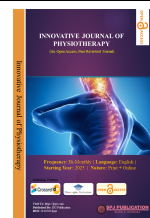




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Exploratory Review

Physiotherapist’s use of AI and machine learning in rehabilitation and evaluation: An Exploratory Review

¹Axuna Patel* ²Kruti Desai

¹Physiotherapist, NAMO Hospital, Silvassa, India

²Assistant Professor, NAMO College of Allied Health Sciences, Silvassa, India

<p>*Corresponding author:</p> <p>Axuna Patel, Physiotherapist NAMO Hospital Silvassa, India</p>	<p>Abstract</p> <p>Background: Artificial intelligence (AI) and machine learning (ML) have emerged as transformative technologies in healthcare, reshaping clinical decision-making, professional responsibilities, and patient–clinician interactions. Their ability to analyze large, complex datasets has enabled more objective assessments, personalized treatment planning, and predictive analytics. In physiotherapy and rehabilitation, the integration of AI represents a significant advancement, particularly in clinical evaluation, functional assessment, and outcome prediction.</p> <p>Aim: The aim of this review is to examine the role of artificial intelligence and machine learning in physiotherapy, with particular emphasis on their applications in clinical evaluation, rehabilitation assessment, and management, as well as their implications for decision support and patient care.</p> <p>Methods and Results: A narrative review of the literature was conducted, focusing on studies that explored AI- and ML-based applications in physiotherapy assessment and rehabilitation management. Evidence indicates that machine learning models can predict rehabilitation outcomes, analyze movement quality, support pain assessment, and enable personalized exercise prescription. AI-driven systems, including activity recognition, fall detection, virtual reality–based rehabilitation, and wearable sensor technologies, have demonstrated potential to improve functional outcomes, patient engagement, and quality of life. Collaborative human–AI models further enhance clinical interpretability and support therapist involvement in decision-making.</p> <p>Conclusion: Artificial intelligence and machine learning hold substantial promise for advancing physiotherapy practice by improving clinical evaluation, rehabilitation management, and decision support. However, successful integration requires harmonization of technological innovation with clinical expertise, ethical considerations, and patient-centered care. Continued research, clinician education, and evidence-based implementation are essential to ensure that AI-enhanced physiotherapy delivers equitable, efficient, and ethically sound healthcare outcomes.</p> <p>Keywords: Artificial Intelligence; Machine Learning; Physiotherapy Assessment; Clinical Decision Support Systems.</p>
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INTRODUCTION

Artificial intelligence (AI) and machine learning (ML) are rapidly transforming healthcare by enabling data-driven clinical decision-making, enhancing diagnostic accuracy, and supporting personalized treatment planning. AI refers to computational systems designed to mimic human cognitive functions such as learning, reasoning, perception, and problem-solving, while ML is a subset of AI that focuses on developing algorithms capable of learning from data without explicit programming. [1–3] The increasing availability of electronic medical records (EMRs), wearable sensor data, and imaging datasets has accelerated the adoption of AI and ML across multiple healthcare domains. [4] In physiotherapy and rehabilitation, clinical evaluation traditionally relies on subjective assessment, therapist experience, and standardized functional tests. While effective, these approaches may be limited by inter-rater variability and reduced sensitivity to subtle changes in movement or function. The integration of AI-based tools offers an opportunity to enhance objectivity in assessment, predict rehabilitation outcomes, and support clinical decision-making through advanced data analytics. [5–7] Recent studies have demonstrated the utility of ML models in predicting rehabilitation success, assessing movement quality, and supporting pain assessment and management. [7–9] Furthermore, AI-driven systems such as activity recognition, fall detection, wearable technologies, and virtual or augmented reality–based rehabilitation platforms have shown promise in improving patient engagement and functional outcomes. [10,11]

Despite these advances, the clinical implementation of AI in physiotherapy requires careful consideration of ethical, interpretability, and professional challenges. This narrative review explores the role of artificial intelligence and machine learning in physiotherapy, focusing on their applications in clinical evaluation, rehabilitation management, and decision support, while highlighting current evidence and future directions.

AIM AND OBJECTIVES

Aim: The aim of this review is to evaluate the applications and impact of artificial intelligence and machine learning in physiotherapy assessment, rehabilitation management, and clinical decision-making.

Objectives

1. To describe the fundamental concepts of artificial intelligence and machine learning relevant to physiotherapy practice.
2. To review AI- and ML-based approaches used in physiotherapy assessment and functional evaluation.
3. To examine the role of AI in rehabilitation management, including activity monitoring, fall detection, and virtual rehabilitation.
4. To discuss clinical implications, challenges, and future directions for AI integration in physiotherapy.

METHODS AND MATERIALS

Study Design: This study was conducted as a narrative review aimed at providing a comprehensive and clinically oriented overview of the applications of artificial intelligence (AI) and machine learning (ML) in physiotherapy. A narrative review methodology was chosen to enable the synthesis of evidence from heterogeneous study designs, emerging technologies, and interdisciplinary research, rather than restricting inclusion to randomized controlled trials alone.

Data Sources and Search Strategy: A systematic literature search was carried out using major electronic databases, including PubMed/MEDLINE and Google Scholar, along with relevant physiotherapy and rehabilitation journal platforms. Articles published in the English language up to the year 2023 were considered eligible. The search strategy employed a combination of keywords and medical subject headings related to artificial intelligence, machine learning, physiotherapy, rehabilitation, clinical evaluation, movement analysis, pain assessment, wearable sensors, and virtual rehabilitation.

Eligibility Criteria: Studies were included if they examined the application of AI or ML in physiotherapy assessment, rehabilitation monitoring, functional evaluation, or clinical decision support. Eligible publication types included original research articles, review papers, and conference proceedings relevant to rehabilitation sciences. Editorials, opinion pieces, and studies not directly related to physiotherapy or rehabilitation practice were excluded.

Data Synthesis: Given the narrative nature of the review, no

formal risk-of-bias assessment or quantitative meta-analysis was performed. Instead, the selected evidence was synthesized qualitatively, with emphasis placed on methodological rigor, clinical relevance, and applicability to physiotherapy practice. Findings were organized thematically to highlight key areas of AI and ML integration within assessment, rehabilitation management, and clinical decision-making.

RESULTS

The expanded review of the literature demonstrates a substantial and rapidly growing body of evidence supporting the integration of artificial intelligence (AI) and machine learning (ML) in physiotherapy practice. Across multiple domains, AI-based systems have shown improvements in assessment accuracy, personalization of rehabilitation, and efficiency of clinical decision-making. Predictive modeling using ML algorithms has been widely applied to estimate rehabilitation outcomes. Studies report that supervised learning models, including support vector machines, random forests, and neural networks, can integrate clinical variables, demographic data, and patient-reported outcome measures to predict functional recovery and treatment responsiveness with higher accuracy than traditional statistical approaches.^[7,12,13] These models enable early identification of patients at risk of poor outcomes, allowing timely modification of rehabilitation protocols.

AI-driven movement and exercise assessment has emerged as one of the most clinically impactful applications. Wearable inertial sensors, markerless motion capture, and computer vision systems have been used to objectively quantify joint kinematics, movement symmetry, balance, and exercise quality.^[9,14–16] Reinforcement learning and feature-selection techniques further enhance interpretability by highlighting clinically meaningful movement parameters and generating real-time feedback for both patients and therapists. Pain assessment and monitoring have also benefited from AI integration. Multimodal AI systems combining facial expression analysis, physiological signals, voice patterns, and self-reported pain scores have demonstrated improved reliability and consistency in pain evaluation compared with subjective scales alone.^[8,17,18] These approaches support individualized pain management strategies and continuous monitoring during rehabilitation.

In rehabilitation management, AI-based activity recognition and fall detection systems have shown promising results, particularly in geriatric and neurological populations. Machine learning models applied to wearable sensors and smart home environments can accurately classify daily activities and detect fall-related events, facilitating early intervention and reducing injury risk.^[10,19–21] Virtual and augmented reality-based rehabilitation platforms enhanced by AI have demonstrated positive effects on patient engagement, adherence, and functional outcomes. Studies report improvements in joint mobility, muscle strength, balance, and quality of life, alongside psychological benefits such as reduced stress and improved motivation.^[11,22–24] Table 1 summarizes key applications of AI and ML in physiotherapy and their reported clinical benefits.

Table 1. Applications of Artificial Intelligence and Machine Learning in Physiotherapy

Application Area	AI/ML Techniques Used	Clinical Benefits Reported
Outcome prediction	Supervised ML, neural networks	Personalized treatment planning, early risk identification
Movement assessment	Computer vision, wearable sensors, reinforcement learning	Objective evaluation, real-time feedback, reduced observer variability
Pain assessment	Multimodal AI, pattern recognition	Improved pain recognition, consistent monitoring
Rehabilitation management	Activity recognition, fall detection algorithms	Enhanced safety, continuous monitoring
Virtual rehabilitation	AI-driven VR/AR systems	Improved motivation, functional recovery, quality of life

DISCUSSION

This narrative review highlights the significant and expanding role of artificial intelligence and machine learning in physiotherapy assessment, rehabilitation management, and clinical decision-making. AI-enhanced tools address long-standing limitations of conventional physiotherapy assessments, which often rely on subjective observation and clinician experience. By providing objective, data-driven insights, AI systems improve the reliability and reproducibility of clinical evaluations.^[14,25] Predictive ML models support precision rehabilitation by enabling stratification of patients based on recovery potential and treatment responsiveness. Such approaches align with personalized medicine principles and may optimize resource allocation in rehabilitation settings.^[12,13] Importantly, human-AI collaborative frameworks preserve the central role of physiotherapists by positioning AI as a decision-support tool rather than a replacement for clinical judgment.^[9,26]

The integration of AI in pain assessment and rehabilitation monitoring enhances holistic patient care. Continuous, multimodal pain monitoring may reduce under-treatment or over-treatment of pain and improve patient satisfaction.^[17,18] Similarly, AI-driven activity monitoring and fall detection systems contribute to preventive care, particularly for older adults and individuals with neurological impairments.^[20,21] Despite these advantages, several challenges remain. Ethical concerns related to data privacy, algorithm transparency, and bias must be addressed before widespread clinical adoption.^[27,28] Additionally, variability in data quality and the lack of standardized validation protocols limit generalizability across populations and clinical settings. Training and education of

physiotherapists in AI literacy are essential to ensure safe and effective integration into practice.^[29] Large-scale, longitudinal clinical trials are still required to establish robust evidence of long-term effectiveness and cost-benefit outcomes.^[30]

CONCLUSION

Artificial intelligence and machine learning represent significant advancements in physiotherapy assessment, rehabilitation management, and clinical decision support. AI-driven tools enhance objectivity, personalize rehabilitation strategies, and improve patient engagement and functional outcomes. However, successful integration depends on balancing technological innovation with human expertise, ethical responsibility, and patient-centered care. Continued research, interdisciplinary collaboration, and clinician education are essential to ensure that AI-supported physiotherapy delivers safe, effective, and equitable healthcare.

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