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Virtual Reality-Based Rehabilitation in Physiotherapy Practice: A Systematic Review

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Abstract:

Through immersive and interactive therapeutic treatments, virtual reality (VR), an emerging rehabilitation tool, improves physiotherapy. This systematic study assesses the efficacy, uses, advantages, and drawbacks of VR-based rehabilitation in neurological, musculoskeletal, paediatric, geriatric, and cardiopulmonary physiotherapy. According to the reviewed studies, VR increases therapy adherence with gamified workouts and real-time feedback while improving motor function, balance, gait, pain management, range of motion, and patient motivation. VR also facilitates telerehabilitation and home-based rehabilitation, increasing access to physiotherapy treatments. But issues including expensive equipment, inconsistent treatment guidelines, scant long-term data, and cybersickness still exist. Overall, VR is a useful addition to traditional physical therapy, and future developments in wearable technology and artificial intelligence are expected to substantially improve rehabilitation outcomes. Standardised clinical guidelines and ongoing high-quality research are necessary for its wider application in physiotherapy practice.

Keywords: Virtual Reality, Physiotherapy, Rehabilitation, Virtual Reality Rehabilitation, Neurorehabilitation, Musculoskeletal Rehabilitation, Balance Training, Immersive Technology.

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1. INTRODUCTION

VR has been identified as a revolutionary technology in physiotherapy that enables interactive and immersive therapy, promoting motor learning, functional improvement, balance, coordination, and engagement among patients [1]. Unlike traditional rehabilitation methods, VR integrates feedback, task-oriented therapy, and therapeutic activities customized to patients. Development in the technology of VR in terms of hardware, motion capture technologies, wearable sensor and artificial

intelligence has contributed to broadening the scope of applications for hospital and home rehabilitation [2].

The clinical literature has found that VR-assisted physiotherapy results in better rehabilitation for neurological, musculoskeletal, pediatric and cardiopulmonary diseases such as stroke, Parkinson's disease, cerebral palsy, multiple sclerosis, spinal cord injury, osteoarthritis and sport injury[3]. Besides, gamified rehabilitation settings lead to improved motivation, satisfaction and engagement among patients.

Figure 1: Virtual Reality-Based Rehabilitation

1.1 Background and Context

Physiotherapy rehabilitation is a critical part of medicine which is designed to achieve motor restoration, mobility enhancement, and improved quality of life. Traditional physiotherapy is effective, but it faces several challenges, such as limited patient engagement, repetitive therapeutic exercises, and limited accessibility of rehabilitation facilities [4]. VR technology is seen as an innovation for interactive, patient-centered rehabilitation through computer simulation and real-time feedback. Using the principles of neuroplasticity, motor learning and task-oriented training, VR improves motor skills, balance and coordination of the patients and their motivation [5].

According to the literature review, VR technology has already been successfully used in different areas of rehabilitation, including neurological, musculoskeletal, pediatric, geriatric, vestibular and cardiopulmonary rehabilitation [6]. The literature also shows that VR contributes to home and tele-

rehabilitation by improving access to physiotherapist services through portable devices and remote monitoring. Despite all the advantages, the technology has not been widely implemented because of high expenses, lack of treatment protocol, technical difficulties and limited clinical data [7]. Owing to the progress in artificial intelligence, wearable sensors and immersion technology, VR can be further improved to provide personalized and evidence-based rehabilitation. Thus, this systematic review presents the evidence concerning applications, effectiveness, benefits, drawbacks and perspectives of VR technology in physiotherapy practice [8].

1.2 Objectives of the Study

This systematic review aims to:

- To examine the current applications of Virtual Reality (VR) in physiotherapy rehabilitation across different clinical conditions.
- To evaluate the effectiveness of VR-based rehabilitation in improving functional outcomes, including motor function, balance, gait, pain, and quality of life.
- To identify the advantages and limitations of Virtual Reality interventions compared with conventional physiotherapy approaches.
- To analyze the therapeutic mechanisms and technological advancements that support the use of Virtual Reality in physiotherapy practice.
- To highlight existing research gaps and provide recommendations for future research and clinical implementation of VR-based rehabilitation.

1.3 Importance of the Study

- **Enhances Rehabilitation Outcomes** – Improves motor function, balance, coordination, mobility, and overall functional recovery through immersive and interactive rehabilitation.
- **Improves Patient Engagement** – Increases patient motivation and treatment adherence by incorporating gamified and interactive therapeutic exercises.
- **Supports Personalized and Accessible Care** – Enables individualized rehabilitation programs and expands access through tele-rehabilitation and home-based therapy.
- **Provides Evidence for Clinical Practice** – Assists physiotherapists, researchers, and healthcare professionals in adopting evidence-based VR interventions.
- **Identifies Research Gaps** – Highlights the need for standardized protocols, long-term clinical studies, and technological advancements to improve future VR-based rehabilitation.

2. PRINCIPLES AND APPLICATIONS OF VIRTUAL REALITY IN PHYSIOTHERAPY

VR is a new physiotherapy technology characterized by the creation of immersive, interactive, and patient-centered treatment environments using computerized simulations and real-time feedback [9].

This technology contributes to better motor learning, neuroplasticity, balance, coordination, and functional recovery and makes patients more motivated during therapy. It can be effectively used in neurological, musculoskeletal, pediatric, geriatric, vestibular, and cardiopulmonary rehabilitation and for home-based and tele-rehabilitation due to mobile devices and remote monitoring technologies [10]. Even though it shows numerous advantages for physiotherapy, it is hardly used by many health facilities because of the high price of equipment, technical difficulties, lack of standardization of rehabilitation programs, and poor professional skills of therapists [11].

VR systems, which are implemented in physiotherapy, differ from one another according to their degree of immersion and interaction [12]. There are several types of such systems: non-immersive VR, semi-immersive VR, fully immersive VR, augmented reality (AR), and mixed reality (MR). Every VR system has its specific characteristics, which contribute to rehabilitation and make it possible for therapists to choose an adequate technology [13].

2.1 Types of Virtual Reality Systems

VR systems used in physiotherapy vary in their level of immersion and interaction, allowing therapists to select appropriate technologies based on patient needs and rehabilitation goals.

- **Non-Immersive VR** – Uses computers, gaming consoles, and motion sensors to support rehabilitation. It is affordable, easy to use, and widely applied in hospital and home-based therapy.
- **Semi-Immersive VR** – Employs large screens or projection systems to create a more engaging environment while maintaining awareness of the real world. It is commonly used for balance, gait, and postural training.
- **Fully Immersive VR** – Utilizes head-mounted displays and motion-tracking devices to create a completely immersive experience. It is particularly effective in neurological rehabilitation but is associated with higher costs and the possibility of cybersickness.
- **Augmented Reality (AR)** – Integrates virtual objects into the real-world environment, providing real-time guidance for posture correction, balance, and functional exercises.
- **Mixed Reality (MR)** – Combines virtual and real environments, allowing interaction with both simultaneously. It supports advanced rehabilitation and offers significant potential for future physiotherapy applications.

Overall, the selection of a VR system depends on the patient's condition, rehabilitation goals, available resources, and clinical setting [14].

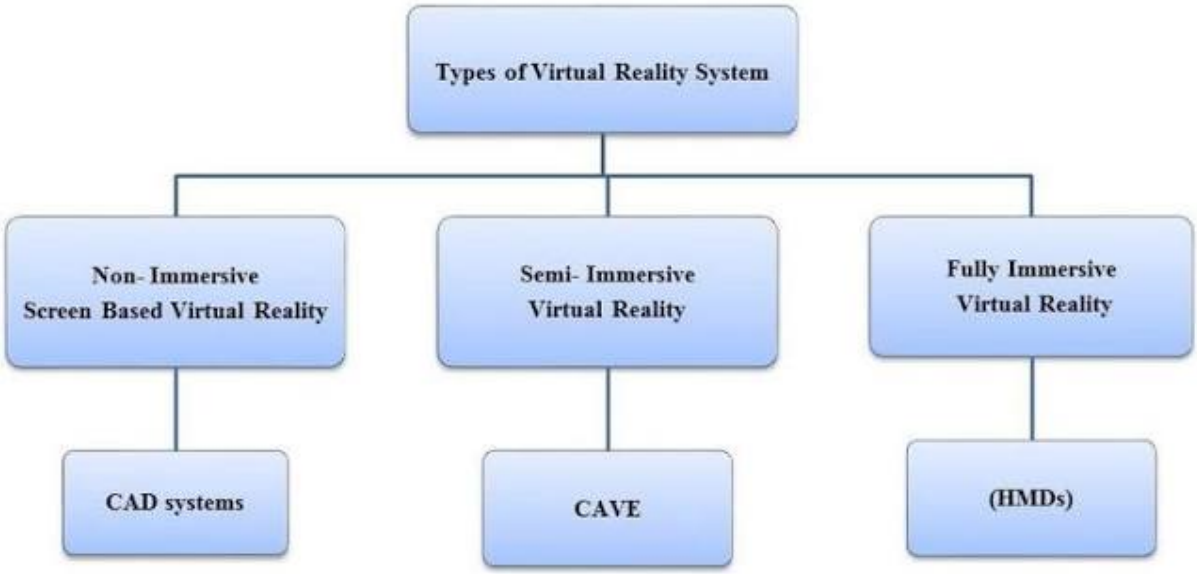

Figure 2: Types Of Virtual Reality System

2.2 Therapeutic Mechanisms of Virtual Reality Rehabilitation

The effectiveness of VR rehabilitation is based on several therapeutic mechanisms that improve functional recovery and patient engagement.

- **Neuroplasticity** – Promotes brain reorganization through repetitive, task-specific exercises that enhance motor recovery.
- **Motor Learning** – Improves movement skills through repeated practice, feedback, and progressively challenging activities.
- **Real-Time Multisensory Feedback** – Provides immediate visual, auditory, and haptic feedback to improve movement accuracy and monitor patient progress.
- **Task-Oriented and Repetitive Training** – Encourages repeated performance of functional activities, enhancing balance, gait, coordination, and daily living skills.
- **Patient Motivation and Gamification** – Uses interactive games, rewards, and challenges to increase motivation, participation, and treatment adherence.
- **Personalized Rehabilitation** – Allows therapists to customize rehabilitation programs based on individual patient needs and monitor progress objectively.
- **Cognitive and Psychological Engagement** – Stimulates cognitive functions, improves confidence, reduces anxiety, and enhances overall psychological well-being during rehabilitation.

Together, these mechanisms make VR an effective complementary approach that supports evidence-based, patient-centered physiotherapy rehabilitation.

Table 1: Summary of Literature on Virtual Reality-Based Rehabilitation in Physiotherapy

Author Name	Topic Covered	Research Study Title
Brepohl & Leite (2023) [15]	Reviewed the application of VR in physiotherapy and discussed its effectiveness in improving motor function, balance, gait, patient engagement, and rehabilitation outcomes. The study also highlighted current challenges and future research needs.	Virtual Reality Applied to Physiotherapy: A Review of Current Knowledge
Heiyanthuduwa et al. (2020) [16]	Developed a VR-based home physiotherapy rehabilitation system for elderly individuals. The study emphasized remote rehabilitation, improved accessibility, patient motivation, and home-based physiotherapy services.	VirtualPT: Virtual Reality Based Home Care Physiotherapy Rehabilitation for Elderly
Jeyakumar et al. (2022) [17]	Presented a VR rehabilitation gaming system designed to improve physiotherapy outcomes through interactive therapeutic exercises, enhancing patient motivation, treatment adherence, and functional recovery.	Virtual Reality-Based Rehabilitation Gaming System
Asadzadeh et al. (2021) [18]	Conducted a scoping review evaluating the effectiveness of VR-based exercise therapy across different rehabilitation settings. The review reported improvements in balance, mobility, motor function, pain management, and quality of life.	Effectiveness of Virtual Reality-Based Exercise Therapy in Rehabilitation: A Scoping Review
Thakur et al. (2025) [19]	Compared VR-based rehabilitation with conventional physiotherapy for post-operative lower limb patients. The	The Effectiveness of Virtual Reality-Based Rehabilitation Versus Conventional Methods in

	review found superior functional outcomes, improved balance, mobility, and higher patient satisfaction with VR-assisted rehabilitation.	Enhancing Functional Outcomes for Post-Operative Lower Limb Patients: A Systematic Review

3. METHODOLOGIES AND FINDINGS

The aim of this systematic review was to assess the effectiveness of using VR in physiotherapy rehabilitation by examining recent peer-reviewed articles available in major scientific databases [20]. The literature search involved randomized controlled trials, systematic reviews, meta-analysis, and observational studies related to rehabilitation in neurological, musculoskeletal, pediatric, geriatric, cardiopulmonary and balance rehabilitation [21].

All pieces of evidence found in this systematic review were able to prove that VR rehabilitation can be considered a complementary therapy to standard physiotherapy with regard to enhancing motor functioning, balance, walking ability, coordination, pain relief, upper- and lower-extremity mobility, and activities of daily living.

In addition, VR in physiotherapy proved to be beneficial for patient motivation, treatment adherence, and satisfaction owing to its engaging environment, feedback, and tasks. Furthermore, VR revealed great success in various areas of rehabilitation such as neurological, musculoskeletal, pediatric, geriatric, vestibular and cardiopulmonary rehabilitation [22].

3.1 Clinical Applications of Virtual Reality Rehabilitation

VR is currently recognized as a flexible rehabilitation technology that is progressively used for physiotherapy practice in different fields of clinical specialization. Providing an immersive and interactive treatment setting, VR allows patients to carry out functional exercises that are close to real-life activities along with immediate feedback [23]. The flexible nature of VR technology allows physiotherapists to create personalized programs of rehabilitation depending on the patient's diagnosis, functional limitations, and rehabilitation goals. During the past decade, the number of clinical studies has proven the effectiveness of VR-assisted rehabilitation as a tool for motor function improvement, balance and gait training, coordination enhancement, pain management, and other purposes.

The clinical use of VR spans over different clinical disciplines, including neurological, musculoskeletal, pediatric, geriatric, cardiopulmonary, and vestibular rehabilitation. In cases of neurological disorders, VR allows carrying out repetitive task-specific training aimed at stimulation of neuroplasticity and functional recovery following different pathologies, such as stroke, Parkinson's disease, multiple sclerosis, and spinal cord injury [24]. Musculoskeletal rehabilitation uses VR to help patients restore joint range of motion, muscle strength, proprioception, and functional performance following injuries and orthopedic surgeries.

3.1.1 Neurological Rehabilitation

VR is now one of the highly successful additions to neurological rehabilitation because of its ability to induce motor recovery through immersion and interactive tasks [25]. It induces better neuroplasticity, motor skills, balance, coordination, gait, and functional independence by allowing patients to practice repetitively through real-time feedback. There is ample proof that it has helped stroke patients in improving their upper-limb performance, gait speed, balance, and daily activities. VR has provided considerable help to Parkinson's patients in achieving improved postural stability, walking speed, stride length, coordination, and mobility [26].

3.1.2 Musculoskeletal Rehabilitation

Inclusion of VR in musculoskeletal rehabilitation has proved beneficial due to its capacity to increase engagement, motivation, and compliance among patients with the help of task-based exercises [27]. The inclusion of such an intervention increases motor learning, accuracy of movements, and recovery of functions due to the feedback that it provides to the user in a simulated environment. It has been found in studies that VR intervention has been helpful in treating chronic low back pain, osteoarthritis, shoulder conditions, sport-related injuries, and orthopedic surgeries because of pain reduction, improved joint function, increased muscle strength, and balance and functional performance.

3.1.3 Balance and Gait Training

VR serves as a very efficient tool in balance and gait rehabilitation especially for those people who suffer from neurological disorders, musculoskeletal issues, vestibular disorders, or age-related mobility problems. With the help of such devices and technologies, people can improve their postural stability, balance, gait velocity, stride length, coordination, and functional mobility in addition to reducing the probability of falls [28]. The use of such technologies and VR has proven to be effective for those people who have strokes, Parkinson's disease, multiple sclerosis, vestibular disorders and other issues as it helps to enhance gait ability and confidence. Moreover, new advancements in treadmills, sensors, motion tracking, artificial intelligence, and VR devices have contributed to home rehabilitation.

3.1.4 Pediatric Rehabilitation

VR has been proven to be a very useful means in pediatric rehabilitation because of how it has been able to make the physical therapy process much more interesting and fun. It has proved to be very effective for children suffering from cerebral palsy, developmental coordination disorders, traumatic brain injury, and other various neurological diseases. It has enabled the improvement of motor skills, balance, coordination, postural control, and functional abilities. It enables the customization of rehabilitation exercises as well as doing physical therapy at home with the involvement of the caregiver [29].

3.1.5 Cardiopulmonary Rehabilitation

VR aids in the development of cardiopulmonary rehabilitation through customized and interactive exercise programs which help in the improvement of functional capacity, respiratory function, exercise tolerance, and quality of life in individuals suffering from heart and lung diseases [30]. Aerobic exercises, breathing exercises, balance training, and functional mobility training in VR environment motivate the patients. Several studies have demonstrated enhanced efficiency of breathing, walking tolerance, physical activity, and performance of exercise, making VR an important adjunctive technique to traditional cardiopulmonary physiotherapy.

3.2 Effectiveness of Virtual Reality Rehabilitation

The efficacy of VR in physiotherapy rehabilitation has extensively been studied for different clinical disorders, with most findings being positive when VR is applied in addition to standard physiotherapy treatment [31]. Literature review suggests that interventions with the use of VR contribute to the enhancement of motor skills, balance, gait, muscle strength, joint mobility, pain relief, functional independence, and quality of life in general. The use of VR with its immersive environment, feedback, repetitive training, and gamification increases patients' involvement into the rehabilitation process, thus leading to better results.

- **Improvement in Motor Function:** One of the most constant advantages of VR-based rehabilitation therapy is an increased level of motor functions [32]. Motor exercises in a virtual environment promote repetition and goal-oriented movements and improve motor control, coordination and muscle activation. Patients who have been affected by various neurological disorders such as stroke, Parkinson's disease and spinal cord injuries experience improved upper and lower limb function through VR-based rehabilitation therapy.
- **Enhancement of Balance and Gait Performance:** Many studies have reported the efficacy of VR in enhancing balance, posture, and gait. Through interactive balance training and virtual walking activities, users gain improvements in shifting their weight, coordination, gait velocity, stride length, and confidence while walking. Balance training through VR is especially helpful for elderly people and those with neurodegenerative diseases. It aids in reducing falls and improves functional mobility. Real time feedback helps patients make corrections to their movements, leading to better motor performance.
- **Pain Reduction and Functional Recovery:** Effectiveness of VR in decreasing pain and enhancing functional recovery of people suffering from musculoskeletal conditions has been proven. Through VR, patients are engaged in activities that distract them from experiencing pain and motivate them to participate in therapy exercises [33]. Patients suffering from chronic low back pain, osteoarthritis, shoulder problems and sports injuries have experienced decreased levels of pain in addition to increased joint mobility, muscle strength, flexibility and functional improvement.

- **Increased Patient Motivation and Treatment Adherence:** In order to achieve good results during rehabilitation, patient motivation plays an extremely important role. Based on the analysis of the reviewed studies, it becomes clear that rehabilitation programs based on VR are significantly more appealing than traditional training programs since VR involves such elements as gamification, rewards, interactive tasks, and instant feedback. Thus, patients feel more enjoyment when using VR and find it less monotonous than standard exercises.
- **Improvement in Quality of Life:** Aside from physical recovery, VR aids in the enhancement of psychological health and general well-being. Accomplishment of the rehabilitation exercises builds up the patients' confidence, lowers their anxiety during physical activities, and helps them become independent in conducting their daily activities. Moreover, VR is an interactive approach that encourages socialization and emotional well-being, especially for patients who go through rehabilitation for extended periods after neurological or orthopedic injuries.
- **Home-Based Rehabilitation and Tele-Rehabilitation:** Advancements in VR technology in portable systems have made it possible for rehabilitation to be performed outside clinical settings. Rehabilitation using VR at home makes it possible for patients to be able to engage in training exercises while being supervised remotely by communicating with physiotherapists. It is through the use of sensors and other forms of electronic monitoring devices that it becomes possible to measure the progress of the patients and even modify their training.

4. DISCUSSION

Conclusions drawn from the results of the systematic review suggest that VR has emerged as an effective and evidence-based supplement to standard physiotherapy in a wide variety of rehabilitation settings [34]. All studies that were analyzed have shown that the use of VR-based interventions increases motor function, balance, coordination, gait, pain, and functional independence in patients while, at the same time, enhances their motivation and adherence to physiotherapy programs. Unlike standard physiotherapy practices, VR allows creating engaging and immersive therapeutic environment, which promotes repetitive and task-oriented practice due to real-time feedback and game-like activities [35].

Furthermore, the results of the systematic review reveal that, alongside improving the physical aspect of rehabilitation, VR intervention addresses psychological and behavioral needs of the patients as well [36]. Interactive VR environment contributes to increased patient confidence and reduced anxiety associated with movement, and improves overall satisfaction of the patient with the process of physiotherapy. The advancement in wearable sensor technology, motion tracking systems, and artificial intelligence has made the process of rehabilitation more precise due to the objective assessment of patient's performance and personalized treatment. In addition, the

emergence of home-based VR systems and tele-rehabilitation tools has broadened the reach of physiotherapy services to people with restricted mobility and residing in remote locations [37].

However, there are still some limitations in the field, which should be discussed. First, there is significant variability in the design of VR interventions, specifically in terms of the hardware and software platforms, the length of treatment, the level of exercise intensity, and the types of outcome measures that are used in each study [38]. In addition, many studies use small sample sizes and short follow-up periods, and therefore, do not allow estimating the sustainability of the rehabilitation outcomes. Finally, the high price of advanced VR equipment, low technical knowledge of health care professionals, and the lack of clinical guidelines hinder its implementation in practice.

4.1 Interpretation and Analysis

The findings of this systematic review indicate that VR has demonstrated consistent therapeutic benefits across multiple areas of physiotherapy rehabilitation. Most of the studies reviewed showed that VR-assisted interventions have a positive effect on improving balance, gait, upper- and lower-extremity function, motor coordination, pain management, and functional independence along with conventional physiotherapy. The reason for such effects lies in principles of repetitive task-oriented training, neuroplasticity, multisensory stimulation, and real-time performance feedback [39].

Among other findings derived from the reviewed literature, one may single out the positive impact of VR on patient motivation and compliance with treatment. While conventional physiotherapy involves repetitive exercises which may make a patient less interested in rehabilitation activities during long periods of therapy, VR makes treatment interactive and appealing by means of gamification, virtual challenges, and feedback. Therefore, the engagement of patients in treatment activities improves clinical outcomes.

Moreover, VR appears to be highly flexible and adaptable to different types of rehabilitation. Thus, neurological rehabilitation demonstrated considerable evidence of motor recovery from stroke, Parkinson's disease, and spinal cord injuries, whereas musculoskeletal rehabilitation has shown positive results in relieving pain, increasing joint mobility, enhancing muscle strength and functional performance. Likewise, pediatric, geriatric, and cardiopulmonary rehabilitation programs have proven beneficial due to the individual approach of VR-based interventions.

4.2 Implications and Significance

The findings of this systematic review have important implications for clinical practice, healthcare systems, rehabilitation research, and the future development of digital physiotherapy [40]. As VR continues to evolve, its integration into rehabilitation programs has the potential to transform the delivery of physiotherapy by making treatment more interactive, patient-centered, and accessible. The following implications highlight the significance of VR-based rehabilitation in contemporary physiotherapy practice.

- **Enhanced Clinical Effectiveness** – The reviewed evidence indicates that VR-assisted rehabilitation improves motor function, balance, gait, coordination, pain management, and functional independence across various clinical conditions. The integration of immersive environments with evidence-based physiotherapy interventions enhances treatment effectiveness and supports better rehabilitation outcomes.
- **Improved Patient Engagement and Adherence** – VR increases patient motivation by incorporating interactive exercises, gamification, and real-time performance feedback into rehabilitation sessions. Higher patient engagement promotes consistent participation in therapy, leading to improved adherence and greater functional recovery compared with conventional rehabilitation alone.
- **Expansion of Home-Based and Tele-Rehabilitation Services** – Advances in portable VR systems and digital communication technologies have enabled the delivery of rehabilitation beyond traditional clinical settings. Home-based VR rehabilitation allows patients to continue supervised therapy remotely, improving accessibility for individuals with mobility limitations, chronic conditions, or those living in geographically remote areas.
- **Support for Personalized Rehabilitation Programs** – VR enables physiotherapists to customize rehabilitation exercises according to each patient's clinical condition, functional abilities, and recovery goals. Continuous monitoring of patient performance allows treatment programs to be modified throughout the rehabilitation process, promoting individualized and patient-centered care.
- **Contribution to Future Healthcare Innovation** – The integration of VR with emerging technologies such as artificial intelligence, wearable motion sensors, motion capture systems, and cloud-based data analytics is expected to further improve rehabilitation efficiency and clinical decision-making. These technological advancements may facilitate more accurate patient assessment, personalized treatment planning, and long-term monitoring, contributing to the modernization of physiotherapy practice.

4.3 Gaps and Future Research Directions

Although the findings of this review demonstrate the considerable potential of VR in physiotherapy rehabilitation, several limitations and research gaps remain. Addressing these challenges will strengthen the evidence base and support the broader implementation of VR in clinical practice.

- **Standardization of Rehabilitation Protocols** – Current studies employ diverse VR systems, intervention durations, exercise intensities, and outcome measures, making comparisons difficult. Future research should establish standardized rehabilitation protocols to improve consistency across clinical studies.

- **Long-Term Clinical Effectiveness** – Most available studies focus on short-term rehabilitation outcomes. Longitudinal investigations are required to determine the sustainability of functional improvements, patient adherence, and quality-of-life benefits following VR-based rehabilitation.
- **Large Multicenter Randomized Controlled Trials** – Many published studies involve relatively small sample sizes and single-center designs. Larger multicenter randomized controlled trials are needed to generate high-quality evidence regarding the effectiveness and generalizability of VR interventions across diverse patient populations.
- **Cost-Effectiveness and Clinical Implementation** – Further research should evaluate the economic feasibility of implementing VR within different healthcare settings. Studies examining equipment costs, maintenance requirements, clinician training, and healthcare resource utilization will assist decision-makers in adopting VR technologies more effectively.
- **Integration of Emerging Technologies** – Future investigations should explore the combined use of VR with artificial intelligence, wearable biosensors, robotic rehabilitation devices, and tele-rehabilitation platforms. These technologies have the potential to deliver highly personalized, data-driven rehabilitation programs that further improve patient outcomes and expand access to physiotherapy services.

5. CONCLUSION

VR is increasingly becoming an effective complementary tool for physiotherapy rehabilitation, which demonstrates numerous advantages for enhancing motor functions, improving balance, gait, coordination, reducing pain, improving functional independence, and quality of life. The immersive nature of VR, real-time feedback, and gamification of rehabilitation exercises can stimulate patients' motivation and adherence to treatment programs. The reviewed studies reveal the applicability of VR for neurorehabilitation, orthopedic rehabilitation, pediatric physiotherapy, geriatric rehabilitation, and cardiopulmonary physiotherapy. At the same time, VR can facilitate personalization of treatment and home rehabilitation using tele-rehabilitation services. Despite the number of positive features and opportunities that VR can offer, there are still some problems associated with high costs, absence of standardized procedures, lack of training of clinicians, and insufficient long-term evidence of the effectiveness of VR in physiotherapy rehabilitation.

5.1 Summary of Main Insights and Conclusions

The present systematic review underscores the importance of VR as a novel rehabilitation device in contemporary physiotherapy practice. According to the reviewed literature, VR-supported treatment regimens enhance patients' motor performance, balance, gait, coordination, pain management, and functional independence. The technology engages the patients within interactive and immersive

therapeutic environment and follows the concepts of motor learning, neuroplasticity, and repetition-based tasks.

It is important to note that the positive results have been obtained in neurological, musculoskeletal, pediatric, balance, gait, and cardiopulmonary rehabilitation using the VR technology. The inclusion of tele-rehabilitation, wearable sensors, and artificial intelligence increases the possibilities for implementing personalized rehabilitation plans and monitoring the patients remotely. While there are some discrepancies between methodologies used in studies and a lack of long-term research, the overall results clearly prove the effectiveness of VR technology as an additional tool in physiotherapy.

5.2 Reiteration of the Importance of the Review

- **Growing Demand for Innovative Rehabilitation Technologies** – The increasing prevalence of neurological, musculoskeletal, and age-related disorders highlights the need for advanced rehabilitation approaches that improve treatment effectiveness and patient outcomes.
- **Significance of Virtual Reality in Physiotherapy** – VR offers an interactive, patient-centered, and evidence-based rehabilitation approach that enhances motor recovery, functional independence, and treatment adherence.
- **Comprehensive Evaluation of Current Evidence** – This systematic review provides a comprehensive synthesis of the available literature regarding the clinical applications, therapeutic effectiveness, benefits, and limitations of VR-based rehabilitation in physiotherapy.
- **Identification of Research Gaps** – The review identifies important challenges related to standardization, long-term effectiveness, clinical implementation, and cost-effectiveness, providing direction for future investigations.
- **Contribution to Evidence-Based Clinical Practice** – The findings provide valuable information for physiotherapists, researchers, educators, and healthcare policymakers seeking to integrate VR into routine rehabilitation practice.

5.3 Recommendations

- Formulate uniform guidelines that can be used in the deployment of VR in the field of physiotherapy rehabilitation.
- Conduct large scale randomized controlled trials in order to generate more evidence on the effectiveness of VR interventions.
- Foster the use of artificial intelligence, wearable devices, and tele-rehabilitation technology in order to personalize rehabilitation and improve patient monitoring.

- Make Virtual Reality technology cheaper and more accessible to allow for its adoption by hospitals, rehabilitation facilities, and community health settings.
- Support education and training efforts in order to equip physiotherapists with adequate knowledge on the use of VR technology.
- Foster cooperation between physiotherapists, engineers, software developers, and researchers from the field of healthcare.

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