MD < ST. MRS: MD (28.24 ± 2.24) < CD (30.54 ± 1.79), WD (31.48±1.36), ST (30.90 ± 2.30).
Connor et al. (2022)	TD (m) and relative (m/min), moving average for 1,2,3 ... 10 presented in m/min	Moving average in m/min: CD < MD, WD and ST, WA > ST, MD and WD.
Delaney et al. (2018)	TD (m/min), HIR (m/min) (> 5,5 m/s), meanAc/Dc (m/s²), metP (W/kg) Moving average for 1,2,3 ... 10 minutes	Moving average peak: MD (196 ± 12), ST (193 ± 13), WD (194 ± 17) and WA (193 ± 14) > CD (173 ± 14) and WN (184 ± 15); WN > CD for TD. meanAc/Dc: WD (0.86 ± 0.05) > MD (0.79 ± 0.05), ST (0.78 ± 0.06), WA (0.79 ± 0.06), CD (0.78 ± 0.06) and WN (0.82±0.06); WN > CD and ST, WN (–0.18 ± 0.03) > WD (–0.17 ± 0.03) and WA (–0.17 ± 0.03). metP: CD (16.1 ± 1.2) < MD (17.8 ± 1.2), ST (17.8 ± 1.3), WA (17.6 ± 1.3), WD (18.3 ± 1.5) and WN (17.4 ± 1.5), CD (–0.19 ± 0.03), ST (–0.19 ± 0.03), WD (–0.20 ± 0.04) WN (–0.20 ± 0.04) > WA (–0.18 ± 0.03) and MD (–0.18 ± 0.07). HIR: ST (61 ± 15) and WD (62 ± 16) > MD (51 ± 16), CD (45 ± 14), WA (48 ± 16) and WN (55 ± 16); WN > CD, CD (–0.19 ± 0.03), ST (–0.19 ± 0.03), WD (–0.20 ± 0.04) and WN (–0.20 ± 0.04) > WA (–0.18 ± 0.03) and MD (–0.18 ± 0.07). Curve steepness ratio: CD (–0.17 ± 0.03), ST (–0.18 ± 0.03), WD (–0.18 ± 0.04) and WN (–0.18 ± 0.04) > WA (–0.16 ± 0.03) for TD.
Díez et al. (2021)	TD (m), MIR (m) (>14 km/h), HIR (m) (> 19,8 km/h), SPR (m) (> 25,0 km/h), MDN e MAN (2 a 4m/s²), NDI, NAI (> 4m/s²).	WD: away, loss (106 ± 44) > win (174 ± 74) for SPR. MD: home, loss (190 ± 29) > win (161 ± 34) for MDN. ST: home, loss (149 ± 10) > win (125 ± 18) for MDN.

Continue...

Table 5. Continuation.

Authors, year	GPS Metrics	Results
Djaoui et al. (2021)	Absolute (m), relative (m/min) and time spent (s) metrics: TD, LIR (0–10.8 km/h), MIR (> 10.8-19.8 km/h), HIR (> 19.8-25.2 km/h), SPR (< 25.2 km/h), DDB (–1 a < 0 m/s²), DDM (–2 a < –1 m/s²), DDI (-3 a < –2 m/s²), MID (< –3 m/s²), LAD (> 0 a 1 m/s²), MAD (> 1 a 2 m/s²), HAD (> 2 a 3 m/s²), MIA (> 3 m/s²), TAD (m/s²), TDD (m/s²).	LIR: WA: NCG (5760 ± 941) < CG (6396 ± 245 m). MIA: MD: NCG (1.00 ± 0.17) > CG (0.79 ± 0.22 m/min) and HAD (3.04 ± 0.37; 2.61 ± 0.70 m/min).
Fahey et al. (2023)	TD (m/min) moving average for 1, 5 and 10 minutes	TD: MD and WA > ST, WD and CD; WD > ST and CD; ST > CD.
Fereday et al. (2020)	TD (m/min) HIR (> 5.5 m/s) m/min 60s to 600s moving average	TD: MD, CDM, WD and WA > CD. HIR: MD, WD, WA, WN and ST > CD.
Jones et al. (2019)	Congestion: G1, G2 and G3. TD (m), LIR (< 4.0 m/s), MIR (4.0–5.5 m/s) and SPR (> 7.0 m/s)	LIR: MD (0–15 min = 1398 ± 487 m) > WD (0–15 min = 1333 ± 544 m); ST (0–15 min = 1329 ± 356 m). TD: MD (0–15min=1774 ± 699 m) > CD (0–15 min = 1588 ± 795 m), WD (0–15 min = 1634 ± 764 m) and ST (0–15 min = 1703 ± 499 m, ST (0–15 min = 1703 ± 499 m) > CD (0–15 min =1588 ± 795 m). SPR: ST (0–15 min = 31 ± 54 m) > CD (0–15 min = 10 ± 88 m), DP (0–15 min = 17 ± 83 m) and MD (0–15 min 18 ± 77 m).
Kalapotharakos et al. (2020)	WALK (m) (3–6.9 km/h), JG (m) (7–10.99 km/h), LIR (m) 11–14.99 km/h), HIR (m) > 19 km/h), MRS (km/h) (14.4–18.99 km/h), NS, TD (m).	WALK: CD (3301.4 ± 229.8) < WD (3524.1 ± 376.7), ST (3703.0 ± 320.8) and MD (3805.2 ± 496.6). JG: MD (2184.3 ± 354.0), ST (2272.0 ± 466.4) and WD (2324.8 ± 406.1) < CD (2802.9 ± 232.7). LIR: CD (1985.1 ± 181.4), ST (2048.6 ± 293.1) and WD (2144.9 ± 225.5) < MD (2447.7 ± 442.0). HIR: CD (860.3 ± 138.1) < WD (1128.4±231.2); ST (1120.0 ± 199.0) < MD (1334.7 ± 279.2). MRS: CD (29.4 ± 1.8) and MD (29.4 ± 1.6) < WD (30.7 ± 2.5) and ST (31.4 ± 1.8). NS: CD (7.3 ± 3.1) and MD (10.0 ± 3.8) < WD (14.9 ± 6.8) <ST (20.0 ± 6.1). TD: CD (10080.0 ± 445.5) <WD (10580.6 ± 509.3), ST (10736.5 ± 653.0) and MD (10954.3 ± 671.8).
Mernagh et al. (2021)	m/min, TD/min, Acc/min, Dec/min, HMLD/min.	m/min: Def total (92.9 ± 6.6) > ST total (73.9 ± 9.7) < Mc total (96.6 ± 10.2); Def Bip (118.2 ± 11.4) < Mc Bip (140 ± 11.5); ST Bop (41.1 ± 9.3) > Mc Bop (31.2 ± 5.8) > Def Bop (19.5 ± 7.2); Mc Max Bip (179.3 ± 9.1) > Def Max Bip (154.9 ± 12.5); Def Max Bip 30–60s (183.5 ± 15.7) < Mc Max Bip 30–60s (210 ± 9.7) > ST Max Bip 30–60s (193.7 ± 21.6); Def Max Bip 60–90s (144.1 ± 13.9) < Mc Max Bip 60–90s (170.9 ± 8.5) > ST Max Bip 60–90s (154.1 ± 16.7); Def Max Bip>90s (136.9 ± 10.6) < Mc Max Bip > 90s (157.1 ± 10.9) > ST Max Bip > 90s (135.3 ± 13). Acc/min: ST total (0.9 ±0.1) < Def total (1.1 ± 0.1) < Mc total (1.2 ± 0.2); Def Bip (1.7 ± 0.2) > ST Bip (1.6± 0.3) < Mc Bip (2.0 ± 0.2); Def Bop < Mc Bop (0.6 ± 0.1) e ST Bop (0.8 ± 0.3). Dec/min: ST total (0.7 ± 0.1) < Mc tota (1.0 ± 0.1) e Def total (1.0 ± 0.1); Def Bip (1.5 ± 0.2) < Mc Bip (1.8 ± 0.2) e ST Bip (1.8 ± 0.2); Mc Max Bip (3.8 ± 0.1) > ST Max Bip (3.3 ± 0.2). HMLD/min: Def total (16.1 ± 2.3) < Mc total (18.5 ±2.1) > ST total (13.8 ± 3.2); Def Bip (25.3 ± 5.2) < Mc Bip (34.2 ± 3.8) > ST Bip (29.5 ± 6.1); Def Bop (7 ± 2.9) < Mc Bop (9.8 ± 1.5) < ST Bop (11 ± 3.2).
Mitrotasios et al. (2022)	TD (m), Intensity zones: LIR (m) (< 4 m/s), MIR (m) (4–5,5 m/s), HIR (m) (> 5,5 m/s). NAc (> 3 m/s²). NDAc (> 3 m/s²). Acceleration and deceleration zones (n): iTotal. 3–10m/s2 i. 3–4 m/s², ii. 4–5.5 m/s², iii. 5.5–7 m/s², iv. 7–10 m/s², v. Total 3–10 m/s². MRS (m/s)	TD: MD > CD, ST, WD and WD > CD, ST. LIR: MD > others and WD > ST. MIR: MD > others. HIR: WD and ST > others. MRS: ST (32.3 ± 1.4) > CD (31.4 ± 3.5), WD (30.6 ± 1.4) > CD (29.9 ± 1.9) and WD (29.4 ± 1.4). NAC iTotal: team (196.5 ± 28.9); MD (210.8 ± 27.6) and WN (188.6 ± 28.9) > CD (190.8 ± 30.0) and WD (203.0 ± 28.5), i.: team (86.3 ± 26.4) and CD (92.3 ± 26.3) > WD (75.2 ± 15.7) < MD (98.8 ± 27.3) > ST (74.8 ± 23.8) < WN (83.6 ± 27.4), ii. : team (51.1 ± 10.7) and CD (49.0 ± 10.5) < WD (54.2 ± 10.5) < MD (56.1 ± 11.4) > ST (49.8 ± 11.5) > WN (48.0 ± 8.3). iii.: team (43.1 ± 19.1) and CD (37.3 ± 17.1) < WD (51.3 ± 13.7) > MD (42.8 ± 22.0) < ST (48.1 ± 20.5) > WN (41.8 ± 19.2), iv.: team (15.6 ± 9.6) and CD (12.2 ± 7.7) < WD (22.4 ± 8.5) > MD (13.1 ± 8.9) <ST (18.8 ± 11.2) > WN (15.2 ± 9.2). NDAC iTotal: team (203.5 ± 33.5); WD (217.3 ± 32.3) and MD (230.6 ± 29.4) > CD (196.5 ± 32.1) and ST (179.3 ± 28.7) and WN (194.0 ± 23.5), i.: team (82.8 ± 24.9) and CD (86.6 ± 26.4) > WD (73.3 ± 14.8) < MD (99.5 ± 24.2) > ST (67.2 ± 17.7) < WN (80.1 ± 24.5), ii. : team (48.8 ± 10.4) and CD (48.1 ± 9.8) > WD (48.1 ± 8.9) <MD (55.9 ± 9.8) > ST (42.4 ± 10.3) < WN (47.8 ± 9.8), iii. : team (45.3 ± 15.8) and CD (40.9 ± 15.3) < WD (53.7 ± 14.2) > MD (49.1 ± 18.4) > ST (44.2 ± 16.7) > WN (42.3 ± 12.0), iv.: team (26.7 ± 14.4) and CD (20.9 ± 9.5) < WD (42.2 ± 14.0) > MD (26.1 ± 13.5) > ST (25.5 ± 14.8) > WN (23.7 ± 12.5).

Continue...

Table 5. Continuation.

Authors, year	GPS Metrics	Results
Modric et al. (2019)	TD (m), Walking (m) = < 7.1 km/h, JG (m) = 7.2-14.3 km/h, Running (m) = 14.4-19.7 km/h, HIR (m) = 29.8-25.1 km/h, SPR (m) => 25.2 km/h, NAc (> 0,5 m/s²). NAI (> 3 m/s²) NDAc (> 0,5 m/s²). NDI (> 3 m/s²)	TD: team (10,298.4 ± 928.68); MD (11,155.1 ± 635.3) > CD (9,313.5 ± 599.4) e WD (10,368 ± 612) e WN (10,264.8 ± 275.2) e ST (9,796.7 ± 703.7). JG: team (4,092.94± 569.73); MD (4,599.7 ± 471.4) > CD (3,859 ± 380.2) e WD (3,975.4 ± 372.8) e WN (3,761.2 ± 324.1) e ST (3530 ± 729.9). Running: team (1,363.27 ± 339.68); MD (1,674.9 ± 226.1) > CD (999.2 ± 197.7) e WD (1,320.7 ± 236.1). HIR: equipe (461.83 ± 160.15); WN (640.7 ± 105.4) > CD (288.2 ± 63.8) e MD (492.7 ± 139.9) e ST (458.7 ± 94.7). SPR: team (155.89 ± 97.13); CD (87.7 ± 59.9) < WD (236.6 ± 97.2) > MD (123.7 ± 69.5) < WN (260.6 ± 68.8) > ST (137.1 ± 46.9). NAc: team (716.19 ± 73.15); CD (743.5 ± 56.2) > ST (610.1 ± 83.7). NAI: team (3.16 ± 2.67); ST (6 ± 2.9) > CD (2.5 ± 1.8) e WD (3.1 ± 1.7) e WN (7 ± 2.6). NDAc: team (674.44 ± 69.29); CD (714.1 ± 51.5) > ST (536.6 ± 69). NDI: team (11.39 ± 6.27); ST (11 ± 3.1) > WN (20.8 ± 5.5).
Nuttouch et al. (2023)	TD (m), TD (m) /min Intensity zone: Z1 (1.0 to 5.99 km/h), Z2 (6.0–10.99 km/h), Z3 (11.0–15.99 km/h), Z4 (16.0–19.33 km/k), Z5 (> 20 km/h). SPR (m), MRS (km/h).	TD(m) /min: ST (91,22 ± 18,85) > WD (73,67 ± 26,02). Z1: WD < CD, MD > WD e ST > WD. Z3: ST > CD, e ST > WD. Z4: ST > CD, WD e MD. Z5: ST > CD, WD e MD. SPR: ST > CD, WD e MD. MRS: WD < CD e ST.
Piñero et al. (2023)	MDP (duration (s); distance (m)); MRS (m/s) (duration (s); distance (m));	MDP: WN had the greatest distance at >80% of MRS (2.4 ± 1.63 s) and the greatest duration (21.91 ± 13.35 m) in its MDP than the other positions (CD, WD, MD and ST).
Rhodes et al. (2021)	NAI (au) (> 3 m/s²), MAI (au) (> 3 m/s²), NDI (au) (< 3 m/s²), MDI (au) (< 3 m/s²).	MAI: CD (12.34 ± 6.25) and ST (14.07 ± 8.14) > MD (9.26 ± 5.33), WN (12.96 ± 6.74) and CDM (10.72 ± 6.20). MDI: CD (25.61 ± 15.18) and ST (17.75 ± 14.73) > MD (22.43 ± 14.44), WN (25.28 ± 15.59) and CDM (22.96 ± 11.33).
Teixeira et al. (2021)	TD (m), Smean (m/min), HIR (19,8–25,1 km/h), NS (> 25,1 km/h), NAc (>3 m/s²), NDAc (> 3 m/s²)	TD: MD (11.54 ± 0.76) and WN (11.29 ± 0.55) > WD (10.82 ± 0.64), ST (10.27 ± 0.69) and CD (10.42 ± 0.69). Smean: MD (0.09 ± 0.01), WN (0.09 ± 0.01) > WD (0.09 ± 0.01), ST (0.09 ± 0.01) and CD (0.09 ± 0.07). HIR: WN (0.89 ± 0.21) and WD (0.77 ± 0.17) > MD (0.58 ± 0.24) > ST (0.52 ± 0.21) > CD (0.49 ± 0.66). SPR: WN (55.58 ± 12.20) and WD (46.26 ± 10.58) > MD (38.73 ± 14.66) and ST (37.44±12.76) > CD (32.19 ± 10.62). Nac: WD (66.52 ± 8.76), ST (70.11 ± 5.11) and WN (80.89 ± 21.59) > MD (61.67 ± 20.75) and CD (62.53 ± 17.47). NDAc: WN (103.42 ± 21.57) and MD (96.42 ± 29.08) > WD (83.42 ± 12.12) > ST (77.89 ± 11.47) > CD (69.17 ± 14.14).
Vardakis et al. (2020)	TD (km). Distances by intensity ranges: Z1 (6–11.8 km/h), Z2 (11.9–15.7 km/h), Z3 (15.8–19.7 km/h), Z4 (19.8–24 km/h), Z5 (> 24 km/h).	Z1: MD > (CD, WD, WN, ST). Z2: MD > (CD, WD, WN, ST). Z3: MD > (CD, WD, WN, ST). Z4: (WD and WN) > (CD, MD and ST). Z5: (WD and WN) > (CD, MD and ST).
Velásquez-González et al. (2023)	NS (> 21 km/h). Distances by intensity ranges: Z4 (21–25 km/h), Z5 (> 25 km/h).	Z4 (m): CD (256.63 ± 137.01) < MD (475 ± 207.40) and WN (537 ± 70.14). Z5 (m): MD (93.25 ± 61.99) < WN (307.75 ± 102.03) and WD (131.50 ± 64.90) > ST (137.37 ± 33.18) < WN. NS: CD (10.25 ± 5.52) < ST (14.25 ± 5.31); WD (17.25 ± 4.46), WN (25.62 ± 4.75) and MD (17.0 ± 6.97) > ST.
GPS METRICS ACCORDING TO MATCH RESULTS		
Abbott et al. (2018)	MRS (m/s); HSR (m); SPR (m); TD (m); MAD (m) HAD (m)	No significant differences in GPS metrics between match results.
Aquino, Vieira, et al. (2017)	TD (m), MRS (km/h), Smean (km/h) HIA (au) (≥ 20,0 km/h)	MRS: loss (24.80 ± 4.38) < draw (27.24 ±3.10) and win (27.55 ± 2.56). Smean: loss (4.74 ± 0.58) < draw (5.12 ± 0.59) and win (5.22 ± 0.76). HIA: win (40.72 ± 20.79) < draw (51.90 ± 16.66). TD: no difference for match location
Aquino et al. (2020)	TD (m), Smean (km/h), MRS (km/h) HIA (au) (≥ 19 km/h), NS (au) (≥ 23,01 km/h) distances traveled in: JG (m) (4,91–11 km/h); LIR (m) (11,01–14 km/h); MIR (m) (14,01–19 km/h); HIR (m) (19,01–23 km/h); SPR (m) (≥ 23,01 km/h)	Smean: win (6.01 ± 0.82) > draw (5.64 ± 0.81) and loss (5.28 ± 0.92), draw (5.64 ± 0.81) > loss (5.28 ± 0.92). TD: draw (9,019.0 ± 1.1310.7) > loss (8,384.3±1.682.5); win (9,295.0 ± 1,458.5) > loss (8,384.3 ± 1.682.5). JG: win (3,659.2 ± 645.9) > loss (3,156.2 ± 684.1). LIR: win (1,418.4 ± 467.8) > loss (1,156.5 ± 468.4). MIR: win (1,297.8 ± 495.0) > loss (1,049.5 ± 535.4). HIR: win (411.4 ± 228.9) > loss (301.8 ± 185.5)
Aquino et al. (2021)	TD (m), HIR (m) (> 18km/h), NS (au) (> 25 km/h), HAD (m) (≥ 3 m/s²), DDI (m) (≤ –3 m/s²)	TD: WRT (10,330.0 ± 1600.0) > PRT (9,657.5±1176.0). HAD: WRT (100.0 ± 35.0) > PRT (85.5 ± 23.5). DDI: WRT (104.0 ± 40.0) > PRT (98.5 ± 24.5).

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Table 5. Continuation.

Authors, year	GPS Metrics	Results
Augusto et al. (2021)	TD (m), HIR (m) HIA (au) (18,1–24 km/h), SPR (m) NS (au) (> 24 km/h), NAI (au) (> 2 m/s²), NDI (au) (–2m/s²)	TD: loss > draw e win. SPR: loss < draw. NS: loss < draw.
Augusto et al. (2022)	TD (m); HIR (m) (≥ 19,8 km/h), HAD (m) (≥ 2 m/s²) DDI (m) (≤ –2m/s²); moving average for 1, 3 and 5 min presented by m/min in all variables	HIR: for 1 min = loss > draw, and for 5 min = loss > draw. HAD: for 1 min = loss > draw, for 5 min = loss > draw and victory > draw. DDI: for 1 min = loss > draw. TD: for 3 min = victory > draw. Momentary match result: TD for 1 min tying > winning; and TD for 3 and 5 min tying > winning and losing.
Conde et al. (2018)	TD (km) and relative (m/min), HIR (m) (> 20km/h), HIA (>20km/h), MRS (km/h)	no significant difference.
Díez et al. (2021)	TD (m), MIR (m) (> 14 km/h), HIR (m) (> 19,8 km/h), SPR (m) (> 25,0 km/h), MDN and MAN (2 to 4m/s²), NDI, NAI (> 4m/s²)	WD: SPR playing away = loss (106 ± 44) > win (174 ± 74). MD: MDN playing at home = loss (190 ± 29) > win (161 ± 34). ST: MDN playing at home = loss (149 ± 10) > win (125 ± 18). Full team: TD at home = loss (11,240 ± 909) > win (10,992 ± 791), NDI at home Home = loss (169 ± 32) > win (142 ± 30); SPR at home = win (152 ± 96) > loss (103 ± 96).
Fereday et al. (2020)	TD (m/min) HIR (> 5.5 m/s) m/min 60s to 600s moving average	TD: Win and loss > draw. HIR: Win and loss > draw.
Gonçalves et al. (2021)	TD (m/min). Based on individual maximum: LIR (m) (0–59,99%), HIR (m) (60–100%).	TD: win (93 ± 8.9) > draw (89.2 ± 9.3) and loss (85.7 ± 15.0). LIR: win (83.7 ± 7.9) > draw (80.5 ± 7.6) and loss (78.6 ± 9.3). HIR: win (9.4 ± 2.4) > draw (8.7 ± 2.5) and loss (8.6 ± 3.5).
Jerkovic et al. (2022)	TD (m), LIR (m) (< 14,3 km/h), MIR (m) (14,4–19,7 km/h), HIR (m) (> 19,8 km/h), HSR (m) (19,8–25,1 km/h), SPR (m) (> 25,2 km/h).	TD: loss (10,355 ± 1,052) > draw (10,298 ± 913) and win (9,893 ± 896). LIR: loss (8,279 ± 742) > draw (8,287 ± 638) and win (8,035 ± 614). MIR: loss (1,406 ± 343) > draw (1,363 ± 320) and win (1,241 ± 312). HIR: loss 661 ± 194 > draw (646 ± 251) and win (617 ± 224). SPR: losses (162 ± 79) > draw (157 ± 99) and win (156 ± 103).
Kalapotharakos et al. (2020)	WALK (m) (3–6.9 km/h), JG (m) (7–10.99 km/h), LIR (m) 11–14.99 km/h), HIR (m) > 19 km/h), MRS (km/h) (14.4–18.99 km/h), NS, TD (m).	HIR: against the best and intermediate teams = victory > defeats. TD: against the best and intermediate teams = victory > defeat, and draw > defeat.
Nobari et al. (2021)	TD (m), Smean (m/min), HIR (m) (18–23 km/h), SPR (m) (> 23 km/h), MRS (km/h), BL (au).	Smean: win (106.0 ± 14.8) < loss (188.8 ± 48.8 (159.4–218.4); draw (111.2 ± 11.2) > loss (188.8 ± 48.8). SPR: win (22.0 ± 11.1) > loss (10.3 ± 9.2). HIR: In 2nd half of games win = (108.7 ± 46.0) < loss (129.3 ± 23.3).
Piñero et al. (2023)	MDP (duration (s); distance (m)); MRS (m/s) (duration (s); distance (m));	MDP: Defeat (distance 20.23 ± 13.04 m; duration 2.24 ± 1.58 sec) > victory (distance 18.77 ± 11.76 m; duration 2.05 ± 1.40). MRS: Draw 1st half (distance 18.02 ± 11.65) < 2nd half (distance 21.48 ± 14.76).
Rhodes et al. (2021)	NAI (au) (> 3 m/s²), MAI (au) (> 3 m/s²), NDI (au) (< 3 m/s²), MDI (au) (< 3 m/s²).	NAI: win (185 ± 48) > draw (146 ± 37) and loss (152 ± 31). NDI: win (360 ± 90) > draw (291 ± 55) and loss ((326 ± 59).
Teixeira et al. (2021)	TD (m), Smean (m/min), HIR (19,8–25,1 km/h), NS (> 25,1 km/h), NAc (> 3 m/s²), NDAc (> 3 m/s²)	HIR: team = win (69.61 ± 17.64) > loss (67.90 ± 15.41) and draw (61.56 ± 21.27); win = CD < WD and CD < WN.
GPS METRICS ACCORDING TO TEAM FORMATION		
Aquino, Martins, et al. (2017)	TD (m), MRS (km/h), Smean (km/h), HIA (au) (≥ 15,0 km/h).	**TD:** 1-4-4-2 (8537.4 ± 1251.6) < 1-4-3-3 (9518.0 ± 1197.1). **MRS:** 1-4-4-2 (27.3 ± 4.5) < 1-4-3-3 (29.2 ± 3.7). **Smean:** 1-4-4-2 (4.6 ± 0.6) < 1-4-3-3 (4.9 ± 0.7). **HIA:** 1-4-4-2 (39.8 ± 22.0) < 1-4-3-3 (55.6 ± 32.0).
Aquino et al. (2020)	TD (m), Smean (km/h), MRS (km/h) HIA (au) (≥ 19 km/h), NS (au) (≥ 23,01 km/h) distances traveled in: JG (m) (4,91–11 km/h); LIR (m) (11,01–14 km/h); MIR (m) (14,01–19 km/h); HIR (m) (19,01–23 km/h); SPR (m) (≥ 23,01 km/h)	TD: 1-4-4-2 (9,575.7 ± 1,320.4) > 1-4-2-3-1 (8,316.8 ± 1,589.4). Smean: 1-4-4-2 (6.0 ± 0.8); 5.2 ± 0.8). JG: 1-4-4-2 (3,724.3 ± 699) > 1-4-2-3-1 (3,186.6 ± 699.2). LIR: 1-4-4-2 (1,441.5 ± 458.6) > 1-4-2-3-1 (1,116.0 ± 425.1). MIR: 1-4-4-2 (1,326.3 ± 480.1) > 1-4-2-3-1 (993.3 ± 437.9). HIR: 1-4-4-2 (417.4 ± 208.4) > 1-4-2-3-1 (291.2 ± 178.8).

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Table 5. Continuation.

Authors, year	GPS Metrics	Results
Fereday et al. (2020)	TD (m/min) HIR (> 5.5 m/s) m/min 60s to 600s moving average	HIR: 4-1-4-1 > 3-5-2 and 3-4-3.
Modric et al. (2020)	TD (m), HIR (m) (> 19.8 km/h), HSR (m) (19.8–25.1 km/h), SPR (m) (≥ 25.2 km/h), NAc (au) (> 0.5 m/s^2), NAI (au) (> 3 m/s^2), NDAc (au) (≤ 0.5 m/s^2), NDAcH (au) (< 3 m/s^2).	3DP = 3-5-2 or 3-4-1-2; 4DP = 4-4-2 or 4-1-3-2. HIR: CD with 3DP (529) > CD with 4DP (404); WD with 3DP (955) > WD with 4DP (708). NDAcH: CD with 3DP [35] > CD with 4DP (27). TD: WD with 3DP (11,021) > WD with 4DP (10,143). HSR: WD with 3DP (729) > WD with 4DP (505); MD with 3DP (632) > MD with 4DP (525). NAc: WD with 3DP (485) > WD with 4DP (451); MD with 3DP (520) > MD with 4DP (423). NDAc: MD with 3DP (514) > MD with 4DP (470). NAI: MD with 3DP (36) > MD with 4DP (30).
GPS METRICS ACCORDING TO TEAM FORMATION		
Aquino, Vieira, et al. (2017)	TD (m), MRS (km/h), Smean (km/h), HIA (au) (>20,0 km/h)	TD: no difference for the place of the match. MRS: home > away. Smean: home > away. HIA: home > away.
Aquino et al. (2020)	TD (m), Smean (km/h), MRS (km/h) HIA (au) (≥ 19 km/h), NS (au) (≥ 23,01 km/h) distances traveled in: JG (m) (4,91–11 km/h); LIR (m) (11,01–14 km/h); MIR (m) (14,01–19 km/h); HIR (m) (19,01–23 km/h); SPR (m) (≥ 23,01 km/h)	TD: home (9,227.8 ± 1,460.1) > away (8,632.3 ± 1,483.0). Smean: home (5.9 ± 0.9) > away (5.4–0.9). JG: home (3,618.4 ± 705.2) > away (3,343.1 ± 564.9). LIR: home (1,382.4 ± 464.4) > away (1,217.4 ± 427.6). HIR: home (395.6 ± 219.4) > away (316.3 ± 180.4). MRS: home (30.2 ± 3.0) < away (31.5 ± 3.0).
Aquino et al. (2021)	TD (m), HIR (m) (> 18km/h), NS (au) (> 25 km/h), HAD (m) (≥ 3 m/s^2), DDI (m) (≤ –3 m/s^2).	TD: home = WRT (10440.0 ± 1310.0) > PRT (9916.0 ± 1257.5) and away = WRT (10290.0 ± 1567.5) > PRT (9829.5 ± 1123.0). HAD: out = WRT (97.5 ± 29.0) > PRT (88.0 ± 23.0). DDI: home = WRT (105.0 ± 35.0) > PRT for home (98.0 ± 25.7).
Augusto et al. (2021)	TD (m), HIR (m), HIA (au) (18,1–24 km/h), SPR (m), NS (au) (> 24 km/h), NAI (au) (> 2 m/s^2), NDI (au) (>2m/s^2).	TD: away > home.
Augusto et al., (2022)	TD (m); HIR (m) (≥ 19,8 km/h), HAD (m) (≥ 2 m/s^2), DDI (m) (≤ –2m/s^2); moving average for 1, 3 and 5 min. presented by m/min in all variables	HIR: for 1 min = away > home. HAD: for 1 min = away > home. DDI: for 1 min = away > home; for 5 min = away > home in DDI.
Connor et al. (2022)	TD (m) and relative (m/min), moving average for 1,2,3 ... 10 presented in m/min	no significant difference
Díez et al. (2021)	TD (m), MIR (m) (> 14 km/h), HIR (m) (> 19,8 km/h), SPR (m) (> 25,0 km/h), MDN e MAN (2 a 4m/s^2), NDI, NAI (> 4m/s^2).	Playing at Home: TD: loss (11.240 ± 909) > win (10,992 ± 791). NDI: loss (169 ± 321) > win (142 ± 30). SPR: win (152 ± 96) > loss (103 ± 96).
Fereday et al. (2020)	TD (m/min) HIR (> 5.5 m/s) m/min 60s to 600s moving average	no significant difference.
García-Unanue et al. (2018)	TD (m), NAI (> 18 km/h)	TD: away games 2nd half > home games 2nd half, difference of (230.65); home games 1st half > 2nd half, difference of (421.44); away games 1st half > 2nd half, difference of (223.04). NAI: away games 1st half > 2nd half, difference of (2.33).
Gonçalves et al. (2021)	TD (m/min). Based on individual maximum: LIR (m) (0–59,99%),	HIR: home (9.3 ± 3.1) > away (8.4 ± 2.4).
Jerkovic et al. (2022)	TD (m), LIR (m) (< 14,3 km/h), MIR (m) (14,4–19,7 km/h), HIR (m) (> 19,8 km/h), HSR (m) (19,8–25,1 km/h), SPR (m) (> 25,2 km/h).	MIR: away (1392 ± 353) > home (1262 ± 294).

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Table 5. Continuation.

Authors, year	GPS Metrics	Results
Nobari et al. (2022)	TD (m), HIR (m) (18–23 km/h), SPR (m) (> 23 km/h), MRS (km/h), Metabolic load (W/kg). Acceleration zones: Z1 (< 2m/s2), Z2 (2 –4 m/s2), Z3 (> 4m/s2). Deceleration zones: Z1 (–2m/s2), Z2 (–2 to –4m/s2), Z3 (> –4m/s2).	Metabolic load: home (19.2 ± 1.6) > away (18.1 ± 2.3).
Teixeira et al. (2021)	TD (m), Smean (m/min), HIR (19,8–25,1 km/h), NS (> 25,1 km/h), NAc (> 3 m/s²), NDAc (> 3 m/s²)	TD: away (10.91 ± 0.83) < home (10.95 ± 0.81). Smean: away (0.63 ± 0.23) < home (0.66 ± 0.25). HIR: away (68.62 ± 15.23) > home (64.17 ± 20.41). NS: away (88.74 ± 23.48) > home (81.32 ± 23.60). NAc: away (40.32 ± 13.48) < home (42.03 ± 15.33).
GPS METRICS ACCORDING TO OPPONENT LEVEL		
Aquino, Vieira, et al. (2017)	TD (m), MRS (km/h), Smean (km/h), HIA (au) (≥ 20,0 km/h).	MRS: WOP (25.05 ± 4.94) < SOP (27.19 ± 2.69). HIA: WOP (37.63 ± 17.83) < SOP (63.26 ± 26.29).
Aquino et al. (2020)	TD (m), Smean (km/h), MRS (km/h) HIA (au) (≥ 19 km/h), NS (au) (≥ 23,01 km/h) distances traveled in: JG (m) (4,91–11 km/h); LIR (m) (11,01–14 km/h); MIR (m) (14,01–19 km/h); HIR (m) (19,01–23 km/h); SPR (m) (≥ 23,01 km/h)	TD: WOP (9,340.1 ± 1,571.8) > SOP (8,762.1 ± 1,437.9). Smean: WOP (5.9 ± 1.0) > SOP (5.6 ± 0.8). LIR: WOP (1,449.5 ± 490.0) > SOP (1,238.3 ± 423.2). MIR: WOP (1,329.8 ± 572.2) > SOP (1,102.3 ± 435.5). HIR: WOP (413.1 ± 224.1) > SOP (332.5 ± 191.5).
Aquino et al. (2021)	TD (m), HIR (m) (> 18km/h), NS (au) (> 25 km/h), HAD (m) (≥ 3 m/s²), DDI (m) (≤ -3 m/s²)	TD: WRT >PRT versus SOP (10,755.0 ± 1305.0) and AOP (10340.0 ± 1567.5). HAD: WRT > PRT versus SOP (107.5 ± 30.5 ; 88.0 ± 23.5) and SOP > WOP (90.0 ± 37.5) in the WRT. NS: SOP (40.0 ± 16.5) > WOP (29.0 ± 19.5) in the WRT. DDI: WRT > PRT versus SOP (117.0 ± 33.0; 101. 0 ± 26.0).
Augusto et al. (2021)	TD (m), HIR (m), HIA (au) (18,1–24 km/h), SPR (m), NS (au) (> 24 km/h), NAI (au) (> 2 m/s²), NDI (au) (> 2m/s²)	no significant difference
García-Unanue et al. (2018)	TD (m), NAI (> 18Km/h)	TD: Against inferior team (1st half 4585.37 ± 419.77 m) > (2nd half 4294.95 ± 386.32) equal difference (290.42); and against medium level teams (1st half 4775.66 ± 471.73) > (2nd half 4401.21 ± 589.16) difference (-374.56). NAI: against low level teams (1st half 16.37 ± 5.40) > (2nd half 13.17 ± 5.10) difference of (3.19).
Gonçalves et al. (2021)	TD (m/min). Based on individual maximum: HIR (m) (60–100%)	TD: match versus SOP > (93.3 ± 9.3 > 88.5 ± 19.4).
Jerkovic et al. (2022)	TD (m), LIR (m) (< 14,3 km/h), MIR (m) (14,4–19,7 km/h), HIR (m) (> 19,8 km/h), HSR (m) (19,8–25,1 km/h), SPR (m) (> 25,2 km/h).	no significant difference.
Kalapotharakos et al. (2020)	WALK (m) (< 6.9 km/h), JG (m) (7–10.99 km/h), LIR (m) 11–14.99 km/h), HIR (m) (> 19 km/h), MRS (km/h) (14.4–18.99 km/h), NS, TD (m).	TD: against the best, middle and last teams = CD < MD and ST; against the best, middle and last teams = CD < MD and ST; against the best teams: MD > CD, FB and ST HSR: against the best, middle and last teams = C D < MD and ST NS: against the best, middle and last teams = CD < MD and ST
Mitrotasios et al. (2022)	TD (m), Intensity zones: LIR (m) (< 4 m/s), MIR (m) (4–5,5 m/s), HIR (m) (> 5,5 m/s), NAc (> 3 m/s²), NDAc (> 3 m/s²), Acceleration and deceleration zones (n): i. Total. 3–10m/s², ii. 3–4 m/s², iii. 4–5.5 m/s², iv. 5.5–7 m/s², v. 7–10 m/s², vi. Total > 3–10 m/s², MRS (m/s)	TD: Rank 9–16 (10425.1 730.8) > Rank 1–8 (10160 ± 706.4), Z1: Rank 9–16 (8359.8 ± 522.3) > rank 1–8 (8105.5 ± 479.2),

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Table 5. Continuation.

Authors, year	GPS Metrics	Results
Teixeira et al. (2021)	TD (m), Smean (m/min), HIR (19,8–25,1 km/h), NS (> 25,1 km/h), NAc (> 3 m/s²), NDAc (> 3 m/s²)	TD: WN > ST against more qualified opponents NDAc: CD < WM against more qualified opponents.
GPS METRICS ACCORDING TO COMPETITION LEVEL		
Aquino, Vieira, et al. (2017)	TD (m), MRS (km/h), Smean (km/h), HIA (au) (≥ 15,0 km/h).	**TD:** 1°CP (8518.3 ± 1090.2) < 3°CB (9108.2 ± 809.6) and 4°CB (9375.4 ± 1219.5) **MRS:** no difference between competitions **Smean:** 1°CP (4.6 ± 0.6) < 3°CB (5.0 ± 0.6) and 4°CB (4.9 ± 0.7) **HIA:** 1°CP (45.9 ± 23.3) < 3°CB (57.2 ± 24.1) and 4°CB (53.3 ± 32.2)
Fereday et al. (2020)	TD (m/min) HIR (> 5.5 m/s) m/min 60s to 600s moving average	No significant difference
GPS METRICS ACCORDING TO THE COMPETITION PHASE		
Aquino et al. (2020)	TD (m), Smean (km/h), MRS (km/h) HIA (au) (≥ 19 km/h), NS (au) (≥ 23,01 km/h) distances traveled in: JG (m) (4,91–11 km/h); LIR (m) (11,01–14 km/h); MIR (m) (14,01–19 km/h); HIR (m) (19,01–23 km/h); SPR (m) (≥ 23,01 km/h)	No significant difference
Velásquez-González et al. (2023)	NS (> 21 km/h). Distances by intensity ranges: Z4 (21–25 km/h), Z5 (> 25 km/h).	Z5 (m): match 1 (189.90 ± 154.63) > match 2 (127.20 ± 107.36) < match 3 (132.80 ± 71.59) > match 4 (128.50 ± 84.00).
GPS METRICS BY MATCH TIME		
Fereday et al. (2020)	TD (m/min) HIR (> 5.5 m/s) m/min 60s to 600s moving average	HIR: 17:30h > 15:00h.
GPS METRICS BY TRAVEL DISTANCE TO GAME		
Augusto et al. (2021)	TD (m), HIR (m), HIA (au) (18,1–24 km/h), SPR (m), NS (au) (> 24 km/h), NAI (au) (> 2 m/s²), NDI (au) (–2m/s²)	HIR: no distance > long distance. SPR: no distance > long distance.
GPS METRICS ACCORDING TO COACH CHANGE		
Augusto et al. (2021)	TD (m), HIR (m), HIA (au) (18,1–24 km/h), SPR (m), NS (au) (> 24 km/h), NAI (au) (> 2 m/s²), NDI (au) (–2m/s²)	HIR: coach 1 > coach 2. SPR: coach 1 > coach 2. HIA: coach 1 > coach 2. NDI: coach 1 > coach 2.
GPS METRICS ACCORDING TO TRANSITION ACTIVITIES		
Bortnik et al. (2022)	Absolute and relative metrics (m) and (m/min) TD, HIR (>19,8km/h), SPR (>25,2 km/h), NAI+NDI (au; n/min) (>3m/s²)	TD: NT < PT, HP and FA; HP > PT and FA. HIR: FA > NT; HP < PT, FA and NT. SPR: PT > HP, FA and NT; HP < FA and NT. NAI + NDI: PT > FA, NT and HP.
GPS METRICS BY MATCH CONGESTION		
Djaoui et al. (2021)	Absolute (m), relative (m/min) and time spent (s) metrics: TD, LIR (0–10.8 km/h), MIR (> 10.8–19.8 km/h), HIR (> 19.8–25.2 km/h), SPR (< 25.2 km/h), DDB (–1 a < 0 m/s²), DDM (–2 a <–1 m/s²), DDI (–3 a < –2 m/s²), MID (< – 3 m/s²), LAD (> 0 a 1 m/s²), MAD (> 1 a 2 m/s²), HAD (> 2 a 3 m/s²), MIA (> 3 m/s²), TAD (m/s²), TDD (m/s²)	MIR: NCG (37.9 ± 7.67 m/min) > CG (35.5 ± 7.66 m/min). MIA: NCG (84.9 ± 18.5m) > CG (73.2 ± 20.3 m); NCG (0.93 ± 0.20 m/min) > CG (0.80 ± 0.23 m/min); time spent = NCG (39.4 ± 7.68) > CG (33.7 ± 8.20 s) and relative NCG (0.43 ± 0.08) > CG (0.37 ± 0.09 s/min). HAD: NCG (267 ± 37.8) > CG (244 ± 49.5 m); NCG (2.92 ± 0.45) > CG (2.65 ± 0.52 m/min); time spent = NCG (110 ± 14.2) > CG (100 ± 19.0 s) and relative = NCG (1.20 ± 0.16 s/min) > CG (1.09 ±0.19). MID: NCG (1.66 ± 0.43) > CG (1.51 ± 0.49 m/min); time spent = NCG (45.3 ± 10.4) > CG (41.4 ± 12.0 s) and relative = NCG (0.50 ± 0.11) > CG (0.45 ± 0.13 s/min). DDM: NCG (10.4 ± 1.33) > CG (10.0 ± 1.54 m/min). TDD: relative time spent = NCG (32.3 ± 2.53) > CG (31.5 ± 2.80 s/min). TAD: CG (4422 ± 870) > NCG (4116 ± 526 m); CG (47.9 ± 8.72) > NCG (44.9 ± 4.97 m/min). LAD: CG (3891 ± 865) > NCG (3567 ± 507 m); CG (42.1 ± 8.83) > MCG (38.9 ± 4.92 m/min).

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Table 5. Continuation.

Authors, year	GPS Metrics	Results
Jones et al. (2019)	Congestion: G1, G2 and G3. TD (m), LIR (< 4.0 m/s), MIR (4.0–5.5 m/s) and SPR (> 7.0 m/s)	TD: G2 (0–15 min 1,837 ± 235; 15–30 min 1,732 ± 213) > G3 (0–15 min 1,772 ± 236; 15–30 min 1,671 ± 215); G1 (15–30 min 1731 ± 303); G2 (30–45 min 1726 ± 236) > G1 (30–45 min 1653 ± 304); G3 (75–90 min 1496 ± 211) < G2 (75–90 min 1582 ± 236) and G1 (75–90 min 1563 ± 303) LIR: G2 (30–45 min 1395 ± 168) > G1 (30–45 min 1341 ± 208), G3 (75–90 min 1222 ± 155) < G2 (75–90 min 1296 ± 168) and G1 (75–90 min 1274 ± 209). MR: G2 (0–15 min 284 ± 95) > G3 (0–15 min 254 ± 87). SPR: G3 (30–45 min 26 ± 26) > G1 (30–45 min 16 ± 35) and G2 (30–45 min 18 ± 28).
Rhodes et al. (2021)	NAI (au) (> 3 m/s²), MAI (au) (> 3 m/s²), NDI (au) (< 3 m/s²), MDI (au) (< 3 m/s²).	NAI: Midweek games (185 ± 53) > Saturday after a midweek game (151 ± 36), and Saturday that were not preceded by a midweek games (155 ± 26). MDI: Midweek games (365 ± 91) > games on Saturdays after Saturday (305 ± 65).
Vieira et al. (2018)	TD (m) MRS (km/h), Smean (km/h), HIR (au) (HIA: ≥15 km·h⁻¹)	MRS: 2 games/week 4-4-2 (28.97 ± 3.08) > 1 game/week 4-4-2 (27.15 ± 5.3); 2 games/week SOP (28.71 ± 3.17) > 1 game/week SOP (27.99 ± 4.1); 2 games/week Mc (28.49 ± 3.33) > 1 game/week Mc (26.86 ± 4.44). HIR: 2 games/week 4-4-2 (56.36 ± 31.45) > 1 game/week 4-4-2 (40.95 ± 23.66). TD: 2 games/week 4-3-3 (8.898 ± 1.005) < 1 game/week 4-3-3 (9,099 ± 1.228), 2 games/week national games (9,077 ± 933) <1 game/week national games (9,142 ± 1.267); 2 games/week SOP (28.71 ± 3.17) > 1 game/week (27.99 ± 4.1). Smean: 2 games/week 4-3-3 (5.60 ± 0.63) < 1 game/week 4-3-3 (5.72 ± 0.75), 2 games/week state games (5.56 ± 0.76) < 1 game/week state games (5.33 ± 0.7).
GPS METRICS ACCORDING TO STARTING OR SUBSTITUTE PLAYER		
Fereday et al. (2020)	TD (m/min) HIR (> 5.5 m/s) m/min 60s to 600s moving average	**TD:** starting player > substitute player. **HIR:** substitute player > starting player.
GPS METRICS ACCORDING TO THE POINTS NEEDED TO ACHIEVE THE POSITION IN THE RANKINGS		
García-Unanue et al. (2018)	TD (m)	**TD:** 1st half Close to safety position > 1st half Far from safety position (+235.86); 1st half Close to safety position > 2nd half Close to safety position (–294.84) and far from safety position (–435.39).
GPS METRICS ACCORDING TO THE TIME THE BALL WAS IN PLAY AND OUT OF PLAY		
Mernagh et al. (2021)	m/min, TD/min, Acc/min, Dec/min, HMLD/min	**m/min:** total (88.5 ± 13) < Beep (128 ± 15.4); Max Beep 30–60s (195.8 ± 19) > ((Max Beep 60–90s (156.5 ± 17.1) and Max Beep > 90s (143.5 ± 14.9)); Total Def (92.9 ± 6.6) < Beep Def (118.2 ± 11.4) > Def Bop (19.5 ± 7.2) < Def Max Bip (154.9 ± 12.5); Mc total (96.6 ± 10.2) > Mc Bip (140 ± 11.5) > Mc Bop (31.2 ± 5.8) < Mc Max Bip (179.3 ± 9.1); ST total (73.9 ± 9.7) < ST Beep (125.4 ± 15.7) > ST Bop (41.1 ± 9.3) < ST Max Bip (161 ± 15.2); Def Max Beep 30–60s (183.5 ± 15.7) > Def Max Beep 60–90s (144.1 ± 13.9) > Def Max Beep > 90s (136.9 ± 10.6); Mc Max Beep 30–60s (210 ± 9.7) > Mc Max Beep 60–90s (170.9 ± 8.5) > Mc Max Beep > 90s (157.1 ± 10.9); ST Max Beep 30–60s (193.7 ± 21.6) > ST Max Beep 60–90s (154.1 ± 16.7) > ST Max Beep > 90s (135.3 ± 13). **TD/min:** total (8.6 ± 1.9) < Beep (16.9 ± 4.6); Max Beep 30–60 S (76.5 ± 16.1) > ((Max Beep 60–90s (39 ± 16.1) and Max Beep > 90s (22.9 ± 7.7)); Total Def (8.7 ± 1.8) > Beep Def (13.7 ± 4.2) > Def Bop (3.2 ± 1.8) < Def Max Bip (41.5 ± 7.6); 2.8) > Mc Bop (4.9 ± 1.3) < Mc Max Bip (49 ± 7.4); ST total (8.2 ± 2.7) < ST Bip (18.5 ± 5.2) > ST Bop (5.7 ± 2.7) < ST Max Bip (48.2 ± 9.4); Def Max Beep 30–60s (69.3 ± 14.8) > Def Max Beep 60–90s (35.5 ± 9.9) > Def Max Beep > 90s (19.8 ± 6.1); Mc Max Beep 30–60s (84.2 ± 15.7) > Mc Max Beep 60–90s (38.3 ± 5.9) Mc Max Beep > 90s (24.1 ± 6.5); ST Max Beep 30–60s (75.6 ± 16.5) > ST Max Beep 60–90s (44 ± 9.5) > ST Max Beep > 90s (25.2 ± 10.4). **Acc/min:** total (1.1 ± 0.2) < Beep (1.8 ± 0.3); Max Beep 30–60 S (5.8 ± 0.6) > ((Max Beep 60–90s (3.1 ± 0.4) and Max Beep > 90s (2.6 ± 0.6)); Total Def (1.1 ± 0.1) < Beep Def (1.7 ± 0.2) > Def Bop (0.5 ± 0.1) < Def Max Bip (3.7 ± 0.1); Mc total (1.2 ± 0.2) > Mc Bip (2.0 ± 0.2) > Mc Bop (0.6 ± 0.1) < Mc Max Bip (4.1 ± 0.3); ST total (0.9 ± 0.1) < ST Beep (1.6 ± 0.3) > ST Bop (0.8 ± 0.3) < ST Max Beep (3.7 ± 0.5); Def Max Beep 30–60s (5.7 ± 0.5) > Def Max Beep 60–90s (3 ± 0.4) < Def Max Beep > 90s (2.5 ± 0.4); MC Max Beep 30–60s (5.9 ± 0.5) > MC Max Beep 60–90s (3.4 ± 0.3) > MC Max Beep > 90s (3 ± 0.5); ST Max Beep 30–90s (5.6 ± 0.8) > ST Max Beep 60–90s (3 ± 0.4) > ST Max Beep > 90s (2.4 ± 0.5). **Dec/min:** total (0.9 ± 0.2) < Beep (1.6 ± 0.2); Max Beep 30–60 S (5.4 ± 1.0) > ((Max Beep 60–90s (2.9 ± 0.5) and Max Beep > 90s (2.4 ± 0.6)); Total Def (1.0 ± 0.1) < Beep Def (1.5 ± 0.2) > Def Bop (0.5 ± 0.1) < Def Max Bip (3.5 ± 0.4); Mc total (1.0 ± 0.1) < Mc Bip (1.8 ± 0.2) > Mc Bop (0.6 ± 0.2) < Mc Max Bip (3.8 ± 0.1); ST total (0.7 ± 0.1) < ST Beep (1.5 ± 0.2) > ST Bop (0.6 ± 0.2) < ST Max Beep (3.3 ± 0.2); Def Max Beep 30–60s (5.0 ± 0.9) > Def Max Beep 60–90s (3.0 ± 0.6) and Def Max Beep > 90s (2.5 ± 0.4); ST Max Beep 30–60s (5.8 ± 0.6) > ST Max Beep 60–90s (3.2 ± 0.4) and ST Max Beep >90s (2.6 ± 0.5); ST Max Beep 30–60s (5.3 ±1.3) > ST Max Beep 60–90s (2.5 ± 0.4) and ST Max Beep > 90s (2.7 ± 0.8).

Continue...

Table 5. Continuation.

Authors, year	GPS Metrics	Results
Mernagh et al. (2021)	m/min, TD/min, Acc/min, Dec/min, HMLD/min	**HMLD/min:** total (16.3 ± 3.1) < Beep (29.7 ± 6.1); Max Beep 30–60s (83.3 ± 15.7) > ((Max Beep 60–90s (49.5 ± 9.3) and Max Beep > 90s (36.4 ± 8.5)). Total Def (16.1 ± 2.3) < Beep Def (25.3 ± 5.2) > Def Bop (7 ± 2.9) < Def Max Bip (50.6 ± 8.9); Mc total (18.5 ± 2.1) < Mc Bip (34.2 ± 3.8) > Mc Bop (9.8 ± 1.5) < Mc Max Bip (62.3 ± 6.6); ST total (13.8 ± 3.2) < ST Beep (29.5 ± 6.1) > ST Bop (11 ± 3.2) < ST Max Bip (56.2 ± 10.4); Def Max Beep 30–60s (76.4 ± 14.9) > Def Max Beep 60–90s (43 ± 9.4) > Def Max Beep > 90s (32.2 ± 6.4); Mc Max Beep 30–60s (91.6 ± 12) > Mc Max Beep 60–90s (53.6 ± 5.8) > Mc Max Beep > 90s (41. 8 ± 6.8); ST Max Beep 30–60s (81.7 ± 18.3) > ST Max Beep 60–90s (51.8 ± 9.3) > ST Max Beep > 90s (35.1 ± 10.1).
GPS METRICS ACCORDING TO THE FIRST AND SECOND HALF OF THE MATCH		
Caro et al. (2022)	Metrics in (au) and (s) for: HIA (< 19.8km/h), NS (25.2km/h), AccD, Mmin, MetP, HMLD (< 25.5W/kg).	AccD: For number and time = 1st beat > 2nd beat. MetP: For number and time = 1st beat > 2nd beat. Mmin: For number and time = 1st beat > 2nd beat.
Nobari et al. (2021)	TD (m), Smean (m/min), HIR (m) (18–23 km/h), SPR (m) (> 23 km/h), MRS (km/h), BL (au).	TD: 1st half draw (4902.9 ± 748.7) > 2nd half draw (4390.5 ± 741.4). HIR: 1st half win (139.3 ± 59.4) > 2nd half win (108.7 ± 46.0).
Vardakis et al. (2020)	TD (km). Distances by intensity ranges: Z1 (6–11.8 km/h), Z2 (11.9–15.7 km/h), Z3 (15.8–19.7 km/h), Z4 (19.8–24 km/h), Z5 (> 24 km/h).	TD: Total team average (9101 ± 1004). 1st half (4662 ± 510) > 2nd half (4439 ± 567). HIR: Total team average (506 ± 195). 1st half (274 ± 12) > 2nd half (232 ± 104). Z1: All reduced in the 2nd half except MD Z2: All reduced in the 2nd half except ST Z3: All reduced in the 2nd half except CD Z4: All reduced in the 2nd half except ST Z5: No one reduced in the 2nd half, only ST

GPS: global positioning system; MRS: maximal running speed; TD: total distance covered; Smean: mean speed; HIA: high-intensity activities; HSR: high- speed running; Def: defenders; Mc: midfield; CD: central defenders; CM: Central Midfielders; CDM: central defensive midfielders; WA: wide attackers; WD: wide defenders; ST: Attackers; WN: winger; 1° CP: 1st division of the São Paulo championship; 3° CB: 3rd division of the Brazilian championship; 4° CB: 4th division of the Brazilian championship; WOP: weak opponent; SOP: strong opponent; JG: distances covered in "jogging"; LIR: distances covered low intensity running; MIR: distances covered moderate-intensity running; HIR: distances covered high intensity running; SPR: distances covered sprinting; NS: number of sprints; DDI: deceleration distances at high intensity; WRT: well ranked team; PRT: poorly ranked team; AOP: averege opponent; NAI: number of high intensity accelerations; MAI: mean accelerations at high intensity; NDI: number of decelerations at high intensity; MDI: mean decelerations at high intensity; PT: positive transition; NT: negative transition; FA: fast attack; HP: high pressure; AccD: acceleration density; MetP: mean metabolic power; Mmin: meters per minute; HMLD: high metabolic load distance; meanAc/Dc: acceleration/deceleration mean; MDN: moderate deceleration number; MAN: moderate acceleration number; DDM: moderate deceleration distance; MID: maximum intensity of deceleration; TDD: total deceleration distance; MAD: moderate acceleration distance; HAD: high intensity acceleration distances; LAD: low intensity acceleration distance; MIA: maximum intensity of acceleration; TAD: total acceleration distance; NAc: number of accelerations; NDAc: number of decelerations; NCG: not congested; CG: congested; *: formation of the opposing team; G1: one game in a week with > 4 days after the previous game; G2: two games in one week played < 4 days since G1; G3: three games in a week played with < 4 days between each of the previous games; m/min: Total distance (m)/Total minutes (min); HMLD/min: Distance accelerating > 2.5 m s−2 and running > 5.5 m s−1/Total minutes; TD/min: Distance traveled > 5m s−2/Total minutes; Acc/min: speed change > 3 m s−2/Total minutes; Dcc/min: Speed change < −3 m s−2/Total minutes; WM: whole match; Bip: ball in play; Bop: ball out of play; Max Bip: worst case scenario game phases; BL: body load; au: arbitrary units; MDP: maximum demand period; 3DP: three defensive players; 4DP: four defensive players

Central defenders (CD) show variations in performance metrics. Abbott et al. (2018), Aquino, Martins, et al. (2017), Aquino, Vieira, et al. (2017) and Kalapotharakos et al. (2020) show that CD cover shorter distances than other positions, such as midfielders and attackers (ST). For example, Aquino, Martins, et al. (2017) report that CD cover a shorter distance (8256.4 ± 698.8 m) than Wide Defenders (WD) (9670.0 ± 739.5 m), Central Midfielders (9201.6 ± 1141.5 m), and Wide Attackers (WA) (9583.8±1432.8 m). Abbott et al. (2018) show that CD (7.4 ± 0.3 m/s) have lower Maximal Running Speed (MRS) than WD (8.4 ± 0.4 m/s) and WA (8.6 ± 0.4 m/s). However, there are divergences in high-intensity activities. Although most studies agree that CD performs worse on HIA, Caro et al. (2022) report comparable performance to other positions on some acceleration metrics.

Central Defensive Midfielders (CDM) run greater distances. Aquino et al. (2020), Aquino, Martins, et al. (2017), Kalapotharakos et al. (2020), and Fereday et al. (2020) provide evidence of this trend. For example, Aquino et al. (2020) report CDM with a greater total distance (TD) (9,216.1 ± 1,244.6 m) compared to CD (7,525.2 ± 922.2 m) and (8,693.7 ± 1,013.9 m). However, there are divergences in

MRS. Abbott et al. (2018) and Aquino, Martins, et al. (2017) report lower MRS for CDM, whereas Delaney et al. (2018) report relatively high values, suggesting a possible influence of contextual or methodological variables.

WD and ST stand out for high physical demands. Aquino et al. (2020), Aquino, Martins, et al. (2017), Abbott et al. (2018), and Kalapotharakos et al. (2020) corroborate that WD travel long distances and perform many HIA. Aquino, Martins, et al. (2017) indicate that WD have higher TD (9670.0 ± 739.5 m) and HIA (66.0 ± 25.0 units) than CD and ST. However, Djaoui et al. (2021) point to a more balanced distribution, suggesting tactical variations that may affect intensity.

ST covers less distance than CD. Aquino et al. (2020) show that ST with TD (8,693.7 ± 1,013.9 m) is lower than CDM (9,216.1 ± 1,244.6 m) but higher than CD (7,525.2 ± 922.2 m). There are divergences in MRS and acceleration metrics. One study reported ST with higher MRS (Abbott et al., 2018), while another reported mixed results (Mitrotasios et al., 2022), reflecting different playing styles or tactical roles attributed to ST.

GPS metrics according to match result

The studies found a common trend in TD and mean speed (Smean) metrics in relation to match outcomes. Aquino, Vieira, et al. (2017) observed that both Smean and TD were higher in wins and draws compared to losses. Aquino et al. (2020) confirmed this trend, showing that Smean was higher in wins (6.01 ± 0.82 km/h) compared to draws (5.64 ± 0.81 km/h) and losses (5.28 ± 0.92 km/h), and TD was higher in draws (9,019.0 ± 1,310.7 m) and wins (9,295.0 ± 1,458.5 m) than in losses (8,384.3 ± 1,682.5 m).

Fereday et al. (2020) also found that TD and distances covered high-intensity running (HIR) were higher in both wins and losses compared to draws. Gonçalves et al. (2021) observed that TD was higher in wins (93 ± 8.9 m/min) compared to draws (89.2 ± 9.3 m/min) and losses (85.7 ± 15.0 m/min). Kalapotharakos et al. (2020) reported that TD was higher against better and intermediate teams in wins compared to losses, as well as in draws compared to losses. Nobari et al. (2021) found that total training session duration was higher in wins (88.8 ± 11.9 min) compared to draws (84.2 ± 13.7 min). On the other hand, some divergences were observed in the metrics related to HIA and distances covered sprinting (SPR). Aquino, Vieira, et al. (2017) reported that the frequency of HIA was lower in victories (40.72 ± 20.79 au) compared to draws (51.90 ± 16.66 units), contrasting with Aquino et al. (2020), who found that distances covered in "jogging" (JG), low-intensity running (LIR), moderate-intensity running (MIR), HIR, and SPR were higher in victories compared to defeats. Augusto et al. (2021) reported that TD was higher in defeats compared to draws and victories, while SPR were lower in defeats compared to draws.

High Intensity was higher in defeats for 1-minute and 5-minute periods compared to draws, and Cumulative Intensity Distance was higher in victories compared to draws for 5 minutes. Díez et al. (2021) found that SPR was higher in losses (106 ± 44 m) compared to wins (174 ± 74 m) away from home, and the number of decelerations (NDAc) was higher in losses (169 ± 32) compared to wins (142 ± 30) at home. Piñero et al. (2023) reported that the duration (seconds) and distance (meters) of the period of maximum demand were higher in losses compared to wins. Rhodes et al. (2021) found that the number of high-intensity accelerations (NAI) was higher in wins (185 ± 48) compared to draws (146 ± 37) and losses (152 ± 31).

The results indicate significant variation in performance metrics related to the match outcome. In general, victories tend to be associated with higher TD covered, higher Smean and HIA. However, some studies also show that defeats can be associated with higher TD and HIA, suggesting that specific contextual and tactical factors may influence these results.

The discrepancies between studies can be attributed to different methodologies, levels of competition, styles of play and specific contextual variables of each match. Therefore, it is crucial to consider these variables when interpreting the results and applying this information to the training practice and physical preparation of athletes.

GPS metrics according to team formation formation 1-4-4-2 versus 1-4-3-3

The studies by Aquino et al. (2020), Aquino, Martins, et al. (2017), and Fereday et al. (2020) provided insights into the impact of the 1-4-4-2 and 1-4-3-3 formations on performance metrics, revealing both convergences and divergences in conclusions.

Aquino, Martins, et al. (2017) investigated performance in relation to the team's own formations, revealing that TD, Smean, and MRS were lower in the 1-4-4-2 formation compared to the 1-4-3-3. Specifically, the TD in the 1-4-4- 2 formation was 8,537.4 ± 1,251.6 m, while in the 1-4-3-3 formation it was 9,518.0 ± 1,197.1 m.

The MRS was 27.3 ± 4.5 km/h in 1-4-4-2, compared to 29.2 ± 3.7 km/h in 1-4-3-3. The Smean was also lower in 1-4-4-2 (4.6 ± 0.6 km/h) than in 1-4-3-3 (4.9 ± 0.7 km/h).

In addition, the HIA was lower in 1-4-4-2 formation (39.8 ± 22.0 units) compared to 1-4-3-3 (55.6 ± 32.0 units).

Similarly, Aquino et al. (2020) observed that for the own team formation, the TD was higher in the 1-4-4-2 formation (9,575.7 ± 1,320.4 m) than in the 1-4-2-3-1 formation (8,316.8 ± 1,589.4 m). The Smean was (6.0 ± 0.8 km/h) in the 1-4-4-2, compared to (5.2 ± 0.8 km/h) in the 1-4-2-3-1. The 1-4-4-2 formation also resulted in higher JG (3,724.3 ± 699 m), LIR (1,441.5 ± 458.6 meters), MIR (1,326.3 ± 480.1 meters), HIR (417.4 ± 208.4 meters) and SPR (320.0 ± 212.3 meters) compared to the 1-4-2-3-1 formation.

On the other hand, Fereday et al. (2020) found that the 4-1-4-1 formation (which is not a direct comparison with 1-4-4-2 and 1-4-3-3 but may be relevant to understand the context of the formations) presented higher HIR indices compared to the 3-5-2 and 3-4-3 formations. While this suggests that the 4-1-4-1 formation may be associated with greater intensity in terms of HIR, it does not provide a direct comparison with the 1-4-4-2 and 1-4-3-3 formations.

Formation 3-5-2 versus 4-4-2

Modric et al. (2020) compared the 3-5-2 and 4-4-2 formations, focusing on the team's own formation, and found significant differences in intensity metrics. The TD covered was greater in the 3-5-2 formation (11.021 m) compared to the 4-4-2 formation (10.143 m). In addition, the HIR were also greater in the 3-5-2 formation (529 m) than in the 4-4-2 formation (404 m). The 3-5-2 formation showed better results in NAI and the number of decelerations at high intensity (NDI), reflecting an increase in the physical load associated with this formation.

The divergences between the studies can be attributed to different methodologies and tactical contexts analysed. While Aquino et al. (2020) and Aquino, Martins, et al. (2017) reported significant differences in TD and HIA between the 1-4-4-2 and 1- 4-3-3 formations, Modric et al. (2020) found that the 3-5-2 formation may provide greater intensity in some metrics. These discrepancies may reflect variations in game strategies, the level of the opponents, and the playing style of each team.

Analysis of intensity metrics across different tactical formations reveals a complex interplay between team formation and performance variables. In general, the 1-4-4-2 and 1-4-3-3 formations tend to result in higher TD and Smean, while the 3-5-2 formation presents higher HIR and NAc.

These variations highlight the importance of considering both the own and opponents' tactical formations when analysing physical performance and the intensity of players' activities.

GPS metrics according to departure location

Results on TD covered vary across studies. Aquino, Vieira et al. (2017) found that TD covered did not differ significantly based on match venue. However, Aquino et al. (2020) reported that TD was higher at home (9,227.8 ± 1,460.1 m) compared to away (8,632.3 ± 1,483.0 m). Augusto et al. (2021) also indicated higher TD in away matches, while García-Unanue et al. (2018) observed higher TD away during the second half but less difference in the first half.

Aquino, Vieira, et al. (2017) observed that Smean and MRS were higher at home. Aquino et al. (2020) found that Smean was higher at home (5.9 ± 0.9 km/h) than away (5.4 ± 0.9 km/h), and MRS was higher away (31.5 ± 3.0 km/h) compared to home matches (30.2 ± 3.0 km/h). Teixeira et al. (2021) also reported higher Smean at home (0.66 ± 0.25 m/min) compared to away (0.63 ± 0.23 m/min), while Gonçalves et al. (2021) showed that MRS did not differ significantly between venues.

Aquino et al. (2020) and Aquino, Martins, et al. (2017) reported that HIA and HIR were higher at home (39.8 ± 22.0 au and 395.6 ± 219.4 m, respectively) compared to away (55.6 ± 32.0 au and 316.3 ± 180.4 m). Augusto et al. (2021) confirmed higher HIA at home, while Augusto et al. (2022) found that HIR was higher away. Díez et al. (2021) also observed higher HIR away (104.4 ± 47.3 m) than at home (95.7 ± 45.8 m), but Fereday et al. (2020) found no significant differences.

The studies by Aquino et al. (2020) and Teixeira et al. (2021) indicated that the number of sprints (NS) was higher at home (88.74 ± 23.48 au and 40.32 ± 13.48 au, respectively) compared to away (81.32 ± 23.60 au and 42.03 ± 15.33 au). Augusto et al. (2021) also reported higher NS at home, but Augusto et al. (2022) and Connor et al. (2022) found no significant differences.

The analysis of accelerations and decelerations revealed that NAI was higher away from home, as shown by García-Unanue et al. (2018) and Augusto et al. (2022). Deceleration distances at high intensity (DDI) were generally more pronounced away from home, according to Augusto et al. (2022), while Teixeira et al. (2021) indicated that NAc was higher at home.

In summary, the analysis of intensity metrics across match locations demonstrates varying trends. While some studies highlight higher intensity at home, others indicate that away matches may feature greater distances and intensities in certain situations. These variations can be attributed to contextual factors specific to each match, such as the level of the opponent and the physical condition of the team.

GPS metrics according to opponent level

The analysis of intensity metrics as a function of the opponent's level reveals distinct patterns and, in some cases, divergences between studies.

Several studies indicate that the TD covered can vary significantly with the opponent's level. Aquino, Vieira, et al. (2017) observed lower TD against strong opponents (SOP). In contrast, Kalapotharakos et al. (2020) reported lower TD against better teams and higher TD against lower-ranked teams. García-Unanue et al. (2018) corroborated these findings, showing higher TD in the first half against lower-ranked teams.

Smean and MRS also vary with the opponent's level. Aquino et al. (2020) reported higher Smean and MRS against weaker opponents. Teixeira et al. (2021) found an increase in Smean and MRS against SOP, reflecting greater effort.

HIA and NS also vary. Aquino et al. (2020) and Aquino, Vieira, et al. (2017) indicate lower HIA and SPR against SOP. Teixeira et al. (2021) found higher SPR and HIA against less skilled opponents. In contrast, Augusto et al. (2021) found no significant differences, suggesting that intensity may not be uniformly affected by opponent level. Mitrotasios et al. (2022) observed more HIR distance covered against lower-ranked opponents. Jerkovic et al. (2022) found no significant differences, indicating possible variations in methodology or interpretation. Analysis of accelerations and decelerations also reveals variations. Teixeira et al. (2021) and Gonçalves et al. (2021) observed more NAI and NDI against more skilled opponents. In contrast, Mitrotasios et al. (2022) found no significant differences. In summary, the analysis of intensity metrics based on opponent level reveals a significant impact on performance variables. Some studies indicate greater TD, MRS and HIA against lower-level opponents, while others show varying patterns, suggesting the complexity of the interaction between contextual variables and athletes' physical responses.

GPS metrics according to the level of competition

The main convergences between the studies by Aquino, Martins et al. (2017) and Fereday et al. (2020) lie in the finding that the level of competition can influence intensity metrics. Aquino, Vieira, et al. (2017) revealed differences in TD and HIA between divisions: in the 1st Division of the São Paulo Championship, the TD is (8,518.3 ± 1,090.2 m), in the 3rd Division of the Brazilian championship, (9,108.2 ± 809.6 m), and in the 4th Division of the Brazilian Championship, (9,375.4 ± 1219.5 m); HIA in the 1st Division is 45.9 ± 23.3 au, in the 3rd Division is 57.2 ± 24.1 au, and in the 4th Division is 53.3 ± 32.2 au. Fereday et al. (2020), on the other hand, did not find significant variations in these metrics: TD (m/min) and HIR (> 5.5 m/s) did not present significant differences between divisions. The discrepancy can be attributed to different methodologies and approaches in data collection and analysis. Aquino, Martins et al. (2017) focused on a more direct comparison between divisions, while Fereday et al. (2020) used a more general approach.

The style of play and strategies adopted may vary between divisions, affecting physical demand. In lower divisions, where competition may be more intense, greater physical demand is expected in terms of distances covered and HIA.

GPS metrics according to the competition phase

The studies by Aquino et al. (2020) and Velásquez-González et al. (2023) show differences in the influence of the competition phase on intensity metrics. Aquino et al. (2020) found no significant differences in TD and HIA in different competition phases. There were no notable variations in GJ and in the different intensity ranges, including HIR and SPR.

On the other hand, Velásquez-González et al. (2023) identified significant variations in HIR (Z5), with higher values in Game 1 (189.90 ± 154.63 m) compared to Game 2 (127.20 ± 107.36 m), and variations in Games 3 (132.80 ± 71.59 m) and 4 (128.50 ± 84.00 m). These variations indicate that the competition phase can influence the intensity of the activities. Regarding MRS, Aquino et al. (2020) did not observe significant differences between phases, while Velásquez-González et al. (2023) found HIR (Z5), suggesting that the competition phase may affect players' ability to maintain high speeds.

Aquino et al. (2020) reported a stable NS, while Velásquez-González et al. (2023) showed significant variations in HIR Z5, which may correlate with NS. This suggests that the competition phase may affect intensity and NS, even if the absolute number of sprints remains constant.

In summary, Aquino et al. (2020) did not find significant variations, while Velásquez-González et al. (2023) identified variations in HIR, indicating a potentially considerable impact of the competition phase on intensity metrics.

GPS metrics according to game time

In the context of analysing the influence of match time on displacement and intensity parameters obtained through GPS devices in professional football athletes, a significant study was conducted by Fereday et al. (2020). This study analysed the TD covered per minute and HIR (> 5.5 m/s) using moving averages from 60 seconds to 600 seconds.

Fereday et al. (2020) observed that match time significantly influences intensity metrics, particularly HIR. The results indicated that matches played at 5:30 p.m. had higher HIR values compared to matches played at 3:00 p.m. Specifically, high-intensity running was higher during late afternoon matches, suggesting that match time may affect athletes' physical performance.

The results of Fereday et al. (2020) suggest that match time may be a significant contextual variable that should be considered when planning training and recovery strategies. The higher running intensity observed in games at 5:30 p.m. may be associated with several factors, including ambient temperature, pre-game preparation, and athletes' circadian rhythms.

Although Fereday et al. (2020) provide important evidence on the influence of game time on intensity metrics in football, there is a need for further studies to confirm these findings and explore other contextual factors that may interact with game time.

GPS metrics according to travel distance to game

In the context of the influence of travel distance to the game on displacement and intensity parameters, Augusto et al. (2021) found that this distance significantly affects performance. Players covered a greater TD in away games (9,712 m) compared to home games (9,533 m).

SPR was higher in games without long travel times, and fewer high-intensity actions occurred in games with long travel times. Furthermore, there were reductions in NAI and NDI decelerations in games with long travel times.

These findings suggest that long travel times may impair physical performance due to fatigue, circadian rhythm changes, and additional stress. The greater TD in away games may reflect the need to compensate for the disadvantage of not playing at home. The reduction in high-intensity actions and sprints highlights the need for strategies to mitigate the negative effects of travel.

GPS metrics according to coach change

The study by Augusto et al. (2021) analysed the impact of a coaching change on several performance metrics, including TD, HIR, HIA SPR, NS, accelerations, and decelerations.

They observed a reduction in TD covered, HIR, HIA, and SPR after the coaching change. NS, NDI, and NAI also decreased.

These changes can be attributed to contextual factors, such as club culture, the pre-existing relationship between players and the coach, and the competitive situation at the time of the change. The results indicate that coaching change can lead to a reduction in intensity metrics, possibly due to the adaptation period to new methods and strategies.

GPS metrics according to transition activities

The study by Bortnik et al. (2022) analysed how different types of transitions affect parameters such as TD covered, HIR, NS, NDI, and NAI.

The researchers found that negative transitions resulted in higher TD covered than positive transitions, high pressure, and fast attacks, indicating that players covered more ground during defensive recovery phases. Positive transitions also showed more NS than high pressure, fast attacks and negative transitions, reflecting the high physical demands of fast offensive transitions.

In addition, fast attacks showed higher HIR values compared to negative transitions, while high pressure had the lowest HIR values. Positive transitions showed more NAI and NDI than fast attacks, negative transitions, and high pressure, highlighting the need to train rapid changes of speed to improve offensive transitions.

GPS metrics according to game congestion

The analysis of the influence of game weeks on intensity metrics revealed significant findings and divergences.

Djaoui et al. (2021) found that, in non-congested weeks (NCG), MIR was higher (37.9 ± 7.67 m/min) compared to congested weeks (CG) (35.5 ± 7.66 m/min). TD and HIR were higher in NCG, while in CG, these distances were lower. The accumulation of games reduces the ability to maintain high levels of intensity.

Jones et al. (2019) observed that TD covered in the second game (G2) was higher in the first 45 minutes (1,837 ± 235 m) compared to the third game (G3) (1,772 ± 236 m). Despite fatigue, SPR increased during G3 in the 30-45-minute period.

Rhodes et al. (2021) found that midweek games had higher mean accelerations at high intensity (185 ± 53 au) than games on Saturdays after a midweek game (151 ± 36 au) and Saturday games without a previous game in the week (155 ± 26 au). Mean decelerations at high intensity were also higher in midweek games (365 ± 91 units) compared to subsequent Saturdays (305 ± 65 units).

Vieira et al. (2018) observed that in weeks with two games, MRS was higher (28.97 ± 3.08 km/h) compared to weeks with one game (27.15 ± 5.3 km/h). However, TD Walked was lower in weeks with two games (8,898 ± 1,005 m) compared to weeks with one game (9,099 ± 1,228 m). Higher frequency of games may increase intensity at specific efforts but reduce the ability to cover greater distances.

Studies converge on the reduction of intensity metrics and acceleration and deceleration capabilities in congested weeks, but show variations in the maintenance of intensity, with some studies indicating an increase in high-intensity metrics even in congested conditions.

GPS metrics according to starting or substitute player

This segment examines the differences in intensity between starters and substitutes using GPS metrics. Fereday et al. (2020) found that starters cover a higher TD per minute (m/min) compared to substitutes, who in turn perform better in HIA (> 5.5 m/s). These results indicate that while starters engage more in sustained efforts, substitutes contribute more intensity in sprints and fast runs, possibly due to their shorter playing time and greater physical freshness upon entering the field.

The data suggests that starters should focus on endurance and maintaining performance throughout the game, while substitutes should be trained to maximise the intensity of short efforts and have an immediate impact upon introduction.

GPS metrics according to points needed to achieve ranking position

The analysis of the influence of contextual variables on classification position, based on the study by García-Unanue et al. (2018), investigates how factors such as match location and opponent strength affect the physical performance of players in Spain's Segunda Division B. Using GPS devices, the study analysed metrics such as TD covered, HIR, accelerations and SPR.

Players covered significantly greater distances in the first half of matches away from the safety zone (+235.86 m) and in the second half of away games (+230.65 m). In the second half, the difference in distance between games close to and far from safety was (–294.84 m) and (–435.39 m), respectively.

Training should simulate high-pressure conditions and prepare players for away games, focusing on endurance and maintaining physical performance throughout the game, especially in the second half.

GPS metrics according to time of ball in play and out of play

Mernagh et al. (2021) analysed GPS metrics based on ball-in-play (BiP) and out-of-play (BoP) time. The average meters covered per minute (m/min) was higher during BiP (128 ± 15.4) than during the entire game (88.5 ± 13), indicating greater intensity when the ball is in play. Peak physical demands are highest in the first 30–60 seconds (195.8 ± 19) and decrease over time for all players.

High-speed running (HSR/min) is also more intense during BiP (16.9 ± 4.6) compared to the entire game (8.6 ± 1.9), with higher peak demands (76.5 ± 16.1). Accelerations and decelerations occur more frequently during BiP, reflecting greater physical demands during moments of intense play. The high metabolic load distance (HMLD/min) is greater during BiP (29.7 ± 6.1) than during the total game (16.3 ± 3.1), with higher demand peaks (83.3 ± 15.7), indicating greater intensity in these periods.

GPS metrics according to the first and second half of the match

The findings of Caro et al. (2022), Nobari et al. (2021), and Vardakis et al. (2020) align in indicating that game intensity, as measured by various performance metrics, tends to decrease in the second half. Caro et al. (2022) found that NAI, mean metabolic power, and meters per minute were significantly higher in the first half than in the second half. For example, acceleration density was higher in the first half, with mean metabolic power and meters per minute also reflecting greater intensity early in the match.

Nobari et al. (2021) revealed that TD covered was higher in the first half. For draws, the total duration was (44.4 ± 6.5 min) in the first half and (39.8 ± 8.0 min) in the second half. The TD covered was (4,902.9 ± 748.7 m) in the first half and (4,390.5 ± 741.4 m) in the second half. For victories, the HIR was higher in the first half (139.3 ± 59.4 m) compared to the second half (108.7 ± 46.0 m), indicating a reduction in intensity in the second half. Vardakis et al. (2020) observed that the TD covered by the team was (9,101 ± 1004 m), with the first half recording (4,662 ± 510 m) and the second half (4,439 ± 567 m). Furthermore, the HIR was higher in the first half (274 ± 12 m) compared to the second half (232 ± 104 m). Regarding the intensity bands, there was a general reduction in the Z1 (6–11.8 km/h), Z2 (11.9–15.7 km/h), Z3 (15.8–19.7 km/h) and Z4 (19.8–24 km/h) zones in the second half, except for some specific positions, such as the ST and WD in the Z2 and Z4 zones.

However, there are divergences in the magnitudes and specific metrics. For example, while Caro et al. (2022) highlight a decrease in the metrics of acceleration densities, mean metabolic power and meters per minute, Nobari et al. (2021) and Vardakis et al. (2020) provide more detailed data on the decrease in TD covered and HIR, in addition to the variations in the intensity bands (Z1 to Z4). These discrepancies may be the result of differences in the methodologies used.

Additionally, heterogeneity in GPS devices (1–18 Hz) and in speed thresholds for high-intensity running explains part of the divergent findings. Most studies scored 5–7/9 on the Newcastle–Ottawa Scale, reflecting moderate-to-good quality but with some limitations. The absence of female football players and possible publication bias should also be acknowledged. A meta-analysis was not feasible due to heterogeneity of definitions and outcomes across studies. Contextual influences were also interpreted within ecological dynamics and the constraints-led approach framework.

Methodological variation across studies may influence the comparison of results, including differences in GPS technologies and intensity criteria. Furthermore, the inclusion of studies with small sample sizes may limit the generalizability of the findings. Heterogeneity in contextual conditions, such as the level of competition and the tactical style of teams, may also affect the consistency of the data. The lack of longitudinal data prevents a comprehensive assessment of the effects of contextual variables over time. These limitations should be considered when interpreting the results and suggesting the need for further standardised research to validate the findings.

CONCLUSIONS

Contextual variables meaningfully affect GPS-derived match loads. Coaches should consider playing position, match status, venue, and opponent level when planning training and recovery to optimise performance and reduce injury risk.

Player position and match score were found to impact movement intensity, with variations influenced by match congestion and results. Team and opponent formations also influence movement patterns, while factors such as match venue, opponent level, and competition phase determine the required physical intensity.

The analysis of on-field transitions and differences between the first and second halves was crucial for understanding movement dynamics. The results highlight the importance of considering these variables in training planning and periodisation, as well as in developing tactical strategies, aiming at optimising performance and reducing the risk of injury.

Future studies should consider including time played by athletes as an additional variable, as this may provide a more complete understanding of the physical demands in elite football. The variability in influences observed across studies highlights the need to assess the impact of contextual variables, taking into account the specific context of each competitive situation.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

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Magna Leilane da Silva – Resources; Writing – Review & Editing; Submission and Editorial Process Support.

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Tiago de Freitas Damasceno da Rocha – Writing – Review & Editing; Language Editing (English Review).

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