



Original Article

Studying The Reality of Using Artificial Intelligence Applications in The Rehabilitation of Sports Injuries

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Doi: 10.21608/jat.2025.385870.1065

Abstract

This study explores the current applications of artificial intelligence (AI) in sports injury rehabilitation. The author employed a descriptive research design, aligning with the study's purpose and goals. Participants included 380 sports injury and motor rehabilitation specialists, as well as 52 additional surveyed professionals from sports clubs and rehabilitation centers in Giza and Menoufia governorates. Several challenges emerged, such as inadequate wireless infrastructure, limited access to computers and software, and difficulties in utilizing the Internet of Things (IoT) alongside rehabilitation devices. Key findings revealed a strong interest among specialists in computer vision techniques, given their potential to enhance guidance for injured athletes during rehabilitation. Additionally, financial constraints hindered the acquisition of essential AI-based healthcare and rehabilitation equipment. The study recommends integrating AI education and training into sports science curricula to prepare graduates with knowledge of these advanced technologies.

Keywords: *Artificial Intelligence, Sports Injury, Rehabilitation.*

Introduction

The development taking place in the technological field has led to the emergence of many modern sciences that serve many fields and specializations, and among the most important of these sciences is the science of artificial intelligence, which in fact is the result of human experiences, expertise and intelligence, which have been translated into programs and devices that are placed at the service of individuals. Such as conducting scientific research experiments or serving institutions to carry out various tasks and activities. (Mohamed ,2022)

Artificial Intelligence (AI) has become one of the most important effective technologies that leave a strong and tangible impact that would bring about a comprehensive change in the business environment, as it aims to design a machine capable of achieving a specific goal in a way like humans or exceeding the ability of humans. They are specific software algorithms. "A computer or group of computers works to solve problems and make decisions in a logical and organized manner and in the same way as the human mind thinks, the machine can help its



users manage the world with minimal effort by artificial intelligence without requiring more mental and physical effort from humans. Among the most important benefits that we can achieve are eliminating repetition of tasks and saving time, deeper specialization, speed in performing routine tasks, analyzing data in a very deep way, and reaching accurate results . (Al-Dhamd, 2000)

Recent years have witnessed a great development and diversity in the methods and techniques used in treating injuries, especially rehabilitation and physical therapy methods, because this treatment does not result in any side effects and can be used for all ages and stages and for different types of injuries, diseases and disabilities and for all parts of the body; Therefore, many new developments have been made, and old ones have been developed based on the same principle, but the development has been made in order to increase the therapeutic effect and shorten the time, or to double the effect of more than one factor, all of which aims to reach the highest level in rehabilitating the injured and returning to practicing sports activities. (Abd ElJawad ,2013)

It is noteworthy that AI applications can analyze infinite amounts of data, calculating player performance metrics, injury history and recovery policies to provide tailored insights and recommendations. This data-driven approach improves accuracy and skill in injury management and optimizes athletes' recovery. Defining AI-powered setups for major sports organizations, sports medicine clinics and health offices will lead to a wide range of applications. AI can be utilized both in the form of individual preparation programs and real-time monitoring of the physical condition of athletes, which have great potential to transform the field of medicine and enhance athletes' performance. (Zou ,2025)

Both " Abdel Aziz & Abdel Maboud (2020) agree on the significance of the goals and benefits of applying artificial intelligence in sports injury rehabilitation centers, based on linking players' smartphones to artificial intelligence technology to send notifications of the implementation of the rehabilitation program for injured players, Also, the use of artificial intelligence helps in developing a rehabilitation program for players. appropriate to their injury, as well as the use of Internet of Things technologies that can remotely control devices in training halls during players' rehabilitation, This modern technology works to link the players' medical equipment with information and data about their sports history, timings, and type of injuries to know the history of players' injuries to quickly develop the appropriate rehabilitation program, as well as determine the time to use sports equipment and the number of training repetitions for the players in proportion to the age stage and type of competition . (Abdel Aziz & Abdel Maaboud ,2020)

As the ability to predict the occurrence of injury is difficult, predictive modeling should not only focus on predicting the occurrence of injury itself but should also attempt to identify the risk of injury at the individual level and implement interventions to mitigate the level of risk, in order to plan effective preventive intervention. (Al-Maliji ,2023)



In the context of the above, it is worth noting here that artificial intelligence can analyze recorded sports injury data and identify common patterns and factors influencing their occurrence. Artificial intelligence can use deep learning techniques and data analysis to uncover common patterns in sports injuries, such as common injuries to certain body parts or influencing factors such as training techniques or floor type, This information can be used to develop prevention strategies and programs that target these weak points and reduce the risk of injury. (Al-Hamad & Al-Rashidi ,2024)

Mohammed Ibrahim Al-Maliji (2023) adds that predictive models can be used to identify players who are likely to be injured or perform poorly, and coaches and managers can use this information to make decisions about player rotation and game strategy. (Al-Maliji ,2023)

Sports injury is a malfunction or defect in one of the injured person's vital organs because of his exposure to an external or internal influence, which prevents him from practicing his normal or sports life. (Al-Shatouri ,2016)

Artificial intelligence applications in sports injury rehabilitation is a set of technical means and devices used to restore physical and functional efficiency following a motor dysfunction, using a precise technical method that contributes to assessing the severity of the injury ,providing data and reports on the players' measurements throughout their athletic history, and developing appropriate rehabilitation programs using the attraction of objects represented by sensors and connecting them to the Internet to exchange data between them without human intervention ,including the fifth generation of computers .

In recent years, the use of advanced artificial intelligence (AI) methods has emerged in sports medicine to deal with this difficult, multifaceted task. AI methods have already been successfully used in sports science, including the prediction and prevention of sports injuries. Therefore, many teams are now using AI to monitor player health in order to prevent these costly injuries. For example, The Chicago Cubs are using AI to track player stress levels. Additionally, the Cleveland Indians are using AI to monitor players' sleep patterns. These systems can help identify players at risk of injury and help prevent them from getting injured. For another example, the Seattle Seahawks have developed a program that uses machine learning to identify players at risk of injury, this information can be used to make decisions about player rotation and game strategy, Additionally, the NFL is using artificial intelligence to develop a system that can identify concussions, this information can also be used to improve player safety. (Adetiba et.al.,2017; Bartlett, 2017; Ibrahim, 2023)

Abdel Aziz & Abdel Maaboud (2020) agree that among keeping up with modern technical developments is the use of the Internet of Things, as it is a modern technical method that aims to attract things represented by devices and sensors and connect them to the Internet to exchange data between them without human intervention, thus helping to determine the time



for qualifying players in the correct manner, Another benefit of using artificial intelligence is that it helps sports rehabilitation officials identify and measure the severity of players' injuries and develop an appropriate rehabilitation program for them . (Abdel Aziz & Abdel Maaboud, 2020)

The goals and benefits of applying artificial intelligence in sports injury rehabilitation centers is the possibility of linking computer technology to training and rehabilitation halls for players and providing data and reports on the players' injury status periodically and measuring the severity of players' injuries. By using artificial intelligence technology, including the fifth generation of computers, players' measurements are determined and maintained throughout their sporting history. (Abdel Aziz & Abdel Maaboud, 2020; Al-Mulla ,2019)

Through what was presented above, the author, based on what was mentioned by both "Al-Damardash, Mahmoud Ismail Al-Hashemi" (2014), stated that despite the tremendous progress in the field of sports medicine, and specifically in the field of sports injuries, and taking all preventive measures and security and safety factors as much as possible to reduce injuries. However, we notice an increase in the rate of their occurrence, and on an ongoing basis recently, until it became a global phenomenon with medical and technical dimensions. (El-Damardash & El-Hashemi, 2014)

Whereas Hanan Mohammed Abd al-Latif and others (2022) indicate that there is a lack of sufficient expertise among injury and rehabilitation specialists and trainers in the sports field in Egypt, as they are not familiar with the latest methods and modern developments in injuries and rehabilitation in terms of good evaluation methods and rehabilitation, Through field practice in the field of injuries and by surveying the opinions of specialists and reviewing many studies and research, author s noticed the prevalence of injury and its frequent recurrence among athletes and the lack of accurate evaluation at times, which results in some incorrect decisions being made or the lack of rapid treatment or slow rehabilitation and rapid recovery, The author s also noted that traditional programs and methods for assessing injury are good, but not sufficiently and comprehensively, and sometimes lack accuracy to some extent and lack elements of development and modernization in light of technological progress . (Abd al-Latif & Ziada, 2022)

Guided by these considerations, this study was designed to systematically examine contemporary applications of advanced technological innovations, with particular focus on artificial intelligence in sports medicine and injury rehabilitation. The research objectives include assessing the practical utility of AI technologies in rehabilitation processes while simultaneously identifying potential barriers to their successful adoption.

This research aims to study the reality of using artificial intelligence applications in the rehabilitation of sports injuries by identifying the knowledge and information related to artificial intelligence applications used in sports injury rehabilitation, practical proficiency in



using artificial intelligence applications in sports injury rehabilitation and the obstacles to the use of artificial intelligence applications in sports injury rehabilitation.

Study Questions

1. What is the significance of the participants' response to injury and physical rehabilitation specialists' knowledge and information related to artificial intelligence applications used in sports injury rehabilitation?
2. What is the significance of the participants' response to their practical proficiency in using artificial intelligence applications in sports injury rehabilitation?
3. What is the significance of the response of the participants of injury and physical rehabilitation specialists towards the obstacles to using artificial intelligence applications in the rehabilitation of sports injuries?

Materials and Method

The author used the descriptive method, because it is appropriate for the nature and purpose of the study.

Participants

The participants were (380) sports injury and motor rehabilitation specialists, in addition (52) participants for the pilot study. They were working in the mentioned sports clubs and rehabilitation centers in the governorates (Giza - Menoufia), see table (1).

Table 1. Description of the research participant groups (N=432)

Groups	Numbers	Percentage (%)
Main study	380	87.96 %
Pilot study	52	12.03%
Total	432	100.00%

Procedures

1. Forming the questionnaire

The questionnaire's theoretical framework was developed through a comprehensive review and analysis of both Arab and international scientific literature across four key domains: (1) sports medicine and physical therapy, (2) sports injuries and rehabilitation, (3) measurement and evaluation, and (4) artificial intelligence applications in sports science. This systematic literature review enabled the identification of the questionnaire's core dimensions. as shown in Table (2).

The questionnaire's framework was validated through in-depth personal interviews conducted with nine expert professors specializing in sports injuries and rehabilitation, measurement and evaluation, and artificial intelligence applications. These interviews, held from May 10 to October 14, 2024, served three primary purposes: (1) assessing the



framework's alignment with the study objectives, (2) evaluating its appropriateness for the target population, and (3) determining the relative importance of each dimension. Table (3) shows the percentage of agreement between experts on the scale's axes, which reached (% 100).

Table 2. Axes of the questionnaire ‘ the reality of using artificial intelligence applications in sports injury rehabilitation’

Nr	Questionnaire Axis
1	Knowledge and information related to artificial intelligence applications used in sports injury rehabilitation
2	Proficiency in using artificial intelligence applications in sports injury rehabilitation
3	Obstacles to using artificial intelligence applications in sports injury rehabilitation

Table 3. Percentage of expert agreement on the questionnaire axes (N = 9)

Nr	Questionnaire Axis	Agree	Disagree	Agreement Percentage
1	Knowledge and information related to artificial intelligence applications used in sports injury rehabilitation	9	-	% 100
2	Proficiency in using artificial intelligence applications in sports injury rehabilitation	9	-	% 100
3	Obstacles to using artificial intelligence applications in sports injury rehabilitation	9	-	% 100

2. Determining the phrases of the questionnaire

A- The author consulted scientific references and Arab and foreign research, as well as experts, to collect appropriate phrases for each axis. He then formulated them into fifteen phrase per domain, which resulted in the (45) phrases.

Table 4. Initial distribution of the number of phrases for each axis of the proposed scale (n=45)

Nr	Questionnaire Axis	Nr. of phrases
1	Knowledge and information related to artificial intelligence applications used in sports injury rehabilitation	15
2	Proficiency in using artificial intelligence applications in sports injury rehabilitation	15
3	Obstacles to using artificial intelligence applications in sports injury rehabilitation	15



B- The initial draft of the questionnaire was reviewed by a panel of experts to assess: (1) the validity of items in measuring the intended constructs, and (2) the appropriateness of the proposed Likert-type scale (*Always applies* = 3 points, *Sometimes applies* = 2 points, *Not applicable* = 1 point). Based on expert feedback, certain items required modification to enhance clarity and relevance. Additionally, the experts unanimously recommended reversing the scoring direction for the third axis (obstacles to using AI applications in sports injury rehabilitation) to ensure consistent interpretation. Thus, responses for this axis were recalibrated as follows: *Always applies* = 1 point, *Sometimes applies* = 2 points, and *Not applicable* = 3 points. This adjustment maintained methodological rigor while addressing the unique evaluative requirements of this section.

C- The author modified the wording of some phrases based on the opinions of the experts. The following table shows the modified phrases as follows:

Table 5. Modified phrases in the proposed questionnaire axes according to the experts' opinions

Nr	Questionnaire Axis	Modified phrases
1	Knowledge and information related to artificial intelligence applications used in sports injury rehabilitation	6, 8
2	Proficiency in using artificial intelligence applications in sports injury rehabilitation	9
3	Obstacles to using artificial intelligence applications in sports injury rehabilitation	4, 6

D- Based on what is shown in Table (5), the modification is clear in the wording of some of the axes' phrases to reach (45) phrases for the questionnaire, distributed as follows:

Table 6. Final distribution of the number of phrases in each axis of the questionnaire

Nr	Questionnaire topics	Modified phrases
1	Knowledge and information related to artificial intelligence applications used in sports injury rehabilitation	15
2	Proficiency in using artificial intelligence applications in sports injury rehabilitation	15
3	Obstacles to using artificial intelligence applications in sports injury rehabilitation	15

Content validity of the questionnaire



The internal consistency validity is calculated by finding the correlation coefficient between each statement and the axis to which it belongs in the questionnaire. This phase was implemented during the period from (29/10/2024 - 15/11/2024), as shown in Tables (7) and (8).

Table 7. Internal consistency through correlation coefficients between each statement and the axis to which it belongs (N=52)

Nr	Knowledge and information related to artificial intelligence applications used in sports injury rehabilitation	Proficiency in using artificial intelligence applications in sports injury rehabilitation	Obstacles to using artificial intelligence applications in sports injury rehabilitation
1	0.393*	0.440*	0.430 *
2	0.412*	0.308*	0.390 *
3	0.515*	0.320*	0.423 *
4	0.518*	0.437*	0.331 *
5	0.401*	0.398*	0.340 *
6	0.412*	0.454*	0.299 *
7	0.489*	0.380*	0.254 *
8	0.465*	0.400*	0.325 *
9	0.424*	0.313*	0.452 *
10	0.349*	0.311 *	0.334 *
11	0.378*	0.333*	0.456 *
12	0.472*	0.335*	0.450 *
13	0.495*	0.443*	0.454 *
14	0.302*	0.289*	0.368 *
15	0.399*	0.440*	0.394 *

*The tabular value of "r" at a significance level of 0.05 = 0.231

Table 8. Correlation coefficient between each axis and the total questionnaire

Nr	Questionnaire topics	Correlation coefficient with the total score of the questionnaire
1	Knowledge and information related to artificial intelligence applications used in sports injury rehabilitation	0.377 *
2	Proficiency in using artificial intelligence applications in sports injury rehabilitation	0.361 *
3	Obstacles to using artificial intelligence applications in sports injury rehabilitation	0.372 *

*The tabular value of "r" at a significance level of 0.05 = 0.231

All correlation values between each statement showed statistical significance at the (0.05) level, confirming the homogeneity of the questionnaire



The Reliability

The author established reliability on the survey sample by applying the questionnaire and reapplying it again two weeks after the first application. The sample consisted of (52) sports injury and rehabilitation specialists.

Table 9. Correlation coefficient between the first and second applications of the questionnaire (n=52)

Axes	Number of phrases	First application		Second application		Correlation coefficient
		m	SD	M	SD	
Knowledge and information related to artificial intelligence applications used in sports injury rehabilitation	15	30.18	2.69	35.37	2.85	* 0.75
Proficiency in using artificial intelligence applications in sports injury rehabilitation	15	33.03	3.43	37.8	3.2	* 0.66
Obstacles to using artificial intelligence applications in sports injury rehabilitation	15	34.9	3.52	38.03	3.3	* 0.77

* The tabular value of "r" at a significance level of 0.05 is 0.231 * D at 0.05

Main Study

The author administered the attached questionnaire (4) to sports injury and rehabilitation specialists during the period from November 22, 2024 to December 9, 2024. The data was then collected and statistically processed using the statistical methods used in the study.

Statistical Analysis

Statistical processing used. In accordance with the nature of the data associated with the study's methodology, the author used the statistical method appropriate for processing the data statistically using the statistical program (SPSS)

- Percentage
- Relative importance
- Arithmetic mean
- Standard deviation
- Pearson's correlation coefficient
- Chi-square test

Results

Based on the research objectives and hypotheses, the author presented and discussed the results.



Table 10. Percentage of responses regarding the first axis (Knowledge and information related to artificial intelligence applications used in sports injury rehabilitation) (N = 380)

Phrase Nr	Always applies		Sometimes applies		Not applicable		Total marks	Chi square
	Repetition	%	Repetition	%	Repetition	%		
1	319	83.9	61	16.05	0	0	1080	47.83*
2	312	82.1	59	15.50	9	2.4	1063	44.33*
3	287	75.5	87	22.90	6	1.6	1041	30.22*
4	285	75	88	23.20	7	1.8	1038	28.76*
5	241	63.4	139	36.60	0	0	1001	22.91*
6	300	78.9	78	20.50	2	0.5	1058	38.71*
7	299	78.6	70	18.40	11	2.9	1048	32.88*
8	283	74.5	93	24.50	4	1.1	1039	29.66*
9	287	75.5	89	23.40	4	1.1	1043	31.18*
10	271	71.3	104	27.40	5	1.3	1026	24.27*
11	297	78.1	75	19.70	8	2.10	1049	33.69*
12	298	78.4	82	21.60	0	0	1058	38.75*
13	305	80.2	75	19.70	0	0	1065	46.07*
14	304	80	72	19	4	1.1	1060	42.44*
15	300	78.9	77	20.30	3	0.88	1057	35.99*
Total marks							14646	

* chi² value at level (0.05) =5.99

Table 11. Percentage of study sample responses on the second axis Applied proficiency in using artificial intelligence applications in sports injury rehabilitation (N=380)

Phrase Nr	Always applies		Sometimes applies		Not applicable		Total marks	Chi ²
	Repetition	%	Repetition	%	Repetition	%		
1	45	11.8	168	44.2	167	44	638	16.75*
2	76	20	77	20.3	227	59.7	609	16.22*
3	51	13.4	129	34	200	52.6	611	16.29*
4	38	10	297	78.2	45	11.9	753	17.81*
5	35	9.2	120	31.6	225	59.2	570	15.65*
6	78	20.5	155	40.8	147	38.7	691	17.07*
7	103	27.1	211	55.5	66	17.4	797	18.04*
8	121	31.8	214	56.3	45	11.8	836	18.78*
9	319	84	61	16.1	0	0	1079	47.63*
10	108	28.4	222	58.4	50	13.2	818	18.54*
11	33	8.7	111	29.2	236	62.1	557	15.25*
12	35	92.1	33	8.7	312	82.1	483	15.05*
13	66	17.4	68	17.9	246	64.7	580	15.98*
14	41	10.8	288	75.8	51	13.4	750	17.67*
15	177	46.6	182	47.9	21	5.5	916	21.86*
Total marks							10688	

* chi² value at level (0.05) =5.99



Table 12. Percentage of study sample responses on the third axis Obstacles to the use of artificial intelligence applications in sports injury rehabilitation (N=380)

Phrase Nr	Always applies		Sometimes applies		Not applicable		Total marks	Chi- square
	Repetition	%	Repetition	%	Repetition	%		
1	333	87.6	46	12.1	1	0.26	638	16.75*
2	318	83.7	60	15.8	2	0.52	609	16.22*
3	351	92.4	25	6.6	4	1.1	611	16.29*
4	354	93.2	26	6.8	0	0	753	17.81*
5	362	95.3	15	4	3	0.89	570	15.65*
6	335	88.2	44	11.6	1	0.26	691	17.07*
7	297	78.2	83	21.8	0	0	797	18.04*
8	297	78.2	80	21.1	3	0.79	836	18.78*
9	371	97.6	7	8.1	2	0.52	1079	47.63*
10	309	81.3	70	18.4	1	0.26	818	18.54*
11	322	84.7	47	12.4	11	2.9	557	15.25*
12	341	89.5	32	8.4	7	1.8	483	15.05*
13	313	82.4	63	16.6	4	1.1	580	15.98*
14	286	75.3	94	24.7	8	2.1	750	17.67*
15	272	71.6	5	1.3	103	27.1	916	21.86*
Total marks							10688	

* χ^2 value at level (0.05) = 5.99

Table 13. Arrangement of the axes according to their percentage*

Questionnaire Axes	Total Score	Percentage (%)	Axis Ranking
Knowledge and information related to artificial intelligence applications used in sports injury rehabilitation	14646	% 85.6	1
Proficiency in using artificial intelligence applications in sports injury rehabilitation	10688	% 62.5	2
Obstacles to using artificial intelligence applications in sports injury rehabilitation	6705	% 39.2	3

* Axis ranking (the relative weight of the axis within the scale)

$$\text{Axis ranking} = \frac{\text{Total (sum of the axis scores)}}{(\text{Sample numbers} \times \text{upper limit} \times \text{number of axis statements})}$$



Discussion

Based on the research objectives and questions, the author applied the questionnaire to the primary participants and presented the results shown in Tables (9, 11, 10, 12, 13), which enabled the author to answer the research questions, as follows:

Tables (10) and (13), which show the responses of the participants on “sports injury and rehabilitation specialists” to the statements of the first axis, which includes knowledge and information related to artificial intelligence applications used in the rehabilitation of sports injuries, the percentage of responses ranged between (0% to 83.9%), as Table (10) shows the presence of statistically significant differences at a statistical significance level of (0.05) between the repetitions of the statements, which were represented: (Always applies) The sample response ranged between (63.4%:83.9%)- (Sometimes applies) The sample response ranged between (15.5%:36.6%)- (Not applicable) The sample response ranged between (0%: 2.9%)

The axis of “Knowledge and information related to artificial intelligence applications used in the rehabilitation of sports injuries” came in first place with a high total score of 14646 points and a percentage of (85.6%) as shown in Table (13) according to the arrangement of the axes according to their percentage, which is a high percentage that indicates the importance of the axis, and according to what is shown in the results of the aforementioned tables for the most frequent repetitions of the participants for response .

According to the above-mentioned percentages and based on the above, the author sees what was indicated by the results of the first axis, “Knowledge and information related to artificial intelligence applications used in the rehabilitation of sports injuries,” as being the cornerstone in adapting the use of advanced artificial intelligence (AI) methods in sports medicine to deal with this difficult, multifaceted task.

This is further supported by a 2023 study conducted by Imam and colleagues, which highlights the rapid growth of smart applications across various electronic devices, particularly those powered by artificial intelligence (AI). These applications—including mobile apps, chatbots, and automated assistants—have gained significant momentum, especially with the emergence of ChatGPT. Its launch sparked widespread attention and marked a major technological leap, with experts recognizing it as a transformative shift in knowledge dissemination. By simulating human-like reasoning, AI-driven chat platforms present new opportunities for spreading awareness, underscoring the importance of leveraging advanced technology to enhance health education.

The Ninth International Health Conference (2022), organized by the Health Education Department of the Supreme Council for Family Affairs in Sharjah, underscored the critical role of digital health in improving quality of life and healthcare efficiency. The conference explored the future of digital health, its impact on well-being, and the need to maximize digital



transformation for sustainable community health. It also highlighted how information technology and AI can enhance health education practices, affirming that digital health is a key driver of high-quality medical services and outcomes. (Source: Al-Bayan)

Therefore, the author agrees with what was recommended by the study of Rabi (2021) regarding the necessity of preparing and training workers to use smart applications well in terms of enacting strict laws that guarantee all rights for users and reduce the risks facing smart applications.

The author also agrees with the study of Al-Hamad & Al-Rashidi (2024) that artificial intelligence can analyze sports injury data and extract patterns and factors associated with their occurrence. Artificial intelligence can learn from previous injury records and available data on environmental, training and physiological conditions that may lead to sports injuries by analyzing this data, AI can provide teachers with targeted guidance on designing training programs and preventative measures to reduce injuries.

Based on the above, the first question has been answered: " *What is the significance of the participants' response to injury and physical rehabilitation specialists' knowledge and information related to artificial intelligence applications used in sports injury rehabilitation?* "

By reviewing the results of tables (11) and (13), which show the responses of the participants of "sports injury and rehabilitation specialists" to the phrases of the second axis, which is related to the practical proficiency in using artificial intelligence applications in the rehabilitation of sports injuries, it was shown that the percentage of responses ranged between (0% to 92.1%), and the table shows the presence of statistically significant differences at a statistical significance level of (0.05) between the repetitions of the phrases, which were represented in the following:-

- (Always applies) The sample response ranged between (8.7% - 83.5%)
- (Sometimes applies) The sample response ranged between (8.7% - 78.2%)
- ((Not applicable) The sample response ranged between (0% - 82.1%)

According to what the results of the aforementioned tables show, the most frequent responses of the participants to the response (always applies) were (92.1%), (84%) in phrases (12, 9) respectively:

- Statement No. (12): I am proficient in using smart sports analysis techniques in the field of sports injury rehabilitation, utilizing wearable devices and sensors to customize rehabilitation programs tailored to individual needs by providing data-driven analytical insights through analyzing the collected information.

- Statement No. (9): I can use artificial intelligence technology to measure players' temperatures using thermal scanning upon entry to rehabilitation centers.



Table (12) also shows that the axis of “applied proficiency in using artificial intelligence applications used in the rehabilitation of sports injuries” came in second place according to the arrangement of the axes according to their percentage, with a total score of 10,688 points and a percentage of (62.5%).

The author observes that although a high percentage of participants (92.1% and 84%) selected "always applies" for phrases (12, 9) in the second axis, the overall frequency of this response was notably lower across the remaining phrases. This suggests a gap in the practical skills of sports injury and rehabilitation specialists when applying AI in their field. Possible reasons include the high cost of advanced technologies, a lack of specialized scientific literature on AI in sports injury rehabilitation, and insufficient player injury data—such as medical histories, injury types, and recovery timelines—needed to develop scientifically sound rehabilitation programs.

Abd al-Latif & Ziyada (2022) point out the lack of sufficient expertise among injury and rehabilitation specialists and trainers in the sports field in Egypt, as they are not familiar with the latest methods and modern developments in injuries and rehabilitation in terms of good assessment and rehabilitation methods.

The author also agrees with both Khalil (2010) and Bakri (2009) that the sports injuries and motor rehabilitation specialist, in order to carry out his positive and effective role in the proper care of the injured or sick, must work on sound and modern scientific foundations and with a high level of professional competence .

According to the presented criteria, the author agrees with what was confirmed by Ezzat (2013) that the success of the motor rehabilitation specialist in achieving his professional mission depends largely on the preparation he receives.

The author emphasizes what was recommended by the study of Rabi (2021) regarding the necessity of preparing and training workers to use smart applications well in terms of enacting strict laws that guarantee all rights for users and reduce the risks facing smart applications.

It is worth noting that developing the practical proficiency of sports injury specialists in using modern technologies and technological developments allows for identifying and targeting players at risk of injury, mitigating the risk of injury, as well as rapid treatment, rehabilitation and recovery, In the context of the above, it is worth noting here that artificial intelligence can analyze data on recorded sports injuries and identify common patterns and factors influencing their occurrence , Artificial intelligence can use deep learning techniques and data analysis to uncover common patterns in sports injuries, such as common injuries to certain parts of the body or influencing factors such as training techniques or surface quality. This information can



be used to develop preventative strategies and programs that target these weak points and reduce the risk of injury.

Hence, the research results are consistent with what was indicated by both Al-Mulla (2019) and Naseef (2008) that the use of artificial intelligence methods leads to speed and accuracy in providing services and thus ease and distinction, as it is linked to the beneficiaries and the service provided to them from analyzing players' data more quickly.

The study also agreed with Basyouni (2005) that the use of artificial intelligence applications such as the smart agent and the fifth generation of computers, to work on completing work quickly, as well as relying on modern neural network technologies that work to save time and effort to a great extent.

Al-Maliji (2023) also states that predictive models can be used to identify players who are likely to be injured or perform poorly, and coaches and managers can use this information to make decisions about player rotation and game strategy.

Through the above, the first question has been answered, which states: ‘*What is the significance of the participants' response to their practical proficiency in using artificial intelligence applications in sports injury rehabilitation?*’.

By reviewing what was shown by the results of Tables (11) and (12), which show the responses of the study sample of “sports injury and rehabilitation specialists” to the phrases of the third axis, which relates to the obstacles to using artificial intelligence applications in the rehabilitation of sports injuries, The results showed that the percentage of responses ranged between (0% to 97.6%), and the table shows the presence of statistically significant differences at a statistical significance level of (0.05) between the repetitions of the phrases, which were represented in the following:-

- (Always applies) The sample response ranged between (71.6% - 97.6%)
- (Sometimes applies) The sample response ranged between (1.3% - 24.7%)
- (Not applicable) The sample response ranged between (0% - 2.9%)

According to the results of the aforementioned tables, the most frequent responses of the participants to the response (always applies) reached (97.6%) and (95.3%) in statements (9 and 5), respectively:

- Statement (9): Health clubs, motor rehabilitation centers, and sports clubs do not have sufficient computing capacity to run artificial intelligence applications.

- Statement (5): The application of artificial intelligence requires high costs, due to the presence of old rehabilitation sports equipment that is not compatible with fifth generation technology.



The axis “Obstacles to the use of artificial intelligence applications in the rehabilitation of sports injuries” came in third place with a high total score of 6705 points and a percentage of (39.2%), as shown in Table (12) according to the arrangement of the axes according to their percentage.

Commenting on the aforementioned results in this axis, the author moves towards explaining the noticeable decrease in the participants’ response frequency (always applies) , (Not applicable) as an indication of the difficulties and challenges related to the use of artificial intelligence applications in the rehabilitation of sports injuries resulting from a shortage of human capabilities in terms of the low practical skill of injury and rehabilitation specialists in using artificial intelligence applications in the rehabilitation of injured players on the one hand , On the other hand, players find it difficult to understand artificial intelligence applications, as well as the lack of infrastructure in terms of wireless communications, computers, and software, in addition to the lack of proficiency in the English language, as many applications do not support the Arabic language.

The research results are consistent with what is generally indicated by the results of the study by El-Ghazali (2024), as there are many challenges facing the use of electronic applications in the process of motor rehabilitation, such as the lack of training and knowledge exchange, the scarcity of scientific research and studies, the lack of awareness, the high costs of development, and the difficulty of finding suitable applications , Therefore, it is necessary to focus on addressing these challenges in order to promote the more effective use of electronic applications in the field of motor rehabilitation.

The studies of both Abdel Aziz & Abdel Maaboud” (2024), the study of Halawa (2020), Abdullah (2009) concluded that among the implications of the obstacles to applying artificial intelligence in sports injury rehabilitation centers is the lack of human cadres specialized in artificial intelligence, as well as the lack of infrastructure of wireless communications, computers and software , In addition, rehabilitation specialists face difficulty in using the Internet of Things and integrating it into rehabilitation devices, which poses challenges to the application of artificial intelligence in sports injury rehabilitation centers at sports clubs.

Hassan’s study (2023) also indicates that the obstacles to applying artificial intelligence indicate the difficulty of players understanding artificial intelligence applications, as well as the difficulty of analysts developing appropriate programs for players through smartphones.

The author also agrees with Luger (2008) study, which states that the application of artificial intelligence requires high costs due to the presence of outdated rehabilitation sports equipment that is incompatible with fifth-generation technology.

Based on the presented criteria of discussing results, the third question has been answered, which states: “ *What is the significance of the response of the participants of injury*



and physical rehabilitation specialists towards the obstacles to using artificial intelligence applications in the rehabilitation of sports injuries ?''.

Conclusion

Based on the research objectives, sample, and results, the author was able to conclude the following:

First: Regarding the first axis (Knowledge and information related to artificial intelligence applications used in sports injury rehabilitation)

- 1- Sports injury and motor rehabilitation specialists are aware of the contribution of artificial intelligence in creating predictive models of player performance using machine learning algorithms to analyze data including player statistics and previous injury records, which identify players who are likely to be injured.
- 2- Sports injury and motor rehabilitation specialists understand the role of smart agents and fifth-generation computers in giving orders to treat and rehabilitate injured players without human intervention.
- 3- The interest of sports injury and motor rehabilitation specialists in knowing computer vision techniques because of their ability to guide injured players while implementing their rehabilitation programs.
- 4- The interest of sports injury and motor rehabilitation specialists in studying the uses of the Internet of Things in evaluating the levels of physical and functional efficiency of injured players.

Second: Regarding the second axis (Proficiency in using artificial intelligence applications in sports injury rehabilitation)

- 1- The ability of sports injury and motor rehabilitation specialists to use thermal scanning to measure players' temperatures using artificial intelligence technology upon entering rehabilitation centers.
- 2- The ability to use smart sports analysis techniques in the field of sports injury rehabilitation by using wearable devices and sensors to customize rehabilitation programs directed to individual needs by providing data-driven analytical insights by analyzing the collected information.



- 3- Low practical skills in using smart insole technologies, which are currently used in medical rehabilitation for athletes' injuries, by tracking their movement and analyzing the pressure on their feet.
- 4- The lack of practical ability to use sleep measurements and biomarkers to predict injury risk.
- 5- The lack of practical experience in using virtual reality training, known as simulation environments, to guide injured players through rehabilitation programs.

Third: Regarding the third axis (Obstacles to using artificial intelligence applications in sports injury rehabilitation)

- 1- A review of the ITU report reveals that one of the major obstacles facing developing countries is the limited use of social media by their populations, and the difficulty of convincing them to switch from 3G to broadband services.
- 2- Poor English proficiency, as many successful applications do not support Arabic.
- 3- Health clubs, physical rehabilitation centers, and sports clubs do not have sufficient computing power to run artificial intelligence applications.
- 4- The lack of wireless infrastructure, computers, and software, as well as the difficulty of rehabilitation specialists using the Internet of Things and integrating it with rehabilitation devices, are all factors.
- 5- Lack of trust in many applications due to their violation of user privacy, and the high subscription costs for non-free, effective applications.
- 6- There is a shortage of qualified human resources to implement artificial intelligence systems within motor rehabilitation centers.
- 7- Lack of financial funding for the purchase of devices and equipment necessary for artificial intelligence applications in healthcare and sports injury rehabilitation at sports clubs and motor rehabilitation centers

Recommendations

According to the concluded results and discussion, there are some recommendations

- 1- It is necessary to include education and training on the use of artificial intelligence applications in the curricula of motor rehabilitation studies at sports science colleges, to ensure graduates are familiar with these modern technologies.



2. Attention should be given to holding educational seminars and lectures on information, knowledge, and practical applications of the uses of artificial intelligence technological innovations in healthcare and sports injury rehabilitation in sports clubs and motor rehabilitation centers.
- 3- Raising awareness of the importance of using modern neural network technologies, which significantly save time and effort in sports injury rehabilitation.
- 4- Holding workshops to teach and apply the use of machine learning algorithms to predict sports injuries.
- 5- Working to expand the integration of artificial intelligence into the field of sports injury rehabilitation by increasing reliance on artificial intelligence in sports injury rehabilitation centers by linking all sports injury rehabilitation devices to the neural network and converting them to electronic codes for the devices, transforming them into receivers that receive commands and execute them remotely using Internet of Things technology.
- 6- Proposing the addition of a graduate course in sports science colleges aimed at providing practical experience with modern technological devices in the areas of assessment and motor rehabilitation for sports injuries.
- 7- Developing educational programs in collaboration with specialists in sports medicine and artificial intelligence to enhance cognitive competence in the rehabilitation of sports injuries.
- 8- The need to develop the infrastructure within the physical rehabilitation center and sports clubs, while providing all the necessary requirements to keep pace with any future developments in artificial intelligence applications in the field of rehabilitation of sports injuries for players.
- 9- Working to enhance the capacity of sports injury specialists to use computer hardware and software, given the limited language skills and the lack of training programs qualified to address the requirements of digital and electronic transformation.
- 10- Increase the union's role toward sports injury and rehabilitation specialists by developing strategic plans involving multiple stakeholders to implement artificial intelligence systems in motor rehabilitation centers and sports clubs.
- 11- Work to increase the attraction and motivation of players toward using electronic applications in the field of motor rehabilitation by highlighting the results of recovery and achieving the desired results in the shortest time and at the lowest cost



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