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Tracking and Analyzing Running Distances at Various Speeds Using GPS in Some Home and Away Matches (First and Second Leg) of The Algerian Women's National Soccer League Division1

تتبّع وتحليل مسافات الجري عند سرعات مختلفة باستخدام نظام تحديد المو اقع العالمي (GPS) في بعض مباريات الذهاب والإياب (داخل وخارج الديار) في الر ابطة الوطنية الجز ائرية لكرة القدم النسوية – القسم الأول-

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The Abstract

Background: GPS tracking is an essential tool in soccer performance analysis, providing insights into movement patterns and match demands. Despite its growing use, research on the Algerian Women's National Soccer League Division 1 is still limited. This study aimed to classify and evaluate running distances at various speeds during home and away matches, examining positional differences and tactical implications.

Methods: Eighteen female players from the Constantine Women's Soccer Club participated during the 2023–2024 season. Running distances were categorized into five speed zones: walking (0–8 km/h), jogging (8–14 km/h), moderate running (14–19 km/h), high-speed running (19–24 km/h), and sprinting (>24 km/h). Data were collected over six official matches (three home, three away) using the FieldWiz GPS system (18 Hz). Analyses were performed with SPSS using descriptive statistics and comparative tests to assess home–away variations.

Results: Players covered between 8–11 km per match, with higher distances in home matches. Midfielders and forwards achieved greater high-speed running and sprinting, especially at home. Away matches showed a 5–8% decline in distance, linked to defensive strategies, reduced transitions, and environmental factors. These findings align with existing research, emphasizing the influence of location, tactics, and physical readiness.

Conclusion: GPS tracking provides valuable insights into physical performance and tactical adaptation in women's soccer. Home matches reflected greater offensive intensity, while away games showed more conservative patterns. These results may guide training optimization, conditioning, and tactical decision-making. Further research should explore positional workload and fatigue management in elite women's soccer.

Key words: GPS Tracking, Running Distance, Speed Zones, Women's Soccer, Performance Analysis, Match Demands, Home & Away Matches.

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1. **Introduction and problematic of the study**:

Assessing individual performance in soccer is complex, as it involves a combination of technical, tactical, mantal, and physical factors (Lemoine A, 2005). A player's physical activity during a match varies from one game to another (Carling C, 2016). This variability is influenced by both "situational" factors and "player-related" characteristics, which can impact the performance of competitive athletes (Lago-Penas, 2012). Physical performance is a key factor in soccer, directly impacting a team's overall performance. Assessing the distance covered at varying speeds is essential for enhancing player effectiveness. In this regard GPS technology has become a fundamental tool for tracking movement, offering precise measurements of total distance, speed thresholds, and sprint frequency (Buchheit M, 2017). Such data is instrumental in refining training programs, minimizing injury risks, and improving tactical decision-making (Castellano J, 2011).

In women's soccer, GPS-based performance analysis remains limited, particularly in the **Algerian Women's National Soccer League Division1.** Studies highlight physiological and match-play differences between male and female players, stressing the need for specific research (Pedersen AV, 2019). Additionally, analyzing movement patterns can help manage fatigue-related performance declines observed in elite soccer (Mohr M, 2003). Investigating these aspects in the Algerian women's league will offer valuable insights for player development and coaching strategies.

Despite the growing use of GPS technology in soccer performance analysis, research on the Algerian Women's National Soccer League Division1 remains limited, running distances at different speeds during home matches (first and second leg) are still underexplored, restricting insights into match demands. While GPS tracking is reliable tool for assessing physical performance (Aughey, 2011), (Cummins C, 2013), its application in women's soccer requires further study (Vescovi, 2012). Given the unique physiological demands of female players (Datson N, 2014), this research aims to bridge the gap by analyzing running performance using GPS tracking in selected home matches.

Analyzing running performance in women's soccer is essential for optimizing physical conditioning and tactical strategies. GPS technology provides precise data on movement patterns, enabling coaches to tailor training programs to match specific games demands (Global Performance Insights, 2024). However, research on female players remains limited, particularly in the Algerian league. Given the physiological differences between male and female athletes (Datson N, 2014), it is crucial to investigate how Algerian women's soccer players perform under competitive conditions. This study will contribute valuable insights into match demands, helping coaches enhance player development, manage fatigue, and improve overall team performance.

This study adopts a quantitative research approach, utilizing GPS technology to track running distances at different speeds during selected home matches (first and second leg) in the **Algerian Women's National Soccer League Division1.** Data will be collected from female players using GPS devices to measure total distance covered, speed zones, and sprint frequency. Performance data will be analyzed across matches and player positions to identify trends and variations. Ethical considerations, including player consent and data confidentiality, will be strictly maintained. By applying GPS tracking, this research provides objective insights into match demands, contributing to the optimization of training, recovery strategies, and tactical planning (Player Data, 2025).

- The applied side:

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1. Participants and match samples:

This study was conducted after obtaining official approval, both verbal and written, from the supervisors and the administrative and technical staff of Constantine Sports Club for Women's Soccer, which competes in the **Algerian Women's National Soccer League Division1** for the **2023-2024** season. The study aims to monitor and analyze the distances covered by players at varying speeds using GPS technology in selected official home matches, in order to accurately assess physical performance, contributing to be the improvement of training programs and enhancing physical readiness. The Field Wiz system, operating at 18 Hertz, was utilized, a system whose accuracy and reliability in measuring speeds and distances have been previously validated, with an acceptable error margin (within 5%), according to scientific studies such as **(Beato and al.2018)**, which confirmed the effectiveness of this technology in assessing physical performance in team sports. During matches, each player was equipped with a specially designed vest containing an advanced sensor device positioned on the upper back between the shoulder blades to ensure precise motion data recording. The devices were activated five (05) to ten (10) minutes before each match to ensure proper calibration, with strict criteria set for excluding any incomplete or inaccurate data, following manufacturer recommendations and insights from previous research, such as **(Lozano and al.2020)**. Through this scientific methodology, the study seeks to provide a comprehensive analysis of physical performance during official matches, aiding coaches and specialists in developing training programs based on objective data and refining tactical strategies in line with the demands of competition.

2. Data analysis (manipulation):

The digital data related to player performance was collected using a GPS device and then processed statistically through the Statistical Package for the Social Sciences (SPSS) to ensure an accurate evaluation of the recorded values and their alignment with scientific standards. Each match was analyzed separately based on performance requirements linked to the study variables, with goalkeepers excluded from the analysis. The final sample consisted of 18 players distributed across different positions: Axis defender = 04 players, backhand = 04 players, defensive midfielders = 03 players, attacking midfielders = 03 players, attacking position = 04 players. The analysis was based on data from six (06) official matches (first and second leg) in the Algerian Women's National Soccer League Division 1 for the 2023-2024 season, to assess differences in running distances at various speeds in both settings. This study aims to track and analyze women's player's physical performance using GPS technology, contributing to the development of training strategies and enhancing physical readiness based on the demands of competitive play.

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Table 1. Shows (sample) the list of female players and playing centers

NUMBER:	PLAYER CENTER:
01	Axis Defender
02	Axis Defender
03	Axis Defender
04	Axis Defender
05	Backhand
06	Backhand
07	Backhand
08	Backhand
09	Defensive Midfielders
10	Defensive Midfielders
11	Defensive Midfielders
12	Attacking Midfielders
13	Attacking Midfielders
14	Attacking Midfielders
15	Attacking Position
16	Attacking Position
17	Attacking Position
18	Attacking Position

3. Physical Performance: Running Distances at Various Speeds

The physical performance of players was categorized based on running distances within different speed zones using GPS tracking data. This classification aids in analyzing workload intensity and physical exertion across different playing positions and conditions.

Speed Zone Classification: Running distances were divided into five (05) speed categories, following previous research in soccer performance analysis (Vescovi. 2012, Buchheit and al. 2014, Vescovi. 2019):

1) **Walking (0-8 km/h):** Low-intensity movement primarily for positioning and tactical adjustments.
2) **Jogging (8-14 km/h):** Moderate-intensity running during transitions between attacking and defensive phases.
3) **Moderate-speed running (14-19 km/h):** Controlled running used in build-up play and defensive positioning.
4) **High-speed running (19-24 km/h):** Intense running commonly observed during counterattacks and pressing situations.
5) **Sprint efforts (>24 km/h):** Maximum-speed runs essential for attacking bursts, defensive recovery, and one-on-one duels (Vescovi J. &., 2019).

This classification allows for a detailed assessment of match demands and positional workload, contributing to the development of training strategies and enhancing physical preparedness based on actual competition requirements.

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4. Statistical analysis methods:

In sports performance research, statistical analysis plays a crucial role in evaluating and interpreting data to derive meaningful insights. Descriptive statistics are fundamental in sports performance analysis as they provide a clear summary of the data collected. In this study, descriptive statistics are used to assess running distances at various speeds in (06) official matches (first and second leg) in the Algerian Women's National Soccer League Division 1. Key measures include the **mean** (average distance covered), **standard deviation** (variation in distances), **minimum and maximum** values (range of performance), and **percentiles** (distributing of running efforts among players).

- **Running Distances at Different Speeds in (03) Official Match of the First Leg:**

Table 2. Showing running distances at different speeds in (03) official matches (Mean ± SD)

Position:	Walking (0-8 km/h):	Jogging (8-14 km/h):	Moderate-speed running (14-19 km/h):	High-speed running (19-24 km/h):	Sprinting (>24 km/h):	Total Distance:
Axis Defender (n=4)	2.8 ± 0.3	3.5 ± 0.4	2.2 ± 0.5	1.0 ± 0.3	0.3 ± 0.1	9.8 ± 0.7
Backhand (n=4)	2.6 ± 0.4	4.0 ± 0.3	2.8 ± 0.4	1.5 ± 0.2	0.6 ± 0.2	11.5 ± 0.8
Defensive Mid (n=3)	2.5 ± 0.3	4.2 ± 0.4	3.1 ± 0.5	1.2 ± 0.3	0.4 ± 0.1	11.4 ± 0.6
Attacking Mid (n=3)	2.3 ± 0.4	4.5 ± 0.3	3.5 ± 0.4	1.7 ± 0.2	0.7 ± 0.2	12.7 ± 0.8
Forwards (n=4)	2.1 ± 0.3	3.8 ± 0.4	3.7 ± 0.5	2.0 ± 0.3	0.9 ± 0.2	12.5 ± 0.7

SD: Standard Deviation

- **Running Distances at Different Speeds in (03) Official Match of the Second Leg:**

Table 2. Showing running distances at different speeds in (03) official matches (Mean ± SD)

Position:	Walking (0-8 km/h):	Jogging (8-14 km/h):	Moderate-speed running (14-19 km/h):	High-speed running (19-24 km/h):	Sprinting (>24 km/h):	Total Distance:
Axis Defender (n=4)	3.0 ± 0.4	3.3 ± 0.5	2.0 ± 0.5	0.9 ± 0.2	0.2 ± 0.1	9.4 ± 0.8
Backhand (n=4)	2.7 ± 0.4	3.9 ± 0.3	2.6 ± 0.4	1.4 ± 0.3	0.5 ± 0.2	11.1 ± 0.7
Defensive Mid (n=3)	2.6 ± 0.3	4.0 ± 0.4	2.8 ± 0.5	1.1 ± 0.2	0.3 ± 0.1	10.8 ± 0.6
Attacking Mid (n=3)	2.4 ± 0.4	4.3 ± 0.3	3.2 ± 0.4	1.5 ± 0.2	0.6 ± 0.2	12.0 ± 0.7
Forwards (n=4)	2.2 ± 0.3	3.6 ± 0.4	3.4 ± 0.5	1.8 ± 0.3	0.8 ± 0.2	12.0 ± 0.8

SD: Standard Deviation

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- **The Descriptive Statistics for Running Distances at Different Speeds in all Official Matches of the First and the Second Leg:**

Table 3. Showing running distances at different speeds in (06) official matches (Mean ± SD)

Speed Zone:	Mean (First Leg) ± SD:	Mean (Second Leg) ± SD:
Walking (0-8 km/h):	2.46 ± 0.28 km	2.58 ± 0.31 km
Jogging (8-14 km/h):	3.99 ± 0.42 km	3.82 ± 0.39 km
Moderate-speed running (14-19 km/h):	3.06 ± 0.53 km	2.80 ± 0.49 km
High-speed running (19-24 km/h):	1.48 ± 0.35 km	1.34 ± 0.31 km
Sprinting (>24 km/h):	0.58 ± 0.22 km	0.48 ± 0.21 km

SD: Standard Deviation

- **Discussion and Results:**

Drawing from the statistical data gathered through GPS tracking of player's physical performance, the classification of running distances has been segmented into multiple speed zones. This categorization aids in assessing the intensity and nature of physical exertion during both home and away matches. The analysis of the obtained statistics revealed the following findings:

- Walking Distance (0-8km/h): The distance covered in the walking category ranged between 02-03 km per match, with no significant difference recorded between home and away matches. This movement primarily occurs during set-piece positioning, transitional phases between offensive and defensive situations, and natural pauses in gameplay. These findings align with the study conducted by "Bangsbo & al.2006", which highlighted that walking accounts for approximately 25-30% of the total distance covered during a match, emphasizing its role in player positioning and game rhythm control (Jens Bangsbo, 2006), (Kapelman A E, 2022).

- Jogging Distance (8-14km/h): Players covered a distance of 03 to 05 km per match in the jogging category, with a higher frequency observed in away matches. This suggests an increased reliance on strategic movement and tactical adjustments, particularly in formations that emphasize defensive compactness and rapid transitions between attack and defense. Such movement is essential for maintaining structure, positioning, and coordinated gameplay, particularly among midfielders and defenders. These results align with the study by "Castellano & al.2011", which found that jogging constitutes approximately 35-40% of the total match distance, further highlighting its tactical importance in sustaining team organization and facilitating play transitions (Castellano, 2013), (Okba Selmi, 2017).

- Moderate-Speed Running (14-19 km/h): The average distance covered in this speed zone ranged between 02 to 04 km per match, with a notable decline observed in away matches compared to home games. This running zone is crucial for structured offensive plays and defensive transitions, particularly for midfielders who facilitate link-up play between defensive and attacking units. The reduced distance covered in away matches suggests a more compact and conservative defensive strategy, where teams limit open spaces, restrict passing lanes, and reduce the opponent's offensive advancement. These findings align with the study conducted by "Vescovi & Favero.2014", which highlighted that visiting teams tend to cover less distance in moderate-speed running zones due to environmental factors

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(such as unfamiliar pitch conditions) and tactical adjustments aimed at defensive solidity, depending on match context (Vescovi JD, 2014).

- High-Speed Running (19-24 km/h): Players covered an average distance between 0.5 to 02km per match in the high-speed running category, with higher distances observed during home games. Specifically, there was a 10-15% decline in high-speed running during away matches. This suggests that players exhibit greater offensive strategies, where teams focus on maintaining a compact formation, limiting the opponent's space, and reducing passing lanes. This strategic shift aligns with findings from "Bradly & al.2013", who reported that teams tend to reduce high-speed running during away games to preserve defensive organization (Bradley PS, 2013).

- Sprinting (>24 km/h): Players covered relatively low distances in this speed category, averaging between 0.3 to 0.8 km per match. Attacking players, particularly forwards and wingers, exhibited the highest sprinting is often associated with critical match situations, such as counter-attacks and delivering crosses, underscoring its importance in creating goal-scoring opportunities. This aligns with findings from "Mohr & al.2003", who reported that while sprinting constitutes only about 04-05% of the total distance covered during a match, it plays a pivotal role in decisive moments that can influence the outcome of the game (Mohr M, 2003).

- Women player's covered a total distance ranging between 08-11 km per match, with a noticeable increase in distance covered during the first leg of the competition compared to the second leg, showing an approximate rise of 05-08%. This observation aligns with the findings of "Di Salvo & al.2009", which indicated that players tend to cover greater distances in home matches. This is largely attributed to optimal physical preparedness, as players benefit from reduced travel fatigue, enhanced recovery, and improved psychological readiness, enabling them to perform more efficiently. Additionally, home teams typically adopt a more attack-oriented approach, demanding higher physical output, whereas away matches often involve a more defensive and tactically cautious strategy, leading to lower physical exertion levels (Di Salvo V, 2009), (Ade, 2016).

- **Conclusions:**

This study highlights the physical demands of female soccer players in the Algerian Women's National Soccer League Division 1 by analyzing running distances at various speeds during home and away matches using GPS tracking technology. The results indicate that players cover longer distances and engage in high-intensity activities during home matches, likely due to familiarity with the field and tactical strategies. In contrast, away matches show a noticeable decline in high-speed running and sprinting, reflecting a more conservative defensive approach. Midfielders and defenders focus on maintaining team structure, while attacking players record the highest distances at higher speeds, emphasizing the importance of acceleration and explosive movements in offensive roles. These findings underscore the need for tailored training programs aimed at enhancing endurance, improving sprinting ability, and optimizing recovery strategies to maintain consistent performance across different match settings. Future research should consider additional factors such as game tempo, opponent strength, and physiological adaptations to further refine player performance based on match demands.

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Availability of Data:

The Data, results and outputs of this study are available to researchers and interested parties upon reasonable request, taking into account the ethical controls and confidentiality standards associated with the use of the data. For this purpose, and to obtain an additional copy or other information, a request may be made by contacting the lead authors, providing the purpose of use and also explaining how the data to be collected will be used. The study is committed to providing reference data to enhance scientific transparency and support future studies as stipulated by the Data Protection and Scientific Studies Law.

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