SHI, Zhiming, CHEN, Junjie and CHENG, Guangxin. Applications of Artificial Intelligence in Sports Rehabilitation: Current Applications, Challenges, and Their Impact on Health and Physical Education. Journal of Education, Health and Sport. 2026;87:67695. eISSN 2391-8306.
https://doi.org/10.12775/JEHS.2026.87.67695
https://apcz.umk.pl/JEHS/article/view/67695

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).
Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).
The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 23.12.2025. Revised: 12.01.2026. Accepted: 19.01.2026. Published: 22.01.2026.

Applications of Artificial Intelligence in Sports Rehabilitation: Current Applications, Challenges, and Their Impact on Health and Physical Education

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Abstract

Background: Exercise rehabilitation plays a vital role in improving motor function, promoting health, and enhancing quality of life, and is widely used among people with functional impairments, patients with chronic diseases, and the elderly. However, traditional exercise rehabilitation models still have limitations, particularly in long-term and home-based rehabilitation settings, due to insufficient objectivity in assessment methods, limited training feedback, and low exercise adherence. In recent years, the rapid development of artificial intelligence (AI) technology has provided new technological pathways for the field of exercise rehabilitation, helping to achieve objective assessment, personalized intervention, and continuous monitoring.

Objective: This review aims to systematically summarize the current application status of AI in exercise rehabilitation, conclude its impact on motor function and health-related outcomes, analyze the main challenges currently faced, and explore its implications for health promotion and physical education.

Methods: A narrative review method was used to summarize and analyze research related to AI-assisted exercise rehabilitation, focusing on exercise assessment, personalized training, feedback mechanisms, home-based rehabilitation, and practical applications in different populations and application scenarios.

Results: Existing research indicates that AI-assisted exercise rehabilitation has a positive effect on improving movement quality, enhancing motor function, and increasing exercise adherence. Artificial intelligence systems can support objective and continuous exercise assessments, facilitate the implementation of personalized training programs, and enhance user engagement through real-time feedback. Furthermore, related research shows its potential value in health-related outcomes and long-term rehabilitation management. However, challenges remain regarding data quality, system adaptability, ethical and privacy protection, professional training, and integration with education and health systems.

Conclusion: As a supportive tool, AI demonstrates significant application potential in the field of sports rehabilitation, providing new opportunities for health promotion and physical education. While current evidence generally shows a positive trend, high-quality research and interdisciplinary collaboration are still needed to promote the standardization, ethical considerations, and sustainable development of AI-assisted sports rehabilitation in practice. The rational integration of AI-assisted sports rehabilitation into health and physical education

systems is expected to promote a more human-centered rehabilitation and health management model.

Keywords: Artificial intelligence; sports rehabilitation; health promotion; physical education; exercise assessment; health education

1 Introduction

Against the backdrop of accelerating global population aging, high incidence of chronic non-communicable diseases, and the prevalence of sedentary lifestyles, motor dysfunction and related health problems have become significant factors restricting individual quality of life and public health[1]. Exercise rehabilitation, as an important means of promoting functional recovery, improving health status, and preventing disease progression, is widely used in various fields such as neurological diseases, age-related functional decline, chronic respiratory diseases, and sports injury recovery. However, in practical applications, traditional exercise rehabilitation models still face problems such as reliance on experience-based assessments, lack of real-time quantitative feedback during training, insufficient rehabilitation adherence, and difficulties in monitoring home-based rehabilitation[2]. These issues, to some extent, affect the stability and scalability of rehabilitation outcomes.

In recent years, the rapid development of Artificial Intelligence (AI) technology has brought new opportunities to the field of exercise rehabilitation[3]. By integrating computer vision, wearable sensors, motion-sensing interaction systems, and data analysis technologies, AI can continuously, objectively, and multidimensionally monitor and analyze the human movement process, providing technical support for motor function assessment, training process guidance, and personalized adjustments to rehabilitation programs[4]. Compared to traditional models primarily relying on human guidance, AI-assisted sports rehabilitation demonstrates significant advantages in improving the accuracy of movement assessment, enhancing training feedback, improving the experience of sports participation, and supporting remote and home-based rehabilitation. From a health promotion perspective, the application of AI in sports rehabilitation not only helps improve individual motor function and physical health outcomes but also provides new tools for long-term management of chronic diseases and interventions in health behaviors[5]. Through visualized feedback and data tracking, participants can more intuitively understand their own exercise status and rehabilitation progress, thereby improving their health awareness and self-management abilities. This data-driven rehabilitation approach aligns with the modern health education philosophy that emphasizes active participation and

behavior change, and has a positive impact on improving public health literacy[6]. At the same time, the introduction of AI technology also presents new requirements for the training of professionals in physical education and sports rehabilitation. With the increasing application of intelligent assessment tools, digital training systems, and virtual interactive technologies in rehabilitation practice, traditional teaching models based primarily on experience transmission are no longer sufficient to meet the needs of industry development[7]. How to rationally integrate AI-related content into physical education and sports rehabilitation education, and cultivate professionals with interdisciplinary knowledge structures and digital capabilities, has become an important issue that urgently needs attention. However, the widespread application of artificial intelligence in sports rehabilitation still faces challenges such as technological adaptability, ethical and privacy protection, insufficient professional awareness, and limited support from the education system[8]. Therefore, a systematic review and comprehensive analysis of existing research is necessary.

Based on this background, this paper reviews the research progress of AI in sports rehabilitation, focusing on summarizing the main application forms of AI in exercise assessment, training intervention, and health management. It outlines its potential value for improving motor function and health outcomes and analyzes the main problems and limitations in current research. Building on this, the paper further explores the implications of AI-driven sports rehabilitation for health education and physical education, aiming to provide theoretical basis and reference directions for related research, teaching reform, and practical applications.

2 Conceptual Framework of AI in Exercise Rehabilitation

The application of artificial intelligence in sports rehabilitation is not simply the introduction of a single technological means, but a comprehensive system integrating rehabilitation medicine theory, sports science principles, and digital technology[9]. From a holistic perspective, AI-powered sports rehabilitation systems reconstruct the implementation logic of exercise assessment, training intervention, and rehabilitation management through a data-driven approach, enabling sports rehabilitation to gradually shift from experience-based to evidence-based and refined methods. Constructing a clear conceptual framework helps to understand the functional positioning, operational mechanisms, and extended value of AI in sports rehabilitation within the fields of health and education[10].

2.1 Functional Definition of Artificial Intelligence in Sports Rehabilitation

In the context of sports rehabilitation, artificial intelligence is not equivalent to an independent treatment subject with autonomous decision-making capabilities, but rather a technological tool used to support professional judgment and training management[11-13]. Its

core functions lie in assisting rehabilitation assessment, optimizing the training process, and enhancing the continuity of rehabilitation management. Compared to traditional methods relying on human observation and experience-based judgment, AI can provide a more objective and quantifiable information foundation for sports rehabilitation through continuous collection and analysis of exercise data. From a functional perspective, the role of AI in sports rehabilitation is mainly reflected in three aspects: first, supporting motor function assessment by describing movement quality, exercise intensity, and functional changes through quantitative indicators; second, assisting training intervention by providing feedback and adjustment suggestions during training; and third, serving rehabilitation management by promoting long-term health monitoring through data recording and trend analysis[14]. Therefore, the introduction of AI has not weakened the role of professionals, but rather, to a certain extent, enhanced the scientific nature and repeatability of their decisions.

2.2 Basic Structure of AI-Powered Sports Rehabilitation Systems

From a system composition perspective, AI-powered sports rehabilitation typically consists of a data acquisition module, a data processing module, and a feedback intervention module. The data acquisition module records an individual's athletic performance and related information during training or daily activities, aiming to reflect the body's movement state as realistically as possible. Through continuous or periodic data collection, the system can create a dynamic profile of an individual's movement characteristics[15-17].

The data processing module is the core of the artificial intelligence system. Its main task is to integrate, analyze, and interpret the collected data to identify movement patterns, action deviations, or functional change trends. By structuring the data, complex movement information is transformed into meaningful assessment results, providing a basis for subsequent interventions[18]. The feedback intervention module handles the interaction between the system and the user. By presenting the analysis results in an intuitive way, the system can provide users with immediate or periodic feedback, helping them understand their training performance and make corresponding adjustments. This feedback mechanism extends athletic rehabilitation training beyond post-event evaluation, integrating it into a continuous guidance process[19-20].

2.3 Human-Computer Interaction and Participation Mechanism in Exercise Rehabilitation

Human-computer interaction is a crucial foundation for the effective intervention of AI-based exercise rehabilitation systems. Through well-designed interaction methods, AI systems can transform abstract data results into information easily understood by users, thereby lowering the technological barrier to entry[21-23]. In the exercise rehabilitation process, a clear

and intuitive interface helps improve users' understanding of training goals and execution requirements, thus enhancing the standardization of training. Furthermore, AI systems often reconstruct the rehabilitation training process through contextualization or gamification, making the training content more attractive and engaging[24]. This design is particularly important in home-based rehabilitation and long-term rehabilitation management, helping to alleviate the problem of decreased adherence caused by high repetitiveness or lack of supervision in training. From a behavioral science perspective, good human-computer interaction not only promotes exercise execution but also supports the formation and maintenance of healthy behaviors to a certain extent[25].

2.4 Data-Driven Rehabilitation Feedback and Regulation Mechanism

The core operating logic of AI-based exercise rehabilitation systems can be summarized as a cyclical process of "data-driven—feedback regulation—behavioral optimization." The system continuously collects exercise data, dynamically analyzes the training process, and transforms the results into feedback information, thereby guiding users to adjust their exercise behavior[26-28]. This cyclical mechanism transforms sports rehabilitation from traditional phased assessments to process management, helping to improve the targeting and safety of training. In this process, feedback not only corrects movements but also reinforces learning and guides behavior. Through timely feedback on training performance, users can more quickly identify their shortcomings and make adjustments, gradually forming a more stable and effective exercise pattern. This data-based feedback mechanism provides a new intervention paradigm for sports rehabilitation[29].

2.5 Health and Educational Significance of Artificial Intelligence in Sports Rehabilitation

From a broader perspective, the value of artificial intelligence in sports rehabilitation extends beyond functional recovery to health promotion and educational practices. Through the visualization of the exercise process and rehabilitation results, artificial intelligence systems can enhance individuals' awareness of their own health status, promoting active participation and self-management abilities. This characteristic aligns closely with the goals of active participation and behavioral change emphasized in modern health education. Simultaneously, the application of artificial intelligence also presents new requirements for the training of professionals in physical education and sports rehabilitation[30]. Understanding the basic principles and application logic of artificial intelligence systems has become an important component of competency for sports rehabilitation-related professions. In education, artificial intelligence is not only part of the teaching content, but also provides practical tools for

innovation in teaching methods, which helps to promote the development of sports rehabilitation education towards digitalization and interdisciplinary approaches[31-33].

3 Current Status of Artificial Intelligence Applications in Sports Rehabilitation

With the increasing penetration of artificial intelligence technology into the fields of medical health and sports science, its application in sports rehabilitation is becoming increasingly diversified[34]. Existing research shows that AI is not limited to a single rehabilitation stage, but rather permeates multiple stages such as exercise assessment, training intervention, rehabilitation management, and health promotion. Based on differences in application goals and practical scenarios, the main applications of AI in sports rehabilitation can be summarized as exercise assessment and functional monitoring, personalized training and prescription development, intelligent feedback and adherence support, home and remote rehabilitation, and applications in specific diseases and populations[35-36].

3.1 AI-Assisted Exercise Assessment and Functional Monitoring

Exercise assessment is a fundamental aspect of sports rehabilitation, and its accuracy directly affects the formulation and adjustment of rehabilitation plans. Traditional exercise assessments largely rely on clinical observation and scale scoring by professionals. While these methods have some clinical value, they have limitations in terms of objectivity, continuity, and precision. The introduction of AI provides a new technological path for exercise assessment, enabling the continuous recording and analysis of athletic performance in the form of data. In practical applications, artificial intelligence systems can collect human movement information through motion-sensing devices, visual capture, or wearable devices, and analyze indicators such as joint range of motion, motor coordination, balance, and movement rhythm. By recognizing and comparing movement patterns, the system can assist in judging the quality of movements and their changing trends, providing a more objective basis for rehabilitation assessmen[37]t. This data-driven assessment method helps reduce subjective judgment differences and improves the repeatability of assessment results. Furthermore, AI-supported continuous monitoring expands movement assessment beyond specific time points to a process-oriented observation. This feature is significant in chronic disease management and long-term rehabilitation, providing conditions for dynamic evaluation of rehabilitation effects and adjustment of treatment plans.

3.2 Personalized Exercise Training and Rehabilitation Prescription Support

Individual differences are a crucial factor that cannot be ignored in exercise rehabilitation. Different populations exhibit significant variations in physical condition, disease state, and functional level, making it difficult for a uniform training program to meet the needs of all

individuals. Artificial intelligence (AI) provides technical support for the development of personalized rehabilitation prescriptions through the analysis of individual exercise data and training performance. During training, AI systems can dynamically adjust training content and intensity based on individual exercise capacity and rehabilitation progress. For example, they can gradually increase training difficulty while maintaining training safety, or promptly reduce training load when fatigue or abnormal performance occurs[38]. This dynamic adjustment mechanism makes rehabilitation training more targeted, helping to improve training effectiveness and reduce the risk of adverse events. From a rehabilitation management perspective, AI-supported personalized training models help improve the scientific nature and sustainability of rehabilitation programs, particularly suitable for populations requiring long-term intervention, such as the elderly and patients with chronic diseases.

3.3 Intelligent Feedback Systems and Improved Exercise Adherence

Insufficient exercise adherence is one of the important factors restricting rehabilitation effectiveness. A lack of immediate guidance and positive feedback can easily lead to inadequate training execution or interruption. Artificial intelligence-based sports rehabilitation systems enhance user engagement and initiative by constructing intelligent feedback mechanisms that provide real-time or phased feedback during training[39]. Feedback formats include movement correction prompts, training completion status displays, and visualization of rehabilitation progress. By transforming abstract movement data into intuitive information, users can more clearly understand their training performance and areas for improvement. This feedback not only provides guidance but also serves as a motivator, helping to maintain long-term training behavior. From a health education perspective, intelligent feedback mechanisms enhance individuals' understanding of the relationship between exercise and health, promoting more positive health behavior patterns and providing new practical tools for health promotion.

3.4 Home-based and Remote Exercise Rehabilitation Applications

With the development of information technology, home-based rehabilitation and remote health management have gradually become important directions for the development of exercise rehabilitation. Artificial intelligence provides a technological foundation for overcoming time and space limitations and expanding the accessibility of rehabilitation services. In home-based rehabilitation scenarios, AI systems can monitor and record the user's training process and transmit data and provide remote guidance via the network. This application model has significant advantages for the elderly, patients with chronic diseases, and areas with relatively insufficient rehabilitation resources[40]. With the support of AI systems, home-based rehabilitation no longer relies entirely on face-to-face guidance but can achieve a certain degree

of self-training and remote monitoring while ensuring safety. The promotion of remote exercise rehabilitation also provides a new practical platform for health education, enabling health intervention to shift from short-term projects to continuous management, and helping to build an individual-centered health service model.

3.5 Application Practices in Specific Populations and Disease Areas

At the specific application level, AI-assisted exercise rehabilitation has been explored in multiple disease areas and populations. Patients with neurological diseases often have motor dysfunction; AI-assisted training has shown positive effects in improving limb function, balance, and gait performance. In older adults, AI-supported exercise rehabilitation helps slow functional decline, reduce fall risk, and improve quality of life[41]. In patients with chronic respiratory diseases and long-term functional impairments, AI-assisted exercise rehabilitation supports home-based rehabilitation and long-term management by optimizing training guidance and improving adherence. These applications demonstrate that AI has good adaptability in different rehabilitation scenarios, but its effectiveness is still influenced by various factors such as population characteristics, training design, and implementation conditions.

4 Evidence and Health Outcomes of Artificial Intelligence in Sports Rehabilitation

Assessing the actual effectiveness of artificial intelligence (AI) in sports rehabilitation is crucial for determining its application value and feasibility for widespread adoption. Existing research primarily explores the effects of AI-assisted sports rehabilitation from multiple dimensions, including improvements in motor function, health-related outcomes, and changes in behavior and adherence. Overall, most studies show that AI-assisted sports rehabilitation plays a positive role in improving functional performance, enhancing health status, and promoting long-term rehabilitation participation[42]. However, its effectiveness is still influenced by factors such as study design, population characteristics, and intervention methods.

4.1 Impact on Motor Function and Movement Quality

Improved motor function is one of the core indicators for measuring the effectiveness of sports rehabilitation. Multiple studies have shown that AI-assisted sports training can improve trainees' limb function, balance, and motor coordination to a certain extent. By monitoring and providing feedback on the movement process in real time, AI systems help correct non-standard movements and reduce compensatory movements, thereby improving training quality. In rehabilitation for neurological diseases and individuals with functional impairments, AI-supported sports rehabilitation is used for assisted gait training, upper limb function training, and balance training. Research results generally show that compared to traditional training methods, the AI intervention group exhibits a more significant improvement trend in some

motor function indicators. This advantage may be related to continuous feedback and personalized adjustments during training, enabling trainees to better complete training tasks[43]. Furthermore, the continuous monitoring capabilities of artificial intelligence allow functional assessments to go beyond pre- and post-training comparisons, reflecting the dynamic process of functional changes and providing more comprehensive information for assessing rehabilitation progress.

4.2 Impact on Health-Related Outcomes

Besides motor function, health-related outcomes are also an important dimension for evaluating the effectiveness of AI-assisted exercise rehabilitation. Existing research has assessed AI-assisted exercise rehabilitation from aspects such as quality of life, fitness levels, and disease-related health indicators. Results show that some studies report positive effects of AI-assisted training in improving quality of life scores and physical performance. In patients with chronic diseases and the elderly, AI-supported exercise rehabilitation may help improve overall health by enhancing training standardization and consistency. For example, by optimizing training guidance and enhancing the participation experience, trainees are more likely to adhere to rehabilitation plans, thus gaining benefits in terms of physical fitness and perceived health. Although the health outcome indicators used in different studies vary, the overall trend supports the potential value of AI-assisted exercise rehabilitation in health promotion.

4.3 Impact on Exercise Adherence and Behavioral Outcomes

Exercise adherence is an important behavioral factor affecting rehabilitation outcomes. Multiple studies have indicated that AI systems, by providing immediate feedback, training records, and progress displays, help improve trainee participation and consistency. Compared to traditional training lacking feedback, AI intervention can alleviate, to some extent, the problem of interruptions caused by monotonous or unsupervised training. From a behavioral change perspective, AI-assisted sports rehabilitation may promote more positive health behaviors by enhancing individuals' awareness of their own movement behavior and health status. Through data visualization and goal prompts, trainees can better understand the meaning of training, thereby increasing their willingness to self-manage. This feature is significant in home-based rehabilitation and long-term health management.

4.4 Differences in Effects Across Different Populations and Application Scenarios

Existing research indicates that the effects of AI-assisted sports rehabilitation vary across different populations and application scenarios. For individuals with significant motor dysfunction or requiring long-term rehabilitation intervention, AI-assisted training often

demonstrates its advantages more readily. This may be related to the higher demand for continuous guidance and feedback in this population. In contrast, the additional effects of AI may not be as pronounced as expected in individuals with higher functional levels or milder rehabilitation needs. Furthermore, factors such as intervention frequency, training content design, and technology suitability also influence rehabilitation outcomes. These differences suggest that it is necessary to analyze the specific population and application context when evaluating the effects of AI-assisted sports rehabilitation[44].

4.5 Limitations of Existing Evidence

Although existing research generally supports the positive effects of AI-assisted sports rehabilitation, its evidence base still has certain limitations. Some studies had small sample sizes and limited follow-up periods, making it difficult to fully reflect long-term effects. Significant differences existed among studies in intervention methods, assessment indicators, and outcome reporting, increasing the difficulty of comparing and synthesizing research results. Furthermore, some studies focused more on technical feasibility and short-term functional improvements, neglecting the long-term impact of health education and behavioral changes. These shortcomings suggest that future research needs further standardization and improvement in study design and the selection of evaluation indicators.

5 Challenges and Limitations of Artificial Intelligence in Sports Rehabilitation

Although artificial intelligence has shown broad application prospects and positive health value in the field of sports rehabilitation, its promotion and practice still face multiple challenges. Existing research and application practices indicate that these challenges stem not only from the technical level but also from ethical norms, professional competence, educational system adaptation, and real-world application environments. A systematic review of these issues helps to more rationally understand the applicable boundaries of AI in sports rehabilitation and provides a basis for subsequent research and practical optimization.

5.1 Challenges at the Technical and Data Level

AI-based sports rehabilitation heavily relies on the collection and analysis of exercise data, and its effectiveness largely depends on data quality and system stability. However, in practical applications, exercise data collection still faces problems of insufficient accuracy and consistency. Differences in collection methods, measurement accuracy, and data standards among different devices and systems can lead to inconsistent assessment results, thus affecting the reliability of training feedback. Furthermore, individual motor performance is affected by various factors such as environment, fatigue state, and execution method, resulting in a certain degree of volatility in exercise data itself. Without sufficient data verification and long-term

accumulation, AI systems may struggle to accurately distinguish between real functional changes and short-term fluctuations, thus limiting their application value in rehabilitation decision support. System stability is also a significant technical challenge facing AI-driven sports rehabilitation. Equipment malfunctions, signal interruptions, or software instability can all disrupt the training process and negatively impact the user experience. These issues are particularly pronounced in home-based and remote rehabilitation scenarios, placing higher demands on the reliability of AI systems.

5.2 Individual Differences and Adaptability Issues

Sports rehabilitation is inherently a highly individualized intervention process, and AI systems still have limitations in adapting to different populations. Factors such as age, disease type, functional level, and cognitive ability all affect the effectiveness of AI-driven sports rehabilitation. For example, some elderly individuals or those with severe functional impairments may face difficulties in understanding and executing tasks when operating smart devices, thus reducing training adherence. Furthermore, different populations have varying levels of acceptance of feedback formats and training paces. If the system design does not fully consider user characteristics, a uniform interaction mode may fail to meet diverse needs. This issue suggests that AI-driven sports rehabilitation applications need to prioritize human-centered design rather than simply pursuing technological complexity.

5.3 Ethical and Privacy Issues

AI-powered sports rehabilitation systems typically require the collection and storage of large amounts of individual health and exercise data. While this improves the efficiency of rehabilitation management, it also raises concerns about privacy protection and ethical standards. Exercise data is often highly sensitive, and its improper use or leakage may pose potential risks to individual rights. In existing applications, different platforms vary in their level of compliance with data management, authorization, and information security regulations. Some users lack sufficient understanding of how data is collected, stored, and used, which to some extent weakens their trust in AI systems. How to achieve the application of technology while ensuring data security and privacy is a crucial issue that the sustainable development of AI-powered sports rehabilitation must address. Furthermore, over-reliance on technology may weaken the interaction between professionals and trainees, affecting the embodiment of emotional support and humanistic care during the rehabilitation process. Therefore, when promoting AI-powered sports rehabilitation, it is necessary to clarify the auxiliary role of the technology and prevent it from replacing necessary professional judgment and interpersonal interaction.

5.4 Limitations in Professional Competence and Cognition

The effective implementation of AI-based sports rehabilitation relies on the proper use and guidance of professionals. However, currently, some rehabilitation practitioners still have relatively limited understanding and application capabilities regarding AI technology. On the one hand, some individuals hold a wait-and-see or conservative attitude towards new technologies, affecting their proactive adoption in practice; on the other hand, a lack of systematic training may also lead to improper use of the technology, reducing its effectiveness. Furthermore, the information output by AI systems requires interpretation and judgment by professionals. A lack of necessary interdisciplinary knowledge may lead to misinterpretation or over-reliance on system recommendations. This issue, to some extent, restricts the deep integration of AI-based sports rehabilitation into clinical and educational fields.

5.5 Insufficient Educational System and Practical Support

From the perspective of education and talent cultivation, the current sports rehabilitation and physical education systems still lack sufficient systematic integration of AI-related content. Some courses emphasize traditional theory and skills training, with limited coverage of digital technology and intelligent system applications. This disconnect may lead to graduates' insufficient adaptation to intelligent rehabilitation practices, affecting the effectiveness of technology implementation. In addition, at the practical level, the cost, maintenance requirements, and venue conditions of AI-based sports rehabilitation equipment and systems also limit their promotion in grassroots areas and resource-scarce regions. How to promote the application of technology while ensuring fairness is a key issue that needs to be addressed in the future.

5.6 Limitations of Existing Research

From a research perspective, the current evidence base for AI-based exercise rehabilitation remains insufficient. Some studies have small sample sizes and short study periods, making it difficult to comprehensively reflect long-term effects. Furthermore, the lack of unified standards in intervention methods, evaluation indicators, and outcome reporting among different studies increases the difficulty of comparing and synthesizing research results. At the same time, existing research largely focuses on functional improvement and technical feasibility, paying insufficient attention to the effects of health education, behavioral change mechanisms, and social impacts. These limitations suggest that future research needs to further expand its scope in research design and evaluation.

6 Implications of AI-Powered Sports Rehabilitation for Health and Physical Education

The application of artificial intelligence in sports rehabilitation is not only a technological innovation but also has a profound impact on health promotion concepts, physical education models, and professional talent training systems. A systematic examination of the implications of AI-powered sports rehabilitation from a comprehensive perspective of health and education can help extend its application from localized technology to broader health education and sports practices, realizing the social transformation of its technological value.

6.1 Implications for Health Promotion and Health Education

Health promotion emphasizes the synergistic effect of individual active participation, long-term behavioral change, and environmental support. AI-powered sports rehabilitation, through continuous monitoring and data feedback, enables individuals to more intuitively understand their own exercise status and rehabilitation progress, thereby enhancing health awareness and self-management consciousness. This data-driven health intervention approach helps transform abstract health concepts into perceptible and actionable practices.

At the health education level, AI-powered sports rehabilitation provides new tools for personalized health guidance. By recording and analyzing exercise behavior and health indicators, educators can adjust intervention strategies according to individual differences, improving the relevance and effectiveness of health education. Simultaneously, the real-time feedback mechanism helps reinforce the positive outcomes of health behaviors and promote their sustained maintenance. Furthermore, the application of AI-powered sports rehabilitation in home and community settings offers the possibility of breaking through the boundaries of traditional classrooms and medical institutions in health education. By integrating health education content into daily exercise and rehabilitation training, individuals can continuously strengthen their health awareness in practice, achieving a "learning by doing" health education model.

6.2 Implications for Physical Education and Sports Rehabilitation Teaching

The introduction of AI technology is reshaping the teaching content and methods of physical education and sports rehabilitation. Traditional physical education and sports rehabilitation teaching mainly relies on theoretical lectures and experiential demonstrations, while AI systems provide more objective and repeatable tools for practical teaching through digital assessment and feedback.

In the teaching process, AI-powered sports rehabilitation systems can be used to demonstrate standard movements and individual differences, helping students understand key

points of sports techniques and functional assessment methods. This teaching method based on real data helps improve students' depth of understanding of athletic performance and rehabilitation effects, enhancing their problem analysis and practical application abilities. In addition, AI also provides possibilities for innovative teaching models in physical education. For example, through virtual or simulated training environments, students can practice and assess repeatedly under relatively safe and controllable conditions. This approach not only improves teaching efficiency but also helps alleviate the problem of insufficient practical teaching resources.

6.3 Implications for Cultivating Interdisciplinary Professionals

The development of AI-powered sports rehabilitation has placed new demands on professionals. Future practitioners in sports rehabilitation and physical education will not only need to master traditional sports science and rehabilitation theories, but also possess basic digital literacy and interdisciplinary understanding. Understanding the application logic, data meaning, and limitations of AI systems has become a crucial component of professional competence.

In the talent cultivation system, AI-related content should be gradually incorporated into the curriculum structure, such as basic data analysis, intelligent system application cases, and ethics and privacy protection. This interdisciplinary training model helps students better understand and use AI tools in future practice, avoiding misuse or over-reliance on the technology. Simultaneously, the development of AI also requires teachers to continuously update their knowledge structure and teaching abilities. Strengthening teacher training and practical participation, and promoting the deep integration of AI with physical education and sports rehabilitation teaching, will help improve the overall quality of education and the level of talent cultivation.

6.4 Implications for Sports and Health Service Practices

In practical health and sports services, AI-powered sports rehabilitation offers new insights for improving service quality and accessibility. Through intelligent assessment and training management, service providers can better understand individual needs and optimize intervention programs. This model has broad application prospects in community health services, elderly health management, and chronic disease rehabilitation. Furthermore, AI-powered sports rehabilitation helps promote the transformation of health services from short-term intervention to continuous management. Through long-term data accumulation and analysis, service providers can identify health risk trends and intervene in advance, thereby improving the overall efficiency of health management. This characteristic aligns closely with

the modern health service philosophy that emphasizes prevention and comprehensive management.

6.5 Considerations for Educational Equity and Technology Accessibility

While AI-powered sports rehabilitation has positive implications for health and education, its promotion requires attention to issues of equity and accessibility. Differences in equipment costs, technology maintenance, and digital literacy may lead to inequalities in technology use among different population groups. Therefore, when introducing AI-powered sports rehabilitation into health and sports education, resource allocation and support measures should be comprehensively considered to avoid exacerbating health and educational inequalities. By appropriately introducing artificial intelligence technology into the public education system and community health projects, and providing the necessary training and support, we can help expand the reach of the technology and enable more people to benefit from it.

7 Future Research and Practice Directions

While artificial intelligence has shown promising applications in sports rehabilitation, realizing its long-term value still relies on continuous deepening in research design, practical application, and education systems. Based on existing research evidence and real-world challenges, the future development of AI-based sports rehabilitation can be advanced in the following three core directions:

7.1 Strengthening the Quality of Evidence-Based Research, Focusing on Long-Term Health and Behavioral Outcomes

Future research urgently needs to shift from short-term functional improvements to a systematic evaluation of long-term health outcomes and behavioral changes. Compared to single or short-term intervention results, the maintenance of motor function, the persistence of healthy behaviors, and changes in quality of life better reflect the true value of AI-based sports rehabilitation. Therefore, it is necessary to conduct high-quality studies with larger sample sizes and longer follow-up periods to verify the stability and safety of AI-based sports rehabilitation in different populations and application scenarios. Simultaneously, future research should further standardize intervention content and evaluation indicators, reduce inter-study differences, and improve the comparability of results. Based on this, stratified analysis should be used to clarify the applicable boundaries of AI-based sports rehabilitation, providing evidence-based support for its rational application in health promotion and rehabilitation practice.

7.2 Promoting Human-Centered Technology Applications to Enhance Accessibility and Practical Adaptability

The practical promotion of AI-based sports rehabilitation should adhere to a human-centered principle, emphasizing system usability and adaptation to individual differences. Future practices should pay more attention to the user experience of people of different ages, functional levels, and digital literacy, avoiding technological complexity becoming an obstacle to application. Optimizing human-computer interaction design and simplifying operation processes can help improve the acceptability of AI-based sports rehabilitation in home and community settings. Furthermore, the fairness of AI-based sports rehabilitation should be emphasized, exploring low-cost, scalable application models so that more people can benefit from intelligent rehabilitation services. This direction is of great significance for narrowing health disparities and promoting equal access to health services.

7.3 Deepening the Integration of Health and Physical Education to Improve Talent Cultivation and Institutional Support

The sustainable development of AI-based sports rehabilitation cannot be separated from the support of health education and physical education systems. In the future, AI-related content should be systematically introduced into physical education and sports rehabilitation professional courses to cultivate compound professionals with interdisciplinary perspectives and digital literacy. Simultaneously, through teacher training and innovative teaching models, the rational application of AI technology in practical teaching should be promoted. At the institutional level, relevant regulations and supporting policies should be gradually improved to ensure the application of AI-based sports rehabilitation in the education and health service system. Through the coordinated advancement of educational reform, professional training, and policy guidance, it will be helpful to transform AI-based sports rehabilitation from technological exploration into a routine health and education practice.

8 Conclusion

The rapid development of artificial intelligence in sports rehabilitation has provided new technological pathways for motor function assessment, training intervention, and health management. By integrating sports data collection, analysis, and feedback mechanisms, AI-assisted sports rehabilitation systems demonstrate significant advantages in improving assessment objectivity, supporting personalized training, and expanding home-based and remote rehabilitation scenarios. Existing research evidence generally indicates that AI-assisted sports rehabilitation has positive potential in improving motor function, promoting health-related outcomes, and enhancing exercise adherence.

From a health promotion perspective, AI-assisted sports rehabilitation, through data visualization and continuous feedback, enhances individuals' awareness of their own exercise behavior and health status, contributing to the formation and maintenance of healthy behaviors. This characteristic makes it not only a rehabilitation tool but also an important vehicle for health education and long-term health management. By integrating health interventions into daily exercise and rehabilitation training, AI-assisted sports rehabilitation provides a new practical direction for realizing an individual-centered health service model.

In physical education and sports rehabilitation professional training, the application of AI is driving changes in teaching content and methods. Through digital assessment and intelligent feedback, educators can more intuitively demonstrate exercise techniques and rehabilitation effects, improving the quality of practical teaching. Meanwhile, the development of artificial intelligence (AI) also places new demands on professionals, emphasizing the importance of interdisciplinary knowledge structures and digital literacy. Integrating AI content appropriately into physical education and sports rehabilitation curricula can help cultivate well-rounded professionals capable of meeting future health and sports service needs.

However, it should be noted that the application of AI in sports rehabilitation still faces challenges such as technological adaptability, data quality, ethical and privacy protection, and insufficient support from the education system. Existing research also has limitations in sample size, follow-up time, and the standardization of evaluation indicators, suggesting that while acknowledging the value of AI, a scientific and cautious attitude should be maintained. AI should be seen as a tool to support professional judgment and enhance rehabilitation outcomes, rather than a replacement for professionals.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding statement

This research received no external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data availability statement

Not applicable.

Acknowledgments

The authors declare that there are no acknowledgments for this study.

Conflict of Interest Statement

The authors declare no conflict of interest.

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