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Recent Trends and Directions in Performance Distribution and Path Management of Soccer Players Using GPS and Wearable Technologies

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Abstract

Purpose: This study reviews recent trends and future directions in performance distribution and path management of soccer players using GPS and wearable technologies. The purpose is to synthesize advances in monitoring movement, workload, and spatial patterns, and to explore implications for training optimization, tactical strategies, and sports science innovation. **Research design, data and methodology:** A literature review was conducted using academic databases and industry reports, focusing on GPS tracking, wearable sensors, and performance analytics in soccer. Studies were categorized into themes: workload distribution, positional path analysis, and injury prevention. This systematic synthesis highlights both technological capabilities and practical applications in elite soccer contexts. **Results:** Findings show that GPS and wearable technologies provide valuable insights into player movement, intensity, and workload distribution. Performance data enhances tactical decision-making, supports individualized training, and reduces injury risk. Emerging studies suggest integration with AI-based models, enabling predictive performance management and real-time adjustments in both professional matches and training. **Conclusions:** The review concludes that GPS and wearable technologies are transforming performance distribution and path management in soccer. However, challenges remain regarding data standardization, privacy, and implementation costs. Future research should focus on integrating advanced analytics, machine learning, and longitudinal monitoring to ensure sustainable adoption and evidence-based decision-making in sports performance.

Keywords : Performance Distribution, Logistics in Sports, Digital Distribution of Performance Analytics, Sports Data Distribution

JEL Classification Code: L83, Z20, C46

1. Introduction

Performance distribution and path management has gained relevance in the realm of physical performance and strategy of soccer players. The augmented use of GPS and wearable technologies have altered how performance of players is tracked and regulated. Lutz et al. (2020) assert that these tools (GPS and wearable technologies) provide real-

time data on distance, speed, and heart rate of players, which are then used in monitoring team and individual performance. This has transformed the manner in which coaches, analysts, and medical staffs are assessing the physical performance of the players, optimization training programs, and injury reduction, since data can be processed in large volumes as Matthias et al. (2020) assert.

The increased application of wearable technology in soccer has yielded to a more in-depth description of the

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physical and tactical contribution of a soccer player in the field of sports. In addition to the unceasing tracking of movements and exertion rates along with recovery rates, nowadays, the data can be collected during the matches and training sessions using heart rate wearable and GPS trackers (Ferraz et al., 2023). These technologies offer the coaches the opportunity to monitor the individual performance of players in real time with the possibility of modifying strategies that may be dependent on the data and not mere intuition. Latino and Tafuri (2024) hypothesized that the technological change has altered the way performance is analyzed and provides a true and more inclusive overview of what a player is capable of.

The purpose of this research is to examine the emerging tendencies of the performance distribution and path management in soccer due to use of GPS and wearable technologies. Through comparing literature and technological advancements in recent years, this study strives to find gaps in existing research and showcasing spheres in which future studies are necessary. The study would also enable understanding of how GPS and wearable technologies have changed soccer taking into consideration their effects on the management of players and the future trends and directions in their use. The inquiry plays a key role in comprehending the current shift in the analytics of sports performance and the opportunities of enhancing the performance of players.

2. Literature Review

The integration of emerging technologies in soccer has remarkably changed the mode of analysis of performance distribution and path management. GPS, wearables technologies, machine learning and real-data visualization have become indispensable in comprehending player movements, workload, and physical condition (Latino & Tafuri, 2024). This section of the study summarizes the four major trends in the integration of these technologies in soccer analytics, their role in player management, injury prevention, and choices on tactics in training and competitive games. The section also identifies the gaps in the existing research and present technologies in soccer to reveal areas where future research is required.

Recent Trends in Performance Distribution and Path Management

2.1. Trend 1: Integration of GPS Data in Soccer Analytics

GPS technology in soccer analytics has led to lasting improvement in tracking player movement and spatial performance. GPS tracking devices fitted in the jerseys or

vests of players allow the coaches to capture varied information about the distance the player covers, sprinting, and field position (Silva, 2024). This information is critical in drawing insights into the workload of the players, spatial orientation, and positions during the match. Indicatively, research such as that by Migliaccio et al. (2024) has revealed that using GPS data assists coaches in modifying player loads in training to maximize physical output and avoid overtraining. Additionally, GPS tracking will allow a team to track the positional information on the field, enabling analysts to research the movements of different players in particular tactical formations. Real-time GPS information can track the performance range, such as whether players are working in their allocated zones (Almulla et al., 2020), which can be used to affect player rotation or replacement in the field.

2.2. Trend 2: The Use of Wearable Devices for Continuous Monitoring

Wearable devices have become an indispensable part of the modern monitoring of soccer performance, with the capability to constantly monitor players' physical conditions. Fatigue, stress, and recovery are miscellaneous conditions that require real-time information, monitors, accelerometers, and motion sensors (Callejas-Cuervo et al., 2023). These gadgets (the wearable devices) facilitate continuous monitoring of a player's physiological condition, decreasing the possibility of suffering injuries. Fatigue and the risk of injuries can be prematurely assessed by continuously measuring the players' heart rate variability (HRV). Moreover, Wearables like the Catapult devices are currently actively employed in professional clubs, such as Manchester City and FC Barcelona, to track player workload and ensure that no players are pushed to unsafe physical limits.

2.3. Trend 3: Machine Learning and AI-Driven Analytics

Machine learning and analytics based on AI are transforming the methods through which soccer teams select players, monitor their injuries, and implement tactics. Analyzing enormous datasets of wearable ornaments, GPS positioning, or videos of matches will enable AI to forecast the result of performance eventualities with significant accuracy (Mohana et al., 2024). For example, AI processes movement patterns and physiological data to indicate the probability of injury or fatigue. A study by Mateus et al. (2024) has suggested that machine learning algorithms can assess the players' load through time, so the teams can know which players are at risk before they get injured. There is also an active application of AI towards tactical analysis, where algorithms are developed to evaluate how effective

players' positions are combined with decision-making and sequences as the game progresses (Ranganathan et al., 2025). The adoption of AI in the performance data analysis of clubs such as Liverpool FC and AS Roma has resulted in the coach making more tactical adjustments based on this data and their approaches to developing the players.

2.4. Trend 4: Real-Time Feedback and Data Visualization

The automation of real-time feedback and data visualization has greatly influenced how coaches and analysts make training and match decisions. Dynamic visualization of the performance data (heat maps, sprint distances, or fatigue) and real-time information informs decision-making (Cossich et al., 2023). A case in point is employing tools like STATSports and SportVU, enabling athletes to present live information regarding their movements, energy expenditure, and position work during a game (Linke et al., 2020). Coaches use the systems to adjust the tactical choices they make during games, based on the transmitted data in real time, and, in this instance, they may be to maximize periodic rotations of players or transition defensive formations (Walid, 2025). The other data visualization issue is that there has been more depth in player interaction and acquisition due to the ability to visually display the identified gaps and connection areas to the player (Chew, 2025). The technological wearable animated by this instant feedback loop has transformed not merely into how the performance can be interpreted but also how decisions can be taken on the fly, as the background of the game in its Harlem pace is a soccer game.

2.5. Research Gap

In contrast to most research conducted in recent times that focuses on the measurable time rates, such as distance, speed, and heart rate, the research that examines how such rates can influence the real-time transformation of the matches has not been implemented (Luiz et al., 2024). The available literature frequently isolates physical performance and how blanket strategies are used in a game, ignoring how wearable technology can guide formation changes, player roles, or on-field tactics (Nobari et al., 2023). The lack of connection constrains the possibilities of a fully functional system that will incorporate performance supervision with active decision-making over the course of matches.

The other area lacks are the long-term implications of keeping up with data on the player level of player growth and injury averters. Most studies have focused on data collections in the short run, frequently in the future of solitary training sessions or games of outcomes (Jimenez & Verhagen, 2025). Nevertheless, little is known about the

long-term effects of using player data on the level of a full season or several seasons. Limited knowledge is available around sustained monitoring benefits in the adjustment of the playing, fatigue, and performance in the long run. Moreover, the close connection between data-driven adjustments and the psychological factors of player management, including motivation, mental exhaustion, and emotional states, is not sufficiently covered by many studies and may be essential to optimal performance.

Finally, although machine learning and AI-driven models appear promising in performance and injury prediction, present studies frequently fail to mention at least most predictors, including psychological stress, environmental factors, or recovery processes (Anwar et al., 2023). However, the existing predictive models do not consider the interactions between mental exhaustion, player mentality, and recovery processes with the socio-technical data (each sample collected using GPS and wearable equipment). This means that future studies should be more holistic in their performance management approach, which combines physiology and psychology to construct predictive instruments of greater precision. Sofyan (2022) confirms that this gap creates an opportunity to conduct a study to combine these technologies and have a deeper understanding of player behaviors, mental states, and overall well-being

Table 1: Supporting Previous Literature to Figure Out the Research Gap.

Main Theme	Previous Resources
The other area lacks are the long-term implications of keeping up with data on the player level of player growth and injury averters. Most studies have focused on data collections in the short run, frequently in the future of solitary training sessions or games of outcomes	Migliaccio et al. (2024), Almulla et al. (2020), Callejas-Cuervo et al. (2023), Mohana et al. (2024), Mateus et al. (2024), Ranganathan et al. (2025), Cossich et al. (2023), Linke et al. (2020), Walid (2025), Chew (2025), Luiz et al. (2024), Nobari et al. (2023), Jimenez and Verhagen (2025), Anwar et al. (2023), Sofyan (2022)

3. Methodology

This study uses a systematic review methodology to uncover, criticize, and synthesize the existing research on the application of GPS and wearable technologies in the performance distribution and path management in soccer. This approach is adopted because it offers a comprehensive understanding of this field's trends, gaps, and prospects. Systematic review allows for a rigorous analysis of the existing literature to ensure that the outcomes received are

justified by high-quality and peer-reviewed sources (Ammirato et al., 2022). The review process considers the principles of transparency and reproducibility; all aspects of the process, including conducting a study selection, extractions, and analysis, are appropriately planned and repeatable.

An effective screening and filtering system was used to ensure that the extracted studies were pertinent and that they met the PRISMA (Preferred Reporting Items to Systematic Reviews and Meta-Analyses) criteria (O'Dea et al., 2021). Articles were also not considered when they were not directly related to soccer or when the use of wearable technology in analyzing soccer was not conducted (Mousavinasab et al., 2020). The first search incorporated numerous articles; after selecting inclusion/exclusion criteria, a final list of studies was obtained based on their relevance to the research questions and methodological rigor.

The data sources implicated in the review were collected in quality academic databases like PubMed, Scopus, Google Scholar, and Web of Science. These databases saw hundreds of peer-reviewed journal articles and conference papers (Gusenbauer, 2024; Kim & Kang, 2022). The chosen journals mainly dealt with sports science, technology, biomechanics, and performance analysis. This ensured that the studies incorporated in the review were of quality and of importance, so that there was a strong contribution in the analysis of trends and future directions in the utilization of GPS and wearable technologies in soccer.

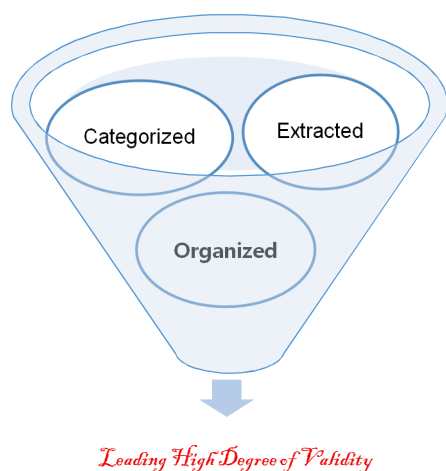


Figure 1: Data Screening Procedure

4. Findings

4.1. Future Direction 1: Further Integration of AI for Real-Time Decision-Making in Player Management

Integrating artificial intelligence (AI) into real-time play

decisions is one of the brightest perspectives behind soccer's performance distribution and path management. AI is entering the field of soccer analytics and is playing a prominent role, mainly when predicting players and player fatigue (Xu & Baghaei, 2025). Its potential in in-game decision-making is nevertheless underdeveloped. GPS-based and wearable data, and other sensors, can give coaches and analysts too much information about a game in real-time. This data could be immediately synthesized with the help of AI, providing actionable changes that will be effective after implementing tactical changes, which could suggest substitutions or changing formations according to the positioning of the players, or the tactics should be used to take advantage of the weaknesses of the opposing side.

For example, AI may use real-time player location and workload to understand the players' position and load and then give feedback to the coaches on when to replace the players without causing fatigue or overwork. Manchester City is one of the teams that have already researched applying AI to inform tactical choices, although much of this tool remains in its post-game review role. The real potential of the future is the creation of systems that can affect the decisions in the match (Rana & Mittal, 2021). The fusing of machine learning with live match data would allow soccer teams to be more active in their approach to performance management of players and real-time adjustment of tactics.

4.2. Future Direction 2: Enhanced Injury Prevention and Recovery Programs Using Predictive Analytics

Prevention of injuries is one of the most important parts where GPS and wearable technology can leave a permanent footprint in soccer. In the current systems, monitoring of player movement and workload is already an option, and much could be developed on predictive analytics so that injuries before they strike can be predicted (Kovoor et al., 2024; Mishra et al., 2024). The injury prevention algorithms could be actualized on-the-fly and fabricated on multiple pointers, including players' heart rate, recovery rates, and even sleep habits. These systems may warn coaches and medical personnel about the increased risk levels of players, so that they may adapt exercises or propose new recovery plans suitable to the needs of the individual as asserted by Gascón et al. (2025).

GPS and wearables to track the recovery stages (How well the players recover after exertion) have already begun bearing fruit in injury reduction. In the future, predictive data, combined with recovery information and performance information, may provide more accurate guidance. Dudek et al. (2025) note that advanced wearables are already used by clubs such as Juventus and Bayern Munich, although the opportunity exists to develop these systems, which can detect injuries earlier and promote quicker healing.

4.3. Future Direction 3: Improvements in Accuracy and Granularity of GPS Data Through New Sensor Technologies

Whilst GPS technology has found its way into the analysis of player performance in soccer, a significant difficulty that has been posed, particularly in high-intensity games such as soccer, is the accuracy and detail of the data. Generally, GPS is not as effective in measuring movements of smaller size and precision (Wu et al., 2025), which is the case with the overall distance that cameras can cover and their speed. Emerging sensor technologies would yield far higher quality information, such as the ability to tell where a player is moving, within a tight area, and how rapidly to turn (Kim & Kang, 2023).

Sensors Technological advances in sensor design, such as ultra-wideband (UWB) sensors or with multi-sensor implementation of methods, have much more promising data. For example, UWB technology can become centimeter-precise, and a device like this would be invaluable at acquiring future insights about players' movement (Tiberi & Ghavami, 2022). Moreover, the multi-dimensional system (which would be based on GPS data and supplemented with other sensor technologies, including inertial measurement units (IMUs), magnetometers, and gyroscopes) might detect not only linear movements but also rotational movements, jumps, or accelerations with even more accuracy (Che et al., 2023).

4.4. Future Direction 4: Personalized Player Development Strategies Based on Continuous Data Feedback

The best opportunities will involve the creation of individual player development strategies because wearable technology and GPS systems are maturing. Regularly delivering the data can help coaches and analysts establish a player's physical characteristics and needs and ground it on the training regimens and performance goals (Zhao et al., 2020). A case in point can be through tracking the metrics such as speed, stamina, and agility, and together with information on a specific player, such as history of injuries and rate of recovery, the technology can be used to create a differentiated training program to address the skills and constraints of a particular player. The capability to follow and constantly trace the program of a player to gain the most optimal way out of it is the future of its formation, the practice of player development. This can be comprised of different intensity rates, working on specific areas that the players require work on, such as speed endurance or the tactical position, or alternating drills based on fatigue/recovery of a player (Chen, 2022; Kang & Kim, 2023).

5. Implications

Implications of both GPS and wearable technology in the sphere of soccer analytics are addressed to coaches, managers, and performance analysts. According to the findings of the study in question, specified technologies can be involved in the field of player management, performance enhancement, and enhancement of tactical decision-making in a variety of ways (Zadeh et al., 2020). The practitioners will obtain insight information on player fitness, workload, and injury prevention through direct data and statistics. This information practice is redefining the training process, the competition process and the decision-making process of teams during training sessions and on the field.

In the scenario of coaches and managers, since wearable devices will enable them to track the physical state of players, they can make improved decisions on how to rotate or sub the players, and how they can give them a certain amount of work (Rebelo et al., 2023). With the help of GPS, say, coaches can ensure that players will not have to strain themselves too hard, which abolishes the risk of the fatigue associated with the injuries on the playground. Using wearable device data, performance analysts can be used to recognize movement and workload trends correlating with the past injury history of their origin. Upon this system exposing such patterns, the staff or even coaching teams involved in each sport are able to take appropriate actions such as alerting medical staff to make scheduling modifications on training, tone down processes or even deploy rest plans to limit the probability of occurrence of injuries.

Moreover, applying AI-based analytics can transform the understanding of tactics. With performance information and the dynamics of the game, AI could offer a representative of the optimal mode of the team structure, the position of the players, and ideal tactics in a game. Specifically, the AI systems may examine the topography and the number of players on the field during the initial half of a game and make possible alterations to the tactics in the second half to take advantage of the weaknesses of the opposing team. Feedback of the real-time data can help coaches to take tactical decisions grounded by the performance indicators of individual players as opposed to any intuition or previous performances (Hribernik et al., 2022). Based on findings of this research, the application of GPS and wearable technology in training and performance analysis of soccer clubs is also appropriate accordingly, and one of them is as follows. First, it is crucial that teams apply the concept of holistic approach, which is the course of wearable technologies being integrated with other performance analysis tools. This can be seen in that GPS data must be added to the video analysis and physiological outputs in order to provide a global view of the player performance.

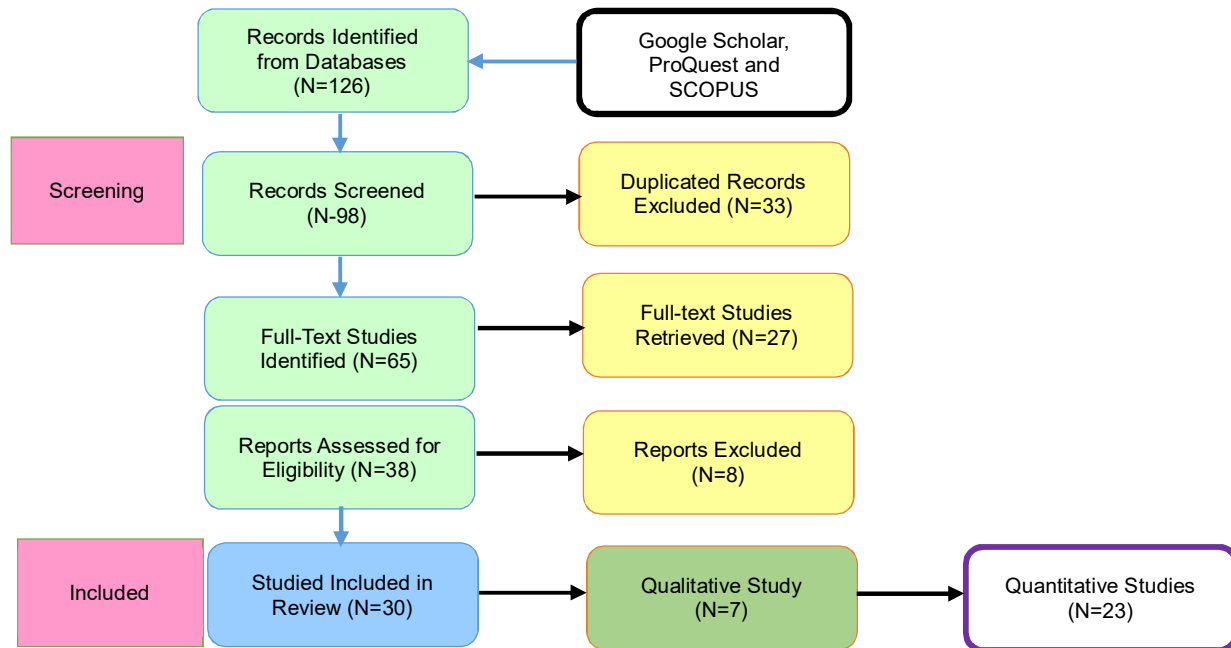


Figure 2: PRISMA Statement of the Research

This multipolar approach, according to Seckin et al. (2023), helps coaches to understand the physical performance of the players and their tactics, location and overall worth towards the machinery of the team.

Second, the teams are advised to invest in incredibly advanced AI-based predictive analytics tools, to be able to better predict player workload and injury risk. This software should be in a position to process data in real-time and should therefore serve feedback that must be reported to coaching and medical females.

By implementing machine learning programs in their theory, teams can predict future health problems or poor performance and take actions in advance. Such systems to be incorporated into daily training regime would minimize risks of overstretching of players leading to incidence of injuries and maximization of performance during a season.

A second important suggestion involves developing a player-specific training program depending on the information collected through wearables. The physical traits, the speed at which each player recovers, and fitness to take place, and this must be captured in the personal training plan (Hao & Qian, 2024). GPS and wearable technologies would be able to give information on each player’s movement pattern, fatigue and recovery requirement so that coaches could design training sessions based on individual need of the respective players. Training programs should also be personalized especially to elite players as some might need varying degrees of intensity based on position, age, injury history, and playing style of the elite player.

Finally, one more thing that must be considered in terms of regular assessment and improvement of data analytics approaches by the teams is related to ongoing evaluation of the effectiveness of the applies being implemented. Due to the development of GPS and wearables, it is vital that the teams stay abreast of the most recent developments and utilize the latest tools that have the potential to enhance the quality and precision of data (Zhang & Guo, 2025). Ongoing research into the advancement of sensor technologies, machine learning systems, and data visualization systems should also increase player performance and tactical decisions.

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