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The Role of AI-based Smart Systems in Developing a Health and Sports Decision-Support System

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ABSTRACT: This study aimed to identify the role of AI-based smart systems in developing a health-and-sports decision-support system within sports organizations by examining the level of use of these systems and their role in improving the quality of health and sports decision-making, enhancing the integration between health and training aspects, and supporting health prevention and managing the risk of sports injuries. A descriptive survey approach was used due to its suitability for the study's nature and objectives. The study population consisted of health and sports professionals within sports organizations, including sports coaches, sports medicine specialists, physical therapists and rehabilitation specialists, athletes, and administrators at sports organizations and clubs. The study sample consisted of 67 individuals selected through purposive sampling due to their direct connection to the field of study and their experience in using smart systems or participating in health and sports decision-making. To achieve the study's objectives, the researcher developed a questionnaire consisting of five main themes: the current state of smart system usage; their role in improving the quality of health-and-sports decision-making; the integration of health and training aspects; support for health prevention and injury risk management; and challenges and barriers. The validity and reliability of the instrument were verified using appropriate scientific methods, and the data were analyzed using SPSS software to calculate means, standard deviations, and relative importance. The study results showed that the level of use of smart systems in the health and sports sector was moderate. These systems also moderately contribute to improving the quality of health and sports-related decision-making, enhancing the integration of health and training aspects, and supporting health prevention and management of sports injury risks. The results also revealed that data privacy concerns, a shortage of qualified personnel, weak technical infrastructure, and high costs are the most significant challenges facing the use of smart systems.

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In light of these findings, the study recommended promoting the use of smart systems within sports organizations, developing technical infrastructure, training specialized personnel, enhancing the integration of health and training aspects, establishing clear policies to protect athletes' data, and conducting further studies on AI applications in health–sports.

INTRODUCTION

Over the past decades of the 20th century, the major technological revolution in the field of information technology has driven fundamental and rapid transformations in information systems. This led to the emergence of innovative applications and modern standards in the design of these systems, which are considered contemporary fields stemming from computer science, aimed at studying and simulating the nature of human intelligence, with the goal of creating a new generation of intelligent technologies capable of performing a vast number of complex tasks that require advanced levels of reasoning and cognition. Today, AI has become a pivotal element in accelerating processes and improving their efficiency by providing accurate and effective solutions compared to traditional methods. (Al-Jubouri and Abdullah, 2025)

Intelligent systems contribute to processing massive amounts of data in a short time and analyzing it using advanced algorithms that enable prediction-based recommendation derivation. This qualitative transformation has opened up broad horizons for societies to enhance their growth and development paths, prompting many countries to adopt strategies and mechanisms aimed at developing specialized scientific expertise and building local capacity in this field. As a result, AI has become an essential partner in driving progress across various vital sectors, such as healthcare, industry, education, and sports. (Al-Harbi, 2022)

The impact of AI has been directly reflected in these vital sectors, where it is now used to diagnose diseases with greater accuracy than some experts, predicting market behavior, monitoring industrial production, and analyzing behavioral patterns.It has also made a strong entry into the field of sports—including kinesiology and sports injuries—thanks to its ability to instantly process big data by monitoring performance, predicting injuries, and optimizing training. AI technologies are particularly valuable in training and competitive environments that require precise and rapid decisions to improve athletes' performance and expand their capabilities (Panch et al., 2019).

In this context, AI-based intelligent systems have emerged as one of the most significant paradigm shifts in sports medicine management due to their ability to collect and analyze physiological, physical, and behavioral data in a systematic and organized manner, This development has also contributed to a paradigm shift from a reactive decision-making model—which responds only after a problem has occurred—to a proactive model based on predicting potential risks, early intervention, and knowledge-based planning, thereby enhancing the protection of athletes' health and the sustainability of their performance. (Musat, 2024)

Decision support systems are one of the fundamental pillars of this transformation, as they provide the framework that links raw data to effective health and sports-related decisions. These systems do not merely present information; they organize it, analyze the relationships between data points, and offer well-considered alternatives that help decision-makers choose the most appropriate course of action. These systems are particularly important in the health and sports field due to the sensitivity of decisions related to training load management, recovery periods, safe return to activity after injury, and assessment of physical readiness, as any misjudgment may lead to long-term health consequences. (Shapiro & Malone, 2021).

With the rapid advancement of AI technologies, decision-support systems have become increasingly capable of self-learning and adapting to individual differences among athletes. Athletes are no longer viewed as a generalizable model but as specific cases with their own unique health, physical, and psychological characteristics. These systems also help analyze recurring patterns in performance and vital signs and link them to the training and health context, thereby enhancing the accuracy of decisions and reducing the reliance on imprecise general estimates. (Bufraj, Abraqat, and Issa, 2024).

The use of smart systems has also contributed to enhancing the integration between health and sports aspects by unifying various data sources within a single system that encompasses medical, training, psychological, and physical aspects. This integration also helps improve communication between coaches, sports medicine specialists, and administrators and provides a comprehensive view of the athlete's overall condition, thereby supporting the development of more consistent and effective training and treatment plans, which reduces conflicting or duplicative decisions within the sports system. (Kovacs et al., 2021)

The importance of smart systems extends beyond the technical aspect to the human dimension of decision-making. By providing objective, data-driven analyses, they help reduce human biases resulting from stress, differing levels of expertise, and conflicting viewpoints. This approach ensures that decisions are guided by the athlete's long-term well-being and health, rather than focusing on immediate results that may come at the expense of their physical or psychological safety. (Al-Jubouri and Abdullah, 2025)

Intelligent systems also play a pivotal role in managing the uncertainty that characterizes the health and sports field, where decisions are often made with incomplete information or under changing circumstances. By analyzing the complex relationships between various variables and presenting multiple scenarios that support the selection of the safest and most appropriate alternatives for each athletic situation, AI-based decision support systems help reduce this uncertainty. (Al-Otaibi et al., 2024)

Therefore, the adoption of intelligent systems to support health and sports decision-making is a fundamental step toward achieving sustainability in modern sports practices, as they contribute to maintaining athletes' health, reducing recurrent injuries, and improving human and medical resource allocation efficiency. These systems also support the development of an institutional culture based on scientific planning and knowledge-based decision-making, which positively impacts the quality of sports healthcare, performance levels, and the continuity of athletic excellence at various levels. (Al-Harbi, Fahd bin Saad, 2022)

Therefore, the role of AI-based smart systems in developing a sports health decision-support system—as a scientific and organizational approach that contributes to improving the quality of decisions, promoting health prevention, and enhancing athletic performance in complex and constantly changing environments—must be studied to keep pace with the demands of modern sports practice and lay the foundation for a new era based on analysis, integration, and proactive vision.

RESEARCH PROBLEM:

The health-sports field is witnessing a remarkable expansion in the use of digital technologies and smart systems; however, this expansion is not always accompanied by the effective and systematic application of these technologies within decision-support systems related to athletes' health and performance, as many health and sports-related decisions are still made partly by relying on individual expertise or momentary assessments without fully leveraging the analytical capabilities provided by AI-based smart systems. (López-Valenciano et al., 2018)

Thus, a gap exists between the increasing availability of health and physical data on the one hand and the ability to transform this data into practical knowledge that supports decision-making on the other. Despite the abundance of information generated by medical examinations, physical tests, and modern monitoring technologies, the absence of an integrated decision-support system limits the ability to utilize it comprehensively and leads to decisions that may lack accuracy, especially in situations requiring a careful balance between athletic performance requirements and maintaining the athlete's health.

Furthermore, the limited integration between health and training aspects within many sports environments leads to conflicting decisions or the absence of a unified view of the athlete's overall condition, which contributes to an increased risk of recurrent injuries, poor management of training loads, and delays in recovery or a safe return to athletic activity.

This problem is further complicated by the significant individual differences among athletes in terms of response to training loads, susceptibility to injury, and physical and psychological readiness, as reliance on general models or standardized decisions does not adequately account for these differences. In the absence of intelligent decision-support systems capable of learning and adapting to individual characteristics, decisions remain complex due to changing circumstances and information gaps, which negatively impact the quality of sports healthcare and performance sustainability.

This is where the research problem arises, stemming from the challenges associated with managing health risks in competitive sports environments, where there is significant pressure to achieve rapid success, sometimes at the expense of the athlete's long-term health. Competitive or administrative considerations may override health considerations in the absence of smart tools that support objective decision-making, thereby increasing the likelihood of chronic injuries or gradual health deterioration.

Understanding and analyzing the role of AI-based smart systems in developing a health-and-sports decision-support system—one that ensures data integration, improves decision quality, and reduces health risks—leading to a more efficient and humane model for managing athletes' health and performance within complex and ever-changing sports environments.

SIGNIFICANCE OF THE RESEARCH

First: Theoretical significance

1. This research contributes to deepening the scientific understanding of the role of AI-based smart systems within the health-sports field by addressing them as integrated decision-support systems, rather than merely as supporting technical tools, thereby strengthening the modern theoretical framework of sports and health sciences.
2. This study clarifies the interactive relationship between the concepts of AI and decision-support systems in the health and sports context, thereby bridging the knowledge gap between technical and sports sciences and providing a more comprehensive scientific framework for understanding decision-making mechanisms in this field.
3. This study highlights the scientific shift from traditional decision-making patterns to more analytical and proactive ones by illustrating how intelligent systems can be used to predict health risks and analyze performance, thereby supporting the development of modern theoretical models in health and sports performance management.
4. This research opens scientific horizons for future interdisciplinary studies by highlighting the potential of AI in injury prevention, training load management, and improving physical readiness, thereby reinforcing the integrative research approach in sports science.

Second: Practical significance

1. This research helps professionals in the health and sports sector improve the quality of decisions regarding athletes' health and performance by clarifying how to leverage smart systems to analyze data and make more accurate and consistent decisions in practical settings.
2. It contributes to supporting preventive practices within sports organizations by highlighting the role of smart systems in predicting health risks and reducing the likelihood of recurrent injuries, which positively impacts athletes' safety and athletic participation continuity.
3. It reinforces the concept of integration between health and training aspects by highlighting the importance of a unified decision-support system, which improves coordination and communication between coaches and health specialists and reduces conflicting decisions within the sports system.
4. It contributes to improving the efficiency of health and sports resource management by guiding training and therapeutic efforts and programs based on scientific data analysis, which supports sustainability and enhances the effectiveness of sports sector institutional performance.

Research Objectives:

The objective of this research is to identify the following:

1. The role of artificial intelligence-based smart systems in developing a health-sports decision support system and improving the quality of decisions related to athletes' health and performance.
2. The role of smart systems in promoting the integration of health and training aspects within the sports ecosystem, thereby supporting the consistency of decisions made.
3. The extent to which AI-based smart systems contribute to health prevention and risk management associated with sports injuries within various sports environments.

Research Questions:

1. What is the role of artificial intelligence-based smart systems in developing a health-sports decision support system and improving the quality of decisions related to athletes' health and performance?
2. How do smart systems contribute to enhancing the integration of health and training aspects within the sports system in a way that supports the consistency of decisions made?

3. To what extent can artificial intelligence-based smart systems support health prevention and risk management associated with sports injuries within various sports environments?

Search Terms:

- **Artificial Intelligence**: Defined as the set of technologies and algorithms that enable intelligent systems to simulate certain patterns of human thinking, such as analysis, prediction, and learning, and to apply them to support health and sports-related decision-making. (Bird et al., 2020)
- **Intelligent systems:** These refer to digital systems based on artificial intelligence technologies that are capable of collecting and analyzing data and learning from past experiences and data to more accurately, effectively, and flexibly support the decision-making process. (IBM, 2025)
- **Health and Sports Decision Support System:** This refers to an integrated framework that collects and analyzes the health, physical, and training data of athletes to help coaches, health professionals, and decision-makers make informed decisions regarding their health and performance. (Sallis et al., 2016)

Research Limitations:

- **Time Scope**: This research was conducted from February 5, 2024, to April 25, 2025.
- **Geographic scope**: Sports clubs, health and sports centers, and institutions involved in athlete care in the Hashemite Kingdom of Jordan.

coaches**ion**: This study was limited to a sample of coaches, health specialists, sports science experts, and administrators working in sports institutions, as well as athletes, who are at the center of the health-sports decision-making system.

PREVIOUS STUDIES

In recent years, there has been a marked increase in interest in artificial intelligence systems in the field of sports, with numerous studies examining their role in improving performance, preventing injuries, and supporting decision-making. In this context, the study "" by Baladaniya & Choudhary (2025) examined AI in sports science from a comprehensive perspective, focusing on its ability to process large amounts of physical and biometric data and convert it into accurate indicators that support training and health decisions. It also highlighted the importance of predictive analysis in reducing risks associated with training loads; however, it focused primarily on technical aspects without delving into the integration of these applications within a comprehensive system to support health and sports decision-making.

Similarly, Pietraszewski et al. (2025) sought to analyze the role of AI in sports performance analysis by using intelligent algorithms to track training loads, analyze movements, and predict injury risks. The study presented a comprehensive systematic review demonstrating the effectiveness of these technologies in improving the accuracy of sports analysis. However, it focused on the technical aspects of the analysis without addressing how these findings could be incorporated into a comprehensive decision-support system that links health, training, and administrative aspects.

Similarly, Zhou's (2025) study provided an analytical review of the impact of AI in the sports field, discussing the conceptual shifts associated with the transition from intuitive to data-driven decisions. Despite the comprehensiveness of the approach, the study addressed decision support in general terms without sufficient focus on the health-and-sports dimension or clarification of the mechanisms for building an integrated system that addresses health, prevention, and risk management issues.

In a different context, Kim's (2025) study focused on the ethical dimensions of using AI in sports, such as privacy, data protection, and transparency, emphasizing the need for regulatory frameworks that protect athletes' rights. However, this study did not directly address the use of AI within a health-and-sports decision-support system; rather, it was limited to general ethical aspects without linking them to decision-making mechanisms.

On the other hand, An (2025) examined the relationship between AI and the health and sports sectors, focusing on the role of smart technologies in monitoring health status, predicting risks, and supporting treatment decisions, and demonstrated that AI serves as a link between healthcare and athletic performance. However, the study focused more on the health aspect than on the development of an integrated decision-support system that includes various stakeholders within the sports environment.

Elkhamisy's (2025) study also aimed to analyze the applications of AI in sports medicine, with a focus on injury prediction, diagnostic support, and treatment decision improvement. The study provided practical examples illustrating the effectiveness of these technologies in improving healthcare quality; however, it addressed health decisions from a purely medical perspective, without integrating them into a broader framework that links medical, training, and administrative aspects within an integrated decision-support system.

Leckey (2025) conducted a review of ML applications in predicting the risk of sports injuries, confirming the effectiveness of logistic regression, random forests, and support vector machines, while emphasizing the importance of improving data quality. Rossi et al. (2017) used GPS data and ML analysis to assess injury risk in soccer and provided practical guidelines for interpreting the relationships between performance and risk. Reis et al. (2024) focused on the challenges of integrating AI and machine learning into sports science, particularly in injury prediction, performance enhancement, and rehabilitation, noting significant progress in prediction accuracy and performance analysis.

Finally, recent studies have focused on developing machine learning and deep learning models for predicting sports injuries; Ye (2023) used temporal image encoding and deep learning algorithms, while Sadr's (2025) study focused on long-short-term memory (LSTM) networks and convolutional neural networks (CNNs) to predict injuries, achieving a high accuracy rate exceeding 91%.

COMMENTARY ON PREVIOUS STUDIES

A review of these previous studies reveals that they focused on the application of AI and intelligent systems in sports and sports medicine. Most studies addressed topics such as improving athletic performance, predicting injuries, health prevention, supporting treatment decisions, and analyzing training loads. The samples in these previous studies included athletes, players, and professional sports environments, and some relied on smart devices, tracking systems, and digital analysis tools to generate biometric and physical data.

A review of previous studies and research revealed that they varied in their objectives; some studies aimed to identify the role of AI in improving athletic performance and analyzing physical data, such as the study by Baladaniya and Choudhary (2025) and Pietraszewski et al. (2025), while others sought to identify the role of AI in predicting and preventing sports injuries, such as the studies by Leckey (2025), Rossi et al. (2017), Ye (2023), and Sadr (2025). Some studies, such as the study by An (2025) and the study by Elkhamisy (2025), also aimed to explore the relationship between AI, sports healthcare, and support for treatment decisions, while other studies focused on the ethical and regulatory aspects associated with the use of AI in sports, such as the study by Kim (2025).

Most previous studies employed descriptive or analytical methods and systematic reviews and relied on digital and biometric data generated by tracking systems and smart devices. Many studies have employed artificial intelligence and machine learning algorithms—such as neural networks, random forests, and logistic regression—to analyze data and predict health risks and sports injuries. Although the statistical methods used in data analysis varied widely, they generally included methods such as the arithmetic mean, standard deviation, t-tests, correlation coefficients, and predictive models; this was due to the nature of the studies' objectives and the variables they sought to analyze.

Previous studies have shown that intelligent systems and AI effectively contribute to improving the quality of sports and health analysis, predicting injuries, and supporting treatment and training decisions, in addition to improving the accuracy of monitoring athletes' physical and health conditions. Studies have also indicated that artificial intelligence (AI) technologies have become an important tool in enhancing athletic performance and reducing risks associated with training loads and injuries.

The current study differs from previous studies in that it does not limit itself to addressing AI from a separate technical or health perspective, but rather seeks to examine intelligent systems as an integrated health-sports decision support system that combines health, training, and administrative aspects within a single framework. The current study is also distinguished by its focus on the comprehensive development of a health-sports decision-support system by linking decision quality, health prevention, risk management, and integration among stakeholders within the sports environment—an approach that previous studies have not comprehensively and clearly addressed.

The researcher drew upon previous studies related to smart systems and AI in the health and sports fields in the following ways:

1. Theoretical aspects related to smart systems and AI and their role in supporting health and sports decision-making.
2. Identifying the most important scientific concepts related to decision quality improvement, health prevention, and sports risk management.
3. The scientific methodology and statistical approach appropriate for the nature and objectives of the current study were determined.
4. To draw on previous studies to develop the research instrument (questionnaire) and make its sections and items consistent with the study's objectives and research questions.
5. To assist in determining the appropriate sample size and selecting the target group related to health and sports.
6. Use statistical methods used in previous studies, such as arithmetic means, standard deviations, and statistical significance tests, to contribute to accurate data analysis.
7. Use the findings of previous studies to interpret and discuss the results of the current study and relate them to the relevant theoretical and research framework.
8. Identify a research gap consisting of a lack of studies that have addressed smart systems as an integrated framework for health and sports decision-making that combines health, training, and administrative aspects.

STUDY PROCEDURES

Research Methodology

The researcher employed a descrip as-analytical approach, as the most appropriate methodology for studying phenomena involving technical, health, and athletic dimensions.

Research Population:

The study population consisted of all professionals working in the health and sports field within sports organizations and clubs, inAIes, sports medicine specialists, physical therapists and rehabilitation specialists, fitness specialists, as well as adPietraszewski et al. (2025ations.

RESEARCH SAMPLE:

The study sample consisted of 67 individuals working in health and sports within sports organizations and clubs. The participants were selected using a purposive sampling method based on their suitability for the nature of the study and their experience in using smart systems or participating in health and sports decision-making, as shown in Table 1.

Study Variables:

- **Independent variable:** AI-based smart systems.
- **Dependent variable:** Development of a decision-support system for health and sports.

Study Methodology:

After reviewing the theoretical literature related to the study topic and examining previous studies on smart systems and AI in health–sports, drawing on the opinions of experts and specialists in this field, and adhering to scientific principles in the construction of measurement tools, a questionnaire was developed to assess the role of AI-based smart systems in the development of a health-sports decision support system. The final version of the study tool consisted of 25 items distributed across five main themes: the current state of smart system usage; improving the quality of health and sports-related decision-making; health prevention and injury risk management; and challenges and obstacles associated with smart system use.

VALIDATION OF THE STUDY TOOL

Content Validity

Content validity, which refers to the tool's ability to appropriately measure the variables for which it was designed, There the validity of the study tool. To achieve this, the preliminary version of the study tool was presented to a group of expert reviewers

with expertise in the fields of physical education, sports medicine, sports management, and artificial intelligence, as well as a number of university faculty members.

The aim of this study was to assess the linguistic accuracy and clarity of the paragraphs, their suitability for measuring the study's objectives, and the relevance of each paragraph to its respective theme, as well as to solicit any comments regarding deletions, additions, or modifications. The reviewers' comments and opinions were incorporated, and the necessary linguistic and scientific revisions were made to certain paragraphs to ensure that the final version of the study instrument is suitable for achieving the objectives of the current study.

Reliability of the Study Instrument

The study instrument was distributed to a pilot sample consisting of 10 individuals selected from the study population and within the sample to verify the reliability indicators of the study's scale. Cronbach's alpha reliability coefficients were calculated for the study domains and the scale as a whole (Table 1).

Table 1. Cronbach's alpha coefficients and reliability of the study scale

No.	Dimensions	Number of Items	Cronbach's Alpha
1	The Reality of Smart System Use in the Health and Sports Sector	5	0.91
2	Role of Smart Systems in Improving the Quality of Health and Sports-Related Decisions	5	0.92
3	Integration of the Health and Training Aspects	5	0.94
4	Health Prevention and Risk Management of Injury	5	0.94
5	Challenges and obstacles	5	0.92
	Overall Scale	25	0.96

Table 1 shows that the Cronbach's alpha coefficients for the domains ranged from 0.91 to 0.94, and the Cronbach's alpha coefficient for the scales as a whole was 0.96. All reliability coefficients are high and acceptable for the purposes of this study, as a Cronbach'salpha coefficient is considered acceptable if it exceeds 0.70.

Response Scale for the Study Instruments:

A five-point Likert scale was used to rate the items on the role of AI-based intelligent systems in the development of a health and sports decision-support system.

Table 2. Five-point Likert scale for the study instrument.

Response	I strongly agree.	I agree to a large extent	I agree to some extent	I agree slightly	I agree very little
Rating	5	4	3	2	1

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ACCORDINGLY, THE FOLLOWING ARE THE NORMATIVE VALUES FOR EVALUATING THE MEAN RESPONSES OF THE SAMPLE PARTICIPANTS ON THE STUDY INSTRUMENT:

Table 2: Standard Scores for Evaluating the Mean Responses of Sample Participants on the Study Instrument

Level	Mean Value
Low	**1.00–2.33**
Medium	**234.–3.67**
High	**3.68–5.00**

Study Procedures

1. The theoretical literature and previous studies related to intelligent systems, AI, and their role in supporting health and sports decision-making were reviewed, and the tools and measures used in studies related to the research topic were examined.
2. After reviewing previous studies and relevant scales, the researcher developed a preliminary version of the study instrument (questionnaire) tailored to the objectives of the study and the nature of the study sample.
3. Scientific procedures were conducted to verify the validity and reliability of the study instrument by presenting it to a group of expert reviewers and calculating reliability coefficients using appropriate statistical methods.
4. The final version of the questionnaire was electronically prepared to facilitate its distribution to the study sample.
5. The questionnaire was administered to a pilot sample to ensure item clarity, wording accuracy, and instrument suitability for the study's purposes.
6. The questionnaire was distributed electronically to the study sample—health and sports professionals working in sports institutions and clubs—via appropriate electronic communication channels.
7. The questionnaires were collected after the completion of the administration process, and the data were verified for completeness and suitability for statistical analysis.
8. The data were entered and statistically analyzed using appropriate statistical methods to extract, interpret, and disdiscusse study's findings considering its objectives and research questions.

Statistical Analysis:

To answer the study's research questions, the data were analyzed using the Statistical Package for the Social Sciences (SPSS), employing the following statistical methods:

- Arithmetic means, standard deviations, and ranks were calculated to answer the first research question and identify the role of AI-based intelligent systems in developing a health-sports decision support system and improving the quality of decisions related to athletes' health and performance.
- To answer the second question, arithmetic means, standard deviations, and ranks were calculated to determine the extent to which smart systems enhance the integration of health and training aspects within the sports system.
- To answer the third question, arithmetic means, standard deviations, and ranks were calculated to determine the extent to which smart systems contribute to health prevention and risk management associated with sports injuries within various sports environments.
- Cronbach's alpha was used to verify the study instrument's internal consistency coefficients and its various dimensions.
- Percentages and relative weights were also used to interpret the response levels of the participants.

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PRESENTATION AND DISCUSSION OF THE RESULTS:

This chapter presents the results of the study, which aims to identify the role of artificial intelligence-based smart systems in developing a health-sports decision support system.

Results related to the first research question: What is the role of AI-based intelligent systems in developing a health-and-sports decision support system and improving the quality of decisions regarding athletes' health and performance?

To answer this question, the researcher used the arithmetic means and SDs for all domains and subdomains within each domain. The results can be presented as follows:

Inor Table 3. Arithmetic Means and Standard Deviations for All Items in the "Reality of Smart Systems Use" domain in the health-sports sector and the domain as a whole (n = 67) .

No.	Item	Arithmetic Mean	Standard Deviation	Relative Importance	Rank	Classification
1	Intelligent systems were used to monitor athletes' health status within the sports organization.	2.78	1.51	55.5	5	Medium
2	Sports organizations rely on modern technologies to collect physical and biometric data from athletes.	3.25	1.48	65.1	1	Medium
3	Data analysis systems are available to continuously evaluate athletes' performance.	2.87	1.46	57.3	4	Medium
4	Smart devices (e.g., wearables) are used to monitor physical conditions.	3.07	1.35	61.5	2	Medium
5	Smart systems provide accurate information to support health and fitness activities.	3.03	1.42	60.6	3	Medium
_	**Overall**	3.00	0.64	60.0	_	Moderate

Table 3 shows that the actual level of smart system usage in the health and sports sector was generally moderate, with an overall arithmetic mean of 3.00, a standard deviation of 0.64, and a relative importance of 60.0%, indicating that these systems are actually being used within sports organizations; however, their use remains at a level that is not advanced or fully optimized.

At the item level, item (2) ranked first with an arithmetic mean of 3.25 and a standard deviation of 1.48, with a relative importance of 65.1%. This paragraph states that sports organizations rely on modern technologies to collect physical and biometric data from athletes, reflecting a clear trend toward the use of technology in basic data collection processes. Paragraph (4) ranked second with a mean of 3.07, indicating the use of smart devices—such as wearables—to monitor physical condition, demonstrating the tangible presence of modern technologies in tracking athletes' physical performance.

Paragraph (5) ranked third with an average score of 3.03, reflecting the contribution of smart systems in providing accurate information to support health and sports initiatives, indicating a relative awareness of the importance of these systems in supporting decision-making. Paragraph (3), meanwhile, ranked fourth with an average score of 2.87; it pertains to the availability of data analysis systems for the continuous evaluation of athletes' performance, indicating that continuous analysis remains less utilized than data collection.

Paragraph (1) ranked last with an average score of 2.78; this refers to the use of smart systems to monitor athletes' health status within the sports organization, reflecting that the use of these systems for direct health monitoring remains relatively limited compared to other applications.

These results indicate that sports organizations have indeed begun to adopt smart systems and AI applications in certain aspects related to athlete health—athlete health—but the level of use remains moderate, reflecting that the digital transformation process within sports organizations has not yet reached the stage of full integration in the use of smart systems across various health and training processes. This may be attributed to disparities in technical capabilities among organizations and the need for specialized personnel capable of managing, analyzing, and using data to support decision-making.

Ine results also show that the greatest focus is on the use of modern technologies for collecting physical and biometric data, as well as the use of smart wearable devices, which reflects sports organizations' recognition of the importance of data in monitoring athletes' performance and physical condition. However, the low averages related to data analysis and continuous health monitoring indicate that many organizations still focus more on the technical aspects of data collection than on utilizing this data to build an integrated analytical system that supports accurate and sustainable decision-making.

This finding is consistent with the conclusions of a study by Baladaniya and Choudhary (2025), who confirmed that artificial intelligence applications in sports have contributed to improving the collection and analysis of physical and biometric data and supporting training and health decisions. However, the use of these applications remains largely focused on technical aspects without fully integrating them into a comprehensive system to support health and sports decision-making.

This finding is also consistent with Pietraszewski et al. (2025), which noted the effectiveness of smart systems in analyzing athletic performance, tracking training loads, and predicting risks. However, they also highlighted that the use of these systems still tends to be more technical and specialized rather than being integrated into a comprehensive institutional framework that links health, training, and administrative aspects—a finding consistent with the results of the current study.

Table 4. Arithmetic means and standard deviations for all items in the "The Role of Smart Systems in Improving the Quality of Health- and Sports-Related Decisions" domain and the domain as a whole (n = 67)

No.	Item	Arithmetic Mean	Standard Deviation	Relative Importance	Rank	Classification
1	Intelligent systems improve the accuracy of decisions regarding training load.	2.64	1.48	52.8	**5**	**Medium**
2	Smart systems help in making quick decisions in emergencies.	2.84	1.33	56.7	**4**	**Medium**
3	Smart systems reduce the reliance on personal judgment in decision-making.	3.03	1.46	60.6	**3**	**Medium**
4	Smart systems support decisions based on data and scientific analysis.	3.09	1.53	61.8	**2**	**Medium**
5	Smart systems assist in selecting appropriate alternatives when making decisions.	3.09	1.28	61.8	**1**	**Medium**
	Overall	2.94	0.66	58.7	___	**Moderate**

The results presented in Table 4 indicate that the role of intelligent systems in improving the quality of health and sports-related decision-making was generally **moderate**, with an arithmetic mean of 2.94 and a standard deviation of 0.66 and a relative importance of 58.7%, reflecting that these systems play an actual role in supporting the decision-making process; however, this role remains below the high level in terms of effectiveness and integration.

At the item level, item (5) ranked first with an arithmetic mean of 3.09, a standard deviation of 1.28, and a relative importance of 61.8%. This paragraph states that intelligent systems help in selecting appropriate alternatives when making decisions, indicating a clear role in supporting the trade-off between available options and enhancing the selection quality. Paragraph (4)

also ranked second with a mean of 3.09; it emphasizes the contribution of intelligent systems to supporting decisions based on data and scientific analysis, reflecting a trend toward relative reliance on digital analysis in the decision-making process.

Paragraph (3) ranked third with an average score of 3.03, indicating that intelligent systems reduce the reliance on personal judgment in decision-making, demonstrating their role in promoting objectivity and limiting the use of inaccurate data in human inter ranked fourth with an average score of 2.84. It concerns the role of smart systems in facilitating rapid decision-making in emergency situations, suggesting that their use in urgent decisions remains moderately effective and requires further enhancement.

Paragraph (1) ranked last with an average score of 2.64; it addresses the contribution of intelligent systems to improving the accuracy of decisions regarding training loads, reflecting that the use of these systems in this vital aspect of sports training remains relatively limited compared to other aspects.

These results indicate that smart systems play a significant role in supporting decision-making within the sports health–sports sector, particularly in data analysis and weighing available alternatives. However, this role remains at a moderate level, indicating that sports organizations have not yet fully rely on smart systems as a primary tool for managing health and training decisions. This may be due to limited technical infrastructure, poor integration among the systems in use, or the need to develop staff skills in applying the results of digital analysis to daily decisions.

The results also show that the ability of smart systems to select appropriate alternatives and support data-driven decisions were the highest-scoring areas, indicating a growing conviction regarding the importance of relying on scientific analysis rather than traditional decisions based solely on personal experience. This reflects a gradual shift toward a data-driven decision-making culture within sports organizations, particularly given the expanding use of AI technologies and the analysis of data related to athletic performance and health.

Conversely, the lower averages related to training load and rapid decision-making in emergency situations indicate that the use of intelligent systems in sensitive and immediate decisions remains relatively limited, which may be due to the need for more advanced systems capable of providing immediate and accurate responses that are tailored to the nature of changing health and physical conditions within the sports environment.

This finding is consistent with the findings of a study by Zhou, L. (2025), which showed that AI has helped facilitate the shift from intuitive decisions to decisions based on data and scientific analysis, thereby improving the quality of sports and health-related decisions, However, the study also emphasized that numerous organizational and technical challenges still face the integrated implementation of these systems within sports organizations.

This finding is also consistent with a study by An (2025), which showed that intelligent systems help support health and treatment decisions by monitoring health status and predicting risks. However, the effectiveness of these systems largely depends on the level of integration between health and training data and on the ability of sports organizations to utilize analytical outputs in a practical manner for decision-making.

Results related to the second question: What is the role of AI-based smart systems in developing a health-sports decision support system and improving the quality of decisions regarding athletes' health and performance?

Table 5. Arithmetic means and standard deviations for all items measuring the integration of health and training aspects and the domain as a whole (n = 67)

No.	Item	Arithmetic Mean	Standard Deviation	Relative Importance	Rank	Classification
1	Smart systems link training data to an athlete's health status.	2.90	1.46	57.9	**4**	**Medium**
2	Smart systems improve the coordination between trainers and health professionals.	3.21	1.40	64.2	**1**	**Medium**

3	Smart systems provide a comprehensive view of an athlete's overall condition.	3.16	1.38	63.3	**2**	**Medium**
4	Smart systems support integrated decision-making that balances health and training considerations.	2.90	1.34	57.9	**3**	**Medium**
5	Smart systems help reduce conflicts between decisions within sports teams.	2.61	1.47	52.2	**5**	**Medium**
	Overall	2.96	0.61	59.1	**-**	**Moderate**

The results presented in Table 6 indicate that the level of integration between health and training aspects in light of the use of smart systems was generally moderate, with an arithmetic mean of 2.96 for the whole domain with a standard deviation of 0.61 and a relative importance of 59.1%. This indicates that smart systems play a clear role in achieving integration between health and training data; however, to reach a high and effective level of integration, this role still needs to be strengthened.

At the item level, item (2) ranked first with an arithmetic mean of 3.21, a standard deviation of 1.40, and a relative importance of 64.2%. This paragraph states that smart systems help improve coordination between coaches and health specialists, reflecting the important role these systems play in fostering collaboration between sports and health professionals. This was followed by paragraph (3) in second place with a mean of (3.16), indicating that smart systems provide a comprehensive view of the athlete's overall condition, thereby enhancing a holistic understanding of the athlete's performance and health status.

Paragraph (4) ranked third with an average score of 2.90, confirming that smart systems support integrated decision-making across health and training aspects. Paragraph (1) ranked fourth with a similar average (2.90); it relates to the contribution of smart systems to linking training data with the athlete's health status, reflecting that this linkage exists but is not yet fully optimized.

Meanwhile, item (5) ranked last with an average of 2.61; this item refers to the contribution of smart systems to reducing decision conflicts within the sports team, indicating that the aspect of reducing decision conflicts remains relatively the weakest in this area.

These results indicate that smart systems are increasingly contributing to enhancing the integration of health and training aspects within sports organizations by improving coordination among different staff members and providing comprehensive information that helps to more accurately understand the athlete's overall condition. This reflects the growing importance of AI in building a sports environment based on information sharing and the integration of health, physical, and training data, thereby supporting more balanced and effective decision-making.

The results also show that smart systems play a clear role in improving communication between coaches and health specialists, which strengthens teamwork within the sports organization and reduces the haphazard approach to managing athletes' health and training conditions. Sports organizations have become more aware of the importance of interdisciplinary integration when addressing athletes' health and performance, particularly considering the rapid technological advancements in data analysis and health monitoring tools.

Conversely, the low scores regarding the reduction of conflicts between decisions indicate that institutional integration still faces some challenges, whether in terms of standardizing databases or establishing coordination mechanisms among decision-making parties. This may reflect a gap between the availability of smart systems and their actual ability to be utilized within an integrated regulatory framework that ensures consistency in health, training, and administrative decisions within the sports organization.

This finding is consistent with the results of a study by An (2025), which confirmed that smart systems serve as a link between health and sports by supporting health monitoring, risk prediction, and improved treatment decisions, thereby contributing to greater integration between healthcare and athletic performance.

This finding is also consistent with that of Elkhamisy (2025), who demonstrated that the application of AI in sports medicine contributes to improving the quality of health and diagnostic decisions and helps provide accurate information that supports coordination between medical and training aspects. However, the study noted that achieving an integrated system requires a higher level of coordination among the various units operating within the sports environment, which is consistent with the findings of the current study.

Results related to the third question: To what extent do AI-based smart systems contribute to health prevention and risk management associated with sports injuries within various sports environments?

Table 6. Arithmetic means and standard deviations for all items related to health prevention and IRM and for the domain as a whole (n = 67).

No.	Item	Arithmetic Mean	Standard Deviation	Relative Importance %	Rank	Classification
1	Smart systems help predict injury risk before it occurs.	3.04	1.49	60.9	**2**	**Medium**
2	Smart systems contribute to the early detection of stress and fatigue signs.	2.79	1.50	55.8	**5**	**Medium**
3	Smart systems support the development of preventive programs to reduce injuries during sports.	3.15	1.32	63.0	**1**	**Medium**
4	Smart systems help athletes make safe decisions regarding their return to play after an injury.	2.97	1.49	59.4	**3**	**Medium**
5	Smart systems help reduce injury rates within sports teams.	2.99	1.60	59.7	**4**	**Medium**
__	**Overall**	2.99	0.77	59.8	___	**Medium**

The results presented in Table 6 indicate that the level of contribution of AI-based smart systems to supporting health prevention and the management of sports injury risks was generally moderate, with an arithmetic mean of 2.99 for the domain as a whole of 2.99 with a standard deviation of 0.77, and a relative importance of 59.8%, reflecting a relatively effective role for these systems in the field of prevention and risk management; however, they still require further development and enhancement to reach an advanced level of effectiveness.

At the item level, item (3) ranked first with an arithmetic mean of 3.15, a standard deviation of 1.32, and a relative importance of 63.0%. This paragraph states that smart systems support the development of preventive programs to reduce sports injuries, indicating that the use of these systems is most prominent in the prevention aspect. This was followed by paragraph (1) in second place with a mean of 3.04, which refers to the role of smart systems in predicting injury risks before they occur, reflecting a relative ability to be proactive and reduce the likelihood of injuries.

Paragraph (4) ranked third with an average score of 2.97. It relates to how smart systems assist in making safe decisions regarding an athlete's return to play after an injury, indicating a moderate role in managing the post-injury phase and ensuring a safe return to athletic participation. Paragraph (5) ranked fourth with an average score of 2.99; it refers to the contribution of smart systems to reducing injury rates within sports teams, reflecting an indirect impact that is still relatively limited in effectiveness.

Paragraph (2) ranked last with an average score of 2.79; it addresses the contribution of smart systems to the early detection of signs of stress and fatigue, indicating that this aspect of early diagnosis remains less developed than the other aspects.

These results indicate that smart systems are beginning to play a growing role in supporting preventive measures within the sports sector, particularly with regard to developing preventive programs and predicting risks associated with sports injuries, reflecting an increasing reliance on digital analysis and biometric data to protect athletes and maintain their physical readiness. The results also show that sports organizations have become more aware of the importance of using modern technologies to reduce injuries and enhance athlete safety; however, the level of such use remains moderate and has not yet reached the comprehensive and integrated implementation stage.

The results also show that smart systems contribute more effectively to preventive measures and advance planning than to aspects related to the early detection of stress and fatigue, indicating that many sports organizations still rely more heavily on general indicators and traditional preventive programs, whereas further technical and organizational development is required for the use of smart systems for early diagnosis and real-time monitoring of physical condition.

The results also reflect that smart systems play a moderate role in supporting decisions regarding a safe return to competition following an injury, which underscores the importance of these systems in reducing the risks associated with an early return to competition. However, the effectiveness of this role depends on the accuracy of the available data and the extent to which it is integrated with medical and training aspects within the sports organization.

This finding is consistent with the conclusions of a study by Leckey (2025), which confirmed that ML and AI applications effectively contribute to predicting the risks of sports injuries and improving preventive measures, particularly when relying on accurate and continuous data regarding training loads and athletes' physical condition.

This finding is also consistent with that of Rossi (2017), who demonstrated that the use of tracking data and machine learning techniques helps analyze injury-related indicators and predict risks before they occur, thereby supporting preventive decisions and reducing injury rates within sports teams—a finding consistent with the results of the current study.

Table 7. Arithmetic means and standard deviations for all sections of the challenges, obstacles, and the domain as a whole (n = 67) were calculated.

No.	Item	Arithmetic Mean	Standard Deviation	Relative importance (%)	Rank	Classification
1	Sports organizations face difficulties in implementing smart systems due to cost.	2.97	1.39	59.4	**3**	**Medium**
2	A shortage of personnel qualified to use smart systems exists.	3.06	1.44	61.2	**2**	**Medium**
3	Institutions lack the necessary technical infrastructure.	2.84	1.36	56.7	**4**	**Medium**
4	There are concerns regarding the privacy of the data of athletes.	3.25	1.40	65.1	**1**	**Medium**
5	The use of smart systems faces resistance from some professionals in the sports field.	2.84	1.45	56.7	**5**	**Medium**
__	**Overall**	2.99	0.62	59.8	___	**Moderate**

The results presented in Table 7 indicate that the level **of challenges and obstacles facing the use of smart systems in the field of sports** was generally **moderate**, with an arithmetic mean of 2.99 for the field as a whole of (2.99) with a standard deviation of 0.62, and a relative importance of 59.8%. This indicates the presence of a set of actual challenges that limit the full utilization of smart systems; however, these challenges are not particularly severe or complex in the sports environment under study.

At the item level, item (4) ranked first with an arithmetic mean of 3.25, a standard deviation of 1.40, and a relative importance of 65.1%. This paragraph addresses concerns regarding the privacy of athletes' data, indicating that security and data protection represent the most significant challenge in smart system implementation. This was followed by paragraph (2) in second place with a mean of 3.06, which indicates a shortage of personnel qualified to use smart systems, indicating a gap in human resources capable of operating and utilizing these technologies efficiently.

Paragraph (1) ranked third with an average score of 2.97; it relates to the difficulty of implementing smart systems due to cost, indicating that financial considerations constitute a barrier of moderate impact on sports organizations' adoption of these systems. Meanwhile, item (3) ranked fourth with an average score of 2.84; it points to the weakness of the necessary technical infrastructure, reflecting challenges in the fundamental technical aspects that support AI implementation.

Paragraph (5) ranked last with an average score of 2.84, indicating resistance among some sports sector professionals toward the use of smart systems, suggesting that challenges related to acceptance and organizational change exist but are less severe than the other barriers.

These results indicate that the implementation of smart systems in the sports sector still faces a range of challenges that affect the ability to fully leverage the potential of AI within sports organizations; however, these challenges were rated at a moderate level, suggesting an environment ripe for development and improvement provided that appropriate technical, human, and organizational support is made available. This reflects the fact that sports organizations have already begun adopting smart technologies but still face some obstacles related to the digital transformation phase and adapting modern systems to the nature of sports and health-related work.

The results also show that concerns regarding the privacy of athletes' data ranked among the top challenges, reflecting a growing awareness of the importance of protecting health and physical data amid the expanding use of digital systems and smart devices. It appears that sports organizations recognize the importance of leveraging data, but they also fear issues related to data confidentiality and the potential for misuse or unauthorized access.

The findings also indicate that a shortage of qualified personnel is one of the most significant obstacles limiting the effective use of smart systems, underscoring that the successful implementation of AI does not depend solely on the availability of technology but also requires personnel with the necessary skills to analyze data, operate the systems, and utilize their outputs to support decision-making in sports and healthcare. Furthermore, cost and infrastructure challenges highlight the need for technological and organizational investments that ensure the creation of an environment conducive to digital transformation within sports organizations.

This finding aligns with the conclusions of a study by Kim (2025), which confirmed that issues of privacy, data protection, and transparency are among the most significant challenges associated with the use of AI in the sports sector, noting the importance of establishing regulatory and ethical frameworks that safeguard athletes' rights and ensure the secure use of data.

This finding is also consistent with the study by Reis (2024), which highlighted that the application of AI technologies in sports science faces multiple challenges related to infrastructure, data quality, and a lack of specialized expertise, in addition to the difficulty of fully integrating smart systems within sports organizations—a finding consistent with the results of the current study.

CONCLUSIONS AND RECOMMENDATIONS:

CONCLUSIONS:

Considering the study's findings, the following conclusions can be drawn:

1. The study's results showed that the level of smart system usage in the health and sports sector was moderate, indicating a genuine trend toward adopting AI applications among sports organizations; however, this adoption remains limited and has not yet reached the level of comprehensive integration.
2. The study revealed that smart systems moderately contribute to improving the quality of health and sports-related decision-making by supporting data-driven decisions, assisting in the selection of appropriate alternatives, and reducing reliance on personal judgment.

3. The results showed that smart systems contribute to health prevention and the management of sports injury risks by predicting risks, supporting preventive programs, and assisting in decisions regarding safe return to play after an injury; however, the level of this contribution remains moderate.
4. The results indicated that the early detection of signs of stress and fatigue is one of the least utilized aspects of smart systems, suggesting the need to develop more accurate tools for real-time monitoring of athletes' physical and health status.
5. The findings revealed a range of challenges facing the use of smart systems, most notably data privacy concerns, a shortage of qualified personnel, high costs, and weak technical infrastructure within some sports organizations.

Recommendations:

Based on the study's findings and conclusions, the study recommends the following:

1. Promote the use of smart systems and AI applications within sports organizations to contribute to the development of a health and sports decision-support system.
2. Develop the technical infrastructure in sports organizations and provide modern systems and devices that support the collection and analysis of athletes' health and physical data.
3. Train sports, health, and administrative staff in the use of smart systems and data analysis to ensure the optimal use of AI technologies in decision-making.
4. Expand the use of smart systems in the areas of early stress and fatigue detection and sports injury prediction before they occur.
5. Strengthen integration among health, training, and administrative aspects by building unified databases and interconnected systems that support information sharing and joint decision-making.
6. Establishing clear policies and procedures to protect the data privacy of athletes and ensure information security when using smart systems.
7. Conducting further prospective studies on the effectiveness of smart systems in the sports field, particularly applied studies addressing the impact of AI on reducing injuries and improving the quality of sports and health-related decision-making.
8. Draw on recent global experiences in the use of AI within sports organizations and adapt them to the local sports environment.

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