

Rethinking Athletic Assessment: Advances in Sports Performance Research and Methodology

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Abstract

Sports performance analysis has become a cornerstone of evidence-based practice in modern sport, integrating insights from technical, tactical, physical, and psychological domains to inform coaching decisions, optimize training, and enhance competitive outcomes. Once reliant on manual observational and notational methods, the field has been transformed by rapid technological advances, including video-based systems, wearable sensors, GPS tracking, motion capture, and artificial intelligence (AI)-powered analytics. These innovations now enable the capture, processing, and interpretation of vast, real-time performance datasets, yielding more objective, precise, and actionable insights. This study traces the evolution of sports performance analysis from traditional manual techniques to contemporary data-driven paradigm.

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I. Introduction

The traditional ways of coaching, training and selecting players have gone through significant transformation. From basic handwritten logs, tapes, scales, stopwatches to application of sophisticated wearable devices, video recordings, high resolution cameras, Machine Learning (ML) and Artificial Intelligence (AI), performance measurement in sports have experienced vast changes. The integration of these latest innovations techniques, statistical tools and huge volume of data have ushered in a major turning point in sports technology and this popularity reached maximum heights after the success of the pioneering book “Moneyball: The Art of Winning an Unfair Game” of Michael Lewis in the year 2003. The book mentions the unexpected rise of a Major League Baseball team named ‘Oakland Athletics’ which applied data-based decisions in scouting talents, creating a balanced team and training the players. This ultimately enabled Oakland Athletics to win 20 consecutive matches in the 2002 season in spite of their severe budgetary constraints. This strategy proved that statistical analysis can help in optimization of sports performance and gain competitive edge sparking a broader analytical revolution across various sports. The introduction of early video analysis provided groundbreaking insights into athletes' movements, allowing coaches to refine techniques with unprecedented precision. Furthermore, the advent of heart rate monitors and early biomechanical sensors marked the initial transition toward data-driven decision-making in athletic training. Building upon this statistical foundation, modern coaching has embraced highly advanced digital systems. Today's coaches utilize artificial intelligence (AI), wearable devices, machine learning algorithms, and virtual and augmented reality. These cutting-edge technologies deliver real-time performance tracking, critical injury prevention insights, and highly personalized skill acquisition strategies. By leveraging data analytics, coaches can provide individualized training plans and better evaluate key performance metrics.

The significance of sports analytics is reflected in its surging market value. A report published by Fortune Business Insights² states that the global sports analytics market is projected to grow to 9.64 billion by 2030 from an estimated 3.05 billion in 2025, expanding at a compound annual growth rate (CAGR) of 25.7%. This explosive growth is fuelled by the convergence of several key technologies viz, Artificial Intelligence (AI), Machine Learning (ML), Wearable Technology, Inertial Measurement Units (IMUs) etc. Wearable Technology provide real-time, data-driven insights into key physiological, biomechanical, and cognitive metrics, ranging from smartwatches to sensor-embedded clothing. They have become a cornerstone of modern athletic training by enabling precise monitoring of training loads, recovery, and performance optimization. The market for these devices alone is projected to be expanded from USD 94.17 billion in 2025 to USD 115.57 billion by 2030. Artificial Intelligence (AI) and Machine Learning are no longer futuristic concepts rather these are emerging as important tools for interpreting the vast datasets generated by modern wearables and tracking systems. These

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² <https://www.fortunebusinessinsights.com/sports-analytics-market-102217>

technologies enable the creation of deep learning models that can find complex, non-linear relationships between performance, workload, and contextual variables, moving beyond simple statistical analysis. Inertial Measurement Units provide high-resolution data on athlete movement, allowing for a detailed quantification of external load beyond traditional time-motion analysis. This technology is proving invaluable in sports like soccer, basketball, rugby, etc for analysing, quantifying physical demands, and monitoring high-impact events (Sang, 2025).

The application of these technologies and methodologies is driving significant advancements across multiple critical areas. Injury prevention & risk management is one of the areas where there is a huge scope for analytical research. Historically, predicting injuries has been a major challenge. However, recent studies have shown significant progress in this direction. Machine learning models are now being used to forecast injuries with increasing accuracy. A study in professional rugby union has shown the application of Deep Learning models for the analysis of player data and predicting training readiness and injury risk and thereby paving the way for transformative injury prevention strategies (Duffuler et. al., 2025). Researchers have even proposed novel frameworks using graph neural networks and cross-sport transfer learning to predict injury risks, demonstrating the potential to generalize insights across different sports. Analytics now permeates every stage of the player recruitment cycle (de la Torre et al., 2022). The use of video and data analysis is now a crucial tool for identifying hidden talent using external datasets and for performance profiling to quantify a player's strengths and weaknesses (Frost, Groom & Nichols, 2025). Emerging platforms are enabling young athletes to build data-backed CVs, helping scouts discover talent that might otherwise go unnoticed. Advanced metrics are currently applied for redefining how to measure the in-game performance. Sapio-temporal analytics has become one of the foundational exercises in the sport of football. Bandara et al. (2026) have proposed a novel method using fractal analysis to quantify a team's offensive spatial complexity through fractal analysis of ball movement trajectories. The study found a positive relationship between higher spatial complexity and match success, demonstrating that the process of play can be a better performance indicator than the final score. Gui (2026) has introduced a new reinforcement learning (RL) algorithm to optimize athlete training strategies and enhance training regimens. According to Alkasasbeh et al. (2026), the integration of AI and wearables supports a "human-in-the-loop" framework, where these systems act as advanced decision-support tools. This allows for more individualized training prescription, improved workload regulation, and early identification of maladaptive patterns, contributing to more adaptive and sustainable athlete management strategies

In the discipline of sports science and athletic administration, sports performance analysis is defined as the objective assessment of actual sporting performance, typically focusing on the tactical, technical, and physical behaviours of athletes and teams (O'Donoghue, 2009). While traditional scouting relied strictly on subjective observation, modern performance analytics combines statistical models, computational processing, and biomechanical tracking to uncover patterns that guide decision-making (Gomez-Ruano et al., 2020). The evaluation of athletic performance is a fundamental aspect of sports performance analysis, enabling coaches, sport scientists, and athletes to understand strengths, identify weaknesses, and develop evidence-based strategies for improvement. Broadly, performance evaluation can be classified into quantitative and qualitative approaches. While quantitative evaluation focuses on measurable and objective indicators, qualitative evaluation emphasizes the interpretation of behaviours, decision-making processes, and contextual factors that influence performance. Together, these approaches provide a comprehensive understanding of athletic performance. Quantitative evaluation involves the collection and analysis of numerical data related to an athlete's performance. It relies on objective measurements that can be statistically analysed, compared over time, and benchmarked against competitors or performance standards. In sports, quantitative data are commonly obtained through notational analysis, wearable technologies, motion-tracking systems, physiological assessments, and biomechanical measurements. Examples include distance covered during a match, sprint speed and acceleration, heart rate and oxygen consumption, number of successful passes, shots, or tackles, jump height and reaction time, strength, endurance, and flexibility measurements etc. The primary advantage of quantitative evaluation is its objectivity and reliability. Numerical indicators allow coaches and analysts to monitor performance trends, evaluate training effectiveness, and identify performance determinants. Advanced statistical techniques, machine learning algorithms, and predictive models further enhance the ability to extract meaningful insights from large datasets. For example, in football, metrics such as pass completion rate, expected goals, real sense assistance for converting goals. In athletics, race times, split times, and biomechanical parameters help evaluate technical efficiency and physical preparedness. Despite its strengths, quantitative analysis may not fully capture the contextual and psychological aspects of performance. Numbers alone cannot always explain why a particular action occurred or how situational factors influenced decision-making. Qualitative evaluation focuses on the descriptive and interpretive aspects of performance. It seeks to understand how athletes perform specific actions, make decisions, interact with teammates, and respond to competitive situations. Methods commonly used in qualitative evaluation include systematic observation, video analysis, expert coach assessments, athlete interviews and reflections, focus groups, behavioural coding and thematic analysis etc. Qualitative approaches are particularly useful for assessing technical execution, tactical awareness, communication patterns, leadership qualities, motivation, and

psychological resilience. For instance, a basketball coach may evaluate an athlete's court vision, positioning, and decision-making under pressure—elements that are difficult to quantify accurately. Video-based performance analysis has become an important qualitative tool, allowing analysts to examine movement patterns, tactical structures, and situational behaviours in detail. Such evaluations help identify subtle technical deficiencies and tactical opportunities that may not be evident through numerical metrics alone. A key strength of qualitative evaluation is its ability to capture context. It provides insights into the reasons behind performance outcomes and facilitates a deeper understanding of athlete behaviour. However, qualitative assessments can be influenced by observer bias and may vary depending on the evaluator's expertise and interpretation.

II. Objectives of Performance Analysis in Sports

Performance analysis in sports is the systematic observation, tracking, and evaluation of athletic events to replace subjective guesswork with objective data. Its primary objective is to enhance coaching and athlete development by providing evidence-based insights into technique, tactics, and movement patterns. Some of the objectives of performance analysis are highly focused on actionable outcomes viz., replacing subjectivity with facts, enhancing technical execution, developing Tactics and Strategy, real-time decision making, tracking and profiling progress.

III. Research Methodologies in Sports Performance Analysis

3.1 Quantitative Approaches

Quantitative methodology serves as the bedrock of sports performance analysis, offering empirical data points necessary to uncover objective patterns of athletic performance, technical proficiency, and tactical efficacy (O'Donoghue, 2009). By eliminating the subjectivity inherent in traditional coaching intuition, quantitative paradigms leverage discrete parameters to categorize and evaluate performance outcomes.

3.1.1 Experimental Studies

Experimental designs in performance analysis establish definitive causal relationships by introducing controlled interventions to monitor isolated performance adaptations. In these configurations, independent variables such as specific training regimes, nutritional variables, or technological modifiers are manipulated to measure their corresponding impact on dependent performance indicators e.g., physiological thresholds, velocity metrics, or technical success rates. The primary structural advantage of experimental methodology resides in its unparalleled internal validity, achieved through systematic participant randomization and rigorous external environmental controls.

3.1.2 Observational Studies

Unlike experimental designs, observational studies prioritize ecological validity by systematically recording, coding, and quantifying athletic behaviours within their organic competitive contexts, entirely free from researcher intervention (Chacón-Moscoso et al., 2018). These studies translate complex, flowing game events into robust empirical frameworks by utilizing pre-determined notation systems. In contemporary performance analytics, observational frameworks are heavily optimized by software integrations such as Sequential Data Interchange Standard (SDIS) and Generalized Sequential Querier (GSEQ) for behaviour sequential mapping or HOISAN for behavioural observation of social interaction system analysis (Chacón-Moscoso et al., 2018). This infrastructure allows researchers to chart spatial-temporal patterns, such as technical proficiency variations in table tennis or the precise success rates of specific shot selections under variable competitive pressure.

3.1.3 Longitudinal Studies

Longitudinal studies track identified performance variables across an extended temporal continuum to evaluate chronic adaptations, developmental trajectories, and fatigue-recovery cycles. While cross-sectional research takes a single snapshot of performance, longitudinal monitoring tracks athletes across full competitive seasons or multi-year Olympic quadrennials. This perspective is vital for determining the long-term efficacy of systemic physical training, psychological resilience modifiers and injury prevention protocols. By observing the trajectory of data points over months or years, performance analysts can isolate cyclical performance troughs from true performance regression.

3.2 Qualitative Approaches

While quantitative approaches reveal what has happened in the field, qualitative studies are necessary to understand why and how those events are materialized (Hoeber & Shaw, 2017). Embracing qualitative approaches facilitate in the cognitive processes, tactical decisions and emotional behaviours which influence the sports performance of athletes.

3.2.1 Coach Interviews

Semi-structured interviews with elite coaching staff serve as a vital mechanism for contextualizing sports performance strategies and decision-making matrices. Because tactical configurations cannot be fully understood from raw numbers alone, direct dialogue offers access to deep strategic intents, game-plan variations, and the specific pedagogical cues used during competitive pressure (Iván-Baragaño et al., 2023). These qualitative interviews are usually recorded ad verbatim, transcribed, and evaluated through inductive or deductive content analyses (Whipple et al., 2019). This process systematically uncovers dominant tactical concepts, talent identification parameters, and the nuanced dynamics governing the coach-athlete relationship.

3.2.2 Athlete Feedback

Capturing the self-reported subjective experiences of athletes bridges the gap between pure mechanical output and actual phenomenological execution. Through post-match descriptive reflections, focus groups, and structured journals, athlete feedback reveals individual cognitive loads, situational anxieties, and perceived barriers to peak performance.

3.2.3 Tactical evaluation

Qualitative tactical evaluation studies game footage, spatial positioning, and team systems as integrated, meaningful units rather than isolated, independent metrics. This approach treats matches as complex, evolving systems where play actions depend heavily on the opponent's counter-movements.

3.3 Mixed-methods research

Mixed-methods research purposefully integrates both quantitative data patterns and qualitative contextual insights within a single study design (Bakhsh et al., 2024). This approach moves beyond simply adding the two methodologies together. Instead, it aims for deep synthesis to generate richer and more robust information. Depending on the primary aims of the study, researchers apply either concurrent designs or sequential designs. In mixed method research forwarded by Iván-Baragaño et al. (2023), GPS data has been used to track an elite team's physical outputs, while integrating qualitative coach and player interviews to explain how tactical changes caused those physical shifts.

3.3.1 Reliability and Validity Assessment

To ensure data from notation and tracking systems is robust and scientifically accurate, researchers must execute strict reliability and validity assessments (O'Donoghue, 2009). Without these controls, human observation errors can corrupt performance datasets, rendering the research findings invalid. Inter-observer reliability measures the degree of consistency and agreement between two or more independent coders evaluating the exact same performance sequence (Sim & Wright, 2005). Establishing high inter-observer consistency is critical whenever multiple analysts split coding duties across a large competitive tournament. To test this, coders independently analyse a randomly selected sample of match videos using identical operational definitions. High alignment across their completed datasets confirms that the behavioural coding criteria are clear and robust, rather than dependent on an individual observer's bias.

Intra-observer reliability is used for gauging the consistency in measurement of a single observer across different instants of time (Sim and Wright, 2005). This acts as a method of testing whether any observer takes the help of operational definitions without falling victim to fatigue or cognitive drift. For this, an observer recodes a section of the performance related data and again compares the new performance data file against their original log. High consistency over time ensures the integrity of the data across the entire study timeline.

3.3.2 Cohen's Kappa

For nominal and categorical performance data (such as identifying shot types or specific pass locations), raw percent agreement is often misleading because it fails to account for agreements occurring purely by chance (Sim & Wright, 2005). To resolve this, sports performance research relies on Cohen's Kappa (κ), which calculates true agreement using the following formula:

$$\kappa = \frac{P_0 - P_e}{1 - P_e}$$

where P_0 represents the proportion of observed agreement between observers and P_e is the proportion of agreement expected entirely by chance (Sim & Wright, 2005). The resulting values scale from -1.0 to +1.0 where 1.0 indicates perfect agreement and 0 indicates agreement no better than chance (Sim & Wright, 2005). In performance analysis systems, researchers typically aim for a Kappa threshold of $\kappa \geq 0.60$ for weighted data and $\kappa \geq 0.75$ for nominal categories to confirm strong, reliable coding systems.

3.4 Measurement error analysis

All computerized tracking architectures, GPS units, and human observation processes carry inherent measurement errors. Performance analysis requires systematic error quantification to separate true performance changes from baseline technical noise. This is achieved by calculating metrics such as the standard error of measurement, the coefficient of variation (cv), and using Bland-Altman plots to establish Limits of Agreement. Quantifying these error boundaries ensures that when an analyst reports an increase in an athlete's sprint velocity or tactical coverage area, it represents a genuine performance improvement rather than a standard measurement hiccup.

IV. Technological advances in sports performance analysis

Technological innovations have reshaped the field of sports performance analysis from predominantly observational domain into one which uses data to draw precise, objective and actionable insights. Advances in big data technologies, video analytics, wearable sensors, AI and ML are enabling sports managers, coaches and analysts to monitor players in unprecedented detail. These technological advancements have benefited the collection, analysis, interpretation of large volumes of performance data and thus enhancing decision-making, training optimization, injury prevention, and competitive success.

4.1 Video Tracking Systems

Video Tracking system represents one of the earliest and most widely adopted technologies in the study of sports performance data. These systems use cameras positioned around training venues or competition arenas to record athlete movements and game events. Modern video tracking platforms use computer vision algorithms to automatically identify and track players, officials, and objects such as balls or pucks throughout a match.

4.2 Motion capture technologies

Motion capture methods collect biomedical data after recording body movements in three-dimensional space. Traditional motion capture systems utilize reflective markers attached to an athlete's body, which are detected by multiple infrared cameras to reconstruct precise movement patterns. With the help of Computer Vision and Artificial Intelligence, marker less motion capture systems capture body movement and are acting as alternatives to physical suits, reflective markers or sensors. Motion capture systems enable the measurement of joint angles, limb trajectories, movement velocities, and biomechanical efficiency. These data are particularly valuable in sports requiring highly refined technical skills, such as athletics, swimming, gymnastics, tennis, and golf. Coaches and bio mechanists use motion capture analyses to identify technical deficiencies, optimize movement mechanics, and reduce injury risks associated with improper movement patterns. The integration of motion capture with biomechanical modelling has further expanded its applications, enabling detailed assessments of kinetic and kinematic variables that were previously difficult to quantify.

4.3 Wearable technologies and sensors

Global Positioning System (GPS) technology has become an essential tool for monitoring athlete movement during training and competition, particularly in outdoor sports. GPS devices worn by athletes provide continuous measurements of position, speed, acceleration, deceleration, distance covered, and movement intensity. In team sports such as football, rugby, hockey, and cricket, GPS tracking helps coaches evaluate external workload and physical demands. Performance staff can monitor training loads, assess fatigue levels, and design individualized conditioning programs based on objective movement data. GPS-derived metrics also facilitate tactical evaluations by revealing positional behaviours and movement patterns during competition. Advancements in satellite connectivity and sampling frequencies have significantly improved the accuracy and reliability of GPS systems, making them indispensable components of modern sports science programs.

4.4 Accelerometers and inertial measurement units

The use of accelerometers and inertial measurement units (IMUs) is a compliment to GPS technology since they capture data on motion which cannot be adequately recorded using only GPS systems. Specifically, accelerometers record linear acceleration in different planes while IMUs incorporate accelerometers, gyroscopes and magnetometers to measure linear acceleration, angular velocity, orientation and rotation. Such sensors provide useful data on explosive actions including jumping, sprinting, cutting, tackling and directional change. Moreover, IMUs are capable of collecting indoor data and thus useful in the analysis of sports where GPS systems do not have enough coverage including basketball, volleyball, and indoor track and field. IMUs are currently being applied in biomechanical analysis, skill assessment, workload and rehabilitation monitoring.

4.5 Heart-rate and physiological monitoring devices

Technological advancements allow the collection of information on the internal response of athletes during physical activity. Specifically, the use of heart-rate monitor represents one of the most popular wearable technologies allowing the evaluation of physiological response to training. Currently, the physiological monitoring systems provide a number of measures which can be used for the analysis of athlete's state during training. They include heart rate variability (HRV), blood oxygen saturation, respiratory rate, body temperature, sweat composition and even the quality of sleep. All these parameters can be used by coaches and sport scientists to assess athlete's recovery level, adaptation to training, fatigue and readiness to perform.

4.6 Artificial Intelligence and Machine Learning

4.6.1 Pattern recognition

In turn, artificial intelligence and machine learning allow the emergence of pattern recognition. Pattern recognition algorithms are capable of identifying behavioural patterns and attributes based on analysis of video materials, tracking and physiological data. Thus, machine learning algorithms can detect patterns of tactical formation in team games, technical errors in movements and correlations between different training parameters and game outcomes. All these opportunities open new doors for coaches and analysts to obtain insights about players' performance impossible to receive through regular analysis techniques. Pattern recognition assists in scouting opponents due to detection of their strategic patterns and prediction of possible tactical moves.

4.6.2 Performance prediction

Prediction of performance is another useful application of artificial intelligence and machine learning. The prediction models work with historical and current data to predict future performance, training results, probability of injury and winning. Machine learning models analyse multiple variables, such as physiological parameters, biomechanics, workload, environmental and match statistics. In turn, they assist coaches to make more informed decisions concerning athlete selection, training program, game tactics and recovery. Despite the constant improvement of prediction accuracy, researchers emphasize the importance of models' interpretability and domain knowledge to ensure applicability in practice.

4.6.3 Automated event detection

Automated event detection involves computer vision and deep learning to identify and classify sports events without human intervention. With the help of such system, it is possible to recognize automatically passes, shots, tackles, goals, serves and other sport-specific events without manual annotation of videos. Automated event detection system saves a lot of time and efforts required for performance analysis and provides almost instant feedback. Such systems are crucial for elite sports due to its ability to influence competition result through rapid tactical adjustment and decision making. Automated event detection is expected to improve continuously with the development of deep learning models.

4.7 Big data and cloud computing

The proliferation of wearable sensors, tracking systems, video technologies, and physiological monitoring devices has generated vast amounts of athlete data. Big data technologies provide the infrastructure necessary to store, process, and analyse these large and diverse datasets efficiently. Cloud-based platforms enable centralized data management by integrating information from multiple sources into unified databases. This integration facilitates longitudinal athlete monitoring, multidimensional performance assessment, and collaborative analysis among coaches, sports scientists, medical personnel, and performance analysts. The ability to manage and analyse large-scale datasets supports evidence-based decision-making and contributes to a more comprehensive understanding of athlete development and performance.

4.8 Real-time analytics and decision support systems

Cloud computing has enabled the development of real-time analytics systems that process performance data as it is generated. These systems provide immediate feedback during training sessions and competitions, allowing coaches and support staff to make timely adjustments. Decision support systems integrate data from multiple sources viz., video tracking, GPS devices, physiological monitors, and AI models for getting actionable recommendations. Examples include identifying fatigue-related performance declines, suggesting tactical modifications, optimizing player substitutions, and monitoring injury risk indicators. The increasing adoption of edge computing, cloud infrastructure, and AI-driven analytics is expected to further enhance the speed, accuracy, and accessibility of real-time performance insights. Consequently, sports organizations are moving toward fully integrated digital ecosystems that support continuous athlete monitoring and evidence-based performance optimization.

V. Challenges and limitations

Despite its immense potential, the field of performance analytics is not without its challenges. Data privacy concerns issue, accuracy limitations of some devices, high implementation costs, etc along with and the need for transparent and explainable AI algorithms remain significant barriers to widespread adoption (Singh et al. 2025). Furthermore, the predictive accuracy of models is highly dependent on data quality, proper validation, and the expertise of the practitioner interpreting the results (Alkawasbeh et. al. 2026). As sports involve dynamic phenomenon and thus capturing high-stakes human behaviour captured under diverse conditions is a difficult endeavour. A player's tracking data is often influenced by the strategies and tactics of the rival team, weather conditions, match status and venue (whether home or away ground). Unscrambling the actual performance of a player from the situational response is exceptionally difficult. Also, the wearable devices, optical tracking systems etc. are also not free from calibration errors. A minor change or flaw of a few centimetres or milliseconds can extremely influence performance metrics like peak acceleration or ball-tracking trajectories. Moreover, traditional metrics are not always perfect as sometimes these metrics fail to capture off-the-ball movement, defensive positioning etc. It is observed that performance data are sometimes insufficient to quantify a player's mental fatigue, decision-making under intense pressure, leadership, or communication on the field. Also, another hurdle in the adoption of advanced performance metrics is to manage the resistance offered by the seasoned professionals who are accustomed to the traditional practices. Therefore, it is crucial to strive for maintaining a balance between application of these tools with the human experiences including trust, mentorship and interpersonal connections.

VI. Conclusions

Ultimately, the evolution of the sports performance analytics emphasizes a distinct shift from traditional observation-oriented discipline to an objective data-driven discipline. As we look toward the future, major trends will include the deeper integration of AI-enabled platforms, the increasing use of real-time player tracking and metrics, and a continued focus on injury risk prediction and prevention. However, the future of the field is dependent on the fine balancing between computational power and tactical context and ethical safeguards. Thus, the most successful sports performance frameworks will not look to replace human intuition, but rather seamlessly integrate advanced data tools to safely, transparently, and holistically elevate human potential.

References

- [1]. Alkawasbeh, W. J., Amawi, A. T., Grivas, G. V., Orhan, B. E., & Alawamleh, T. (2026). Artificial intelligence and wearables in sport: performance, injury risk, and wellbeing. *Frontiers in Artificial Intelligence*, 9, 1838507.
- [2]. Bakhsh, J. T., Robertson, J., & Rowe, K. (2024). Mixed methods in sport management: A review and directions for future research. *Sport Management Review*, 27(5), 682–703. <https://doi.org/10.1080/14413523.2024.2347004>
- [3]. Bandara, I., Shelyag, S., Rajasegarar, S. et al. Fractal Ball Movement Complexity: Spatiotemporal Analysis for Team Performance Evaluation in Association Football. *SN COMPUT. SCI.* 7, 326 (2026). <https://doi.org/10.1007/s42979-026-04878-w>
- [4]. Chacón-Moscoso, S., Sanduvete-Chaves, S., Anguera, M. T., Losada, J. L., Portell, M., & Lozano-Lozano, J. A. (2018). Preliminary checklist for reporting observational studies in sports areas: Content validity. *Frontiers in Psychology*, 9, Article 291. <https://doi.org/10.3389/fpsyg.2018.00291>
- [5]. de la Rubia, A., & Marquina Nieto, M. (2026). Special Issue: Sports Performance: Data Measurement, Analysis and Improvement. *Applied Sciences*, 16(5), 2460. <https://doi.org/10.3390/app16052460>
- [6]. de la Torre, R., Calvet, L. O., Lopez-Lopez, D., Juan, A. A., & Hatami, S. (2022). Business analytics in sport talent acquisition: methods, experiences, and open research opportunities. *International Journal of Business Analytics (IJBAN)*, 9(1), 1-20.
- [7]. Duffler, M., Bourgain, M., Haddad, Z., Heraud, R., Blanchard, S., and Rouch, P. (2025). Recurrent Neural Networks model for injury prevention within a professional rugby union club: a proof of concept over one season. *Clinical Biomechanics*, 106600.
- [8]. Frost, W., Groom, R., and Nicholls, S. B. (2025). The use of performance analysis and data driven approaches within senior men's football recruitment. *International Journal of Sports Science & Coaching*, 20(2), pp. 604-616.
- [9]. Gomez-Ruano, M. A., Ibáñez, S. J., and Leicht, A. S. (2020). Performance analysis in sport. *Frontiers in psychology*, 11, 611634.
- [10]. Gui, Y. (2026). A novel reinforcement learning approach for athlete training optimization using DQ-NAS. *Discover Artificial Intelligence*. <https://doi.org/10.1007/s44163-026-01439-1>
- [11]. Hoerber, L., and Shaw, S. (2017). Contemporary qualitative research methods in sport management. *Sport Management Review*, 20(1), 4–7. <https://doi.org/10.1016/j.smr.2016.11.005>
- [12]. Iván-Baragaño, I., Ardá, A., Anguera, M. T., Losada, J. L., & Maneiro, R. (2023). Future horizons in the analysis of technical-tactical performance in women's football: A mixed methods approach to the analysis of in-depth interviews with professional coaches and players. *Frontiers in Psychology*, 14, Article 1128549. <https://doi.org/10.3389/fpsyg.2023.1128549>
- [13]. O'Donoghue, P. (2009). *Research methods for sports performance analysis*. Routledge. <https://doi.org/10.4324/9780203878309>
- [14]. Sang, S (2025). Evaluating team sport performance: a review of inertial sensor technologies and their applications. *Sensor Review*, Vol. 46 No. 2 pp. 259–278, doi: <https://doi.org/10.1108/SR-07-2025-0477>
- [15]. Sim, J., and Wright, C. C. (2005). The kappa statistic in reliability studies: Use, interpretation, and sample size requirements. *Physical Therapy*, 85(3), 257–268. <https://doi.org/10.1093/ptj/85.3.257>
- [16]. Singh, S. A., Singh, A. J., & Devi, L. S. (2025). Revolutionizing sports: The impact of next-generation wearable technology. *Journal of Medical Society*, 39(1), 9–14. https://doi.org/10.4103/jms.jms_147_24
- [17]. The Business Research Company. (2026, February). *Sports Analytics Market Report 2026*. Research and Markets. <https://www.researchandmarkets.com/reports/5767409/sports-analytics-market-report>
- [18]. Whipple, M. O., Schorr, E. N., Talley, K. M. C., Lindquist, R., Bronas, U. G., & Treat-Jacobson, D. (2019). A mixed methods study of perceived barriers to physical activity, geriatric syndromes, and physical activity levels among older adults with peripheral artery disease and diabetes. *Journal of Vascular Nursing*, 37(2), 91–105. <https://doi.org/10.1016/j.jvn.2019.02.001>