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Literature Review: Implementation of Telerehabilitation for Patients with Eye Disorders in Middle to High-Income Countries

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Abstract: Tele-rehabilitation in eye care services is an innovative intervention solution to overcome geographical limitations and improve accessibility to rehabilitation services. This study aims to examine the implementation of telerehabilitation in patients with eye disorders in various countries, especially in low to high-income countries. This study is a narrative literature review of 3 journal databases, namely PubMed, ScienceDirect, and Google Scholar. Data screening was conducted using Rayyan.ai. Selected articles were then assessed for eligibility using the Mixed-Method Appraisal Tool (MMAT) with a minimum score of 80 points. Articles that passed the MMAT assessment were then analyzed and synthesized before being categorized to obtain themes from the implementation of eye care telerehabilitation in various countries. The screening resulted in 12 articles that met the criteria in this study. The results of the study showed that telerehabilitation is effective in improving access to rehabilitation services, especially in remote areas. Tele-rehabilitation has also been proven to improve the quality of life of patients through improved visual skills, independence, and mental well-being. However, the implementation of telerehabilitation still faces challenges such as limited access to technology, lack of digital skills, and unstable internet connectivity. Tele-rehabilitation has great potential to improve access and quality of life for patients with eye disorders. Although there are several challenges, with adequate technological infrastructure support and comprehensive training, telerehabilitation can be a sustainable solution to improve eye health services. Future research needs to focus on developing more personalized interventions, long-term evaluation, and addressing the digital divide.

Keywords: Accessibility; Eye diseases; Rehabilitation; Telerehabilitation

Introduction

The development of information and communication technology has changed the landscape of healthcare, including in ophthalmology. Telerehabilitation, which combines information and communication technology to deliver rehabilitation services remotely, has emerged as an effective approach to the rehabilitation of patients with various visual impairments (Bittner et al., 2023; Chong et al., 2021). This method has emerged to overcome the geographical, mobility, and human resource limitations that often constrain the accessibility of conventional rehabilitation services. Telerehabilitation is seen to provide a more flexible and efficient solution, allowing patients to receive the therapy and healthcare support they need without having to travel to a healthcare facility frequently (Ihrig, 2019; Massie et al., 2022).

The trend of using telerehabilitation in eye care has been increasing in recent years. There are several factors, such as the COVID-19 pandemic situation, which has

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increased the adoption of information technology in healthcare more broadly. These advances in information technology allow for more *real-time* and personalized interactions between health workers and patients (Lorenzini & Wittich, 2021; Wahab et al., 2021). Several previous studies have shown the effectiveness of telerehabilitation in improving the quality of life and visual function of patients with various eye conditions, such as glaucoma, macular degeneration, and *amblyopia.* (Chong et al., 2021; Mousavi et al., 2023; Nuzzi et al., 2022). Telerehabilitation is considered to help patients improve their visual ability, adapt to changes in their visual ability, and increase their independence in performing daily activities. In addition, telerehabilitation is effective in reducing treatment costs and increasing patient satisfaction (Hennein et al., 2023).

Despite the huge potential of telerehabilitation, its implementation in developing countries still faces some challenges. Limited access to technology means that some patients do not have adequate access to the devices and internet connection needed to participate in telerehabilitation programs (Indria et al., 2020). Lack of digital literacy in patients using varied digital technologies can be a barrier to the implementation of telerehabilitation services. Lack of supporting infrastructure, such as the availability of a stable and quality internet network and adequate technical support is critical to the success of the telerehabilitation program (Ihrig, 2022). Implementation of a telerehabilitation program requires considerable initial investment in hardware, software, and training of health workers (Agaronnik et al., 2019). This needs to be anticipated in the provision of eye care telerehabilitation services.

Eye telerehabilitation services in high-middle-income countries have undergone significant development in recent years. With the advancement of information and communication technology and the increasing awareness of the importance of healthcare accessibility, telerehabilitation has become an increasingly popular option. In *middle-high income* countries, the application of telerehabilitation in eye care has proven to be beneficial, especially in improving access and streamlining services (Bittner et al., 2023; Chong et al., 2021; Ihrig, 2023). However, some challenges need to be overcome, such as the digital and regulatory gaps. With further investment in technology infrastructure and education, telerehabilitation has great potential to support eye healthcare in these countries (Alyacoubi et al., 2023).

The application of telerehabilitation in eye care in Indonesia has great potential to expand access to health services, especially in remote areas. By utilizing information technology, telerehabilitation can help overcome geographical limitations that have been a barrier to health services. In addition, telerehabilitation allows patients with visual impairments such as glaucoma and macular degeneration to receive therapy and support from home, thereby improving their independence and quality of life. Cost savings for both patients and providers is also one of the advantages of telerehabilitation. With the flexibility of time and place, patients do not need to visit health facilities frequently, and health workers can focus more on cases that require direct physical intervention (Mousavi et al., 2023).

Considering the potential possibilities and challenges of telerehabilitation, current research needs to synthesize previous studies. Through literature review, we can identify best practices, knowledge gaps, and future research directions. In addition, research synthesis can also provide useful information for policymakers, healthcare providers, and researchers in developing effective and sustainable telerehabilitation programs. Therefore, this study aims to identify the implementation of telerehabilitation for patients with eye disorders in *lower, middle,* and *high-income* countries as an illustration of strategies for implementing telerehabilitation in Indonesia.

Method

Research Design

This research is a narrative literature review that aims to synthesize information from previous research articles. Secondary data in the form of research articles published in journal databases were carefully selected and reviewed using specific methods and tools to produce high-quality results. In the process of selecting journal articles, we refer to the PRISMA framework (Peters et al., 2022), which has been commonly used in various literature review studies. The articles obtained were then analyzed and categorized based on the purpose of the study, which was to identify the application of telerehabilitation for patients with eye disorders in countries with diverse economic statuses from low, middle to high-income countries. The country categorization was based on the *World Bank*'s categorization of country income status (Bank, 2024).

Inclusion and Exclusion Criteria

We also used several limitation criteria to improve the accuracy of the selected articles, namely journal articles published between 1998 and 2024, research on the topic of the application of telerehabilitation for eye patients, research with a country setting using English or Indonesian, and only focusing on adult diabetes mellitus patients. In this study, the research team excluded articles with the type of *literature review*, research protocols, telerehabilitation applications from

countries with low economic capacity, and synthesis articles that received MMAT scores <80.

Table 1. Keyword Mapping based on the PCC Framework

Question Aspect	Variables	Keywords
Population	Patients with eye disorders	Ophthalmology patient Vision-impaired patient Low vision patient Visually impaired individual
Concept	Telerehabilitation	Telerehabilitation
Context	Middle to high-income country	Middle-income High-income

Data Extraction

In this study, the search for health journal articles related to eye care rehabilitation was conducted in 3 journal databases, namely Pubmed, ScienceDirect, and Google Scholar. In this study, the PCC question framework was used to formulate research questions and identify keywords that would be used to search for articles in the journal databases. The order of the keywords used as shown in Table 1.

Table 2. List of Journal Databases, Query and Journal Article Search Results

Intended database	Journal Article SearchQuery	Search Results
Pubmed	((((((("Ophthalmology patient") OR (Vision-impaired patient)) OR (Low vision patient)) OR (Visually impaired individual)) AND ("Telerehabilitation")) OR (Middle-income)) OR (High-income)	1078
ScienceDirect	"Ophthalmology patient" OR "Vision-impaired patient" OR "Low vision patient" AND "Telerehabilitation" AND "Middle-income"	310
Google Scholar	("Ophthalmology patient" OR "Vision-impaired patient" OR "Low vision patient" OR "Visually impaired individual") AND "Telerehabilitation"	28
	("Ophthalmology patient" OR "Vision-impaired patient" OR "Low vision patient" OR "Visually impaired individual") AND ("Middle-income" OR "High-income")	112
	Total	1528

The search for related journal articles used a *query* to specify the results obtained. All search results were downloaded. RIS format and then the research team used the Rayyan.ai application to screen the journal articles. Data from the articles were extracted through the process of reading and categorizing important information from journal articles in auxiliary tables to facilitate data management. The *query* used in this research is as seen in Table 2.

Result and Discussion

A total of 1,528 journal articles were retrieved through searches of 3 pre-defined databases in this study. The researcher ensured the quality and relevance of the retrieved articles by conducting a systematic review through a screening process, which involved the exclusion of duplicate articles, and identifying the appropriateness of titles, abstracts, and content to the research questions. The screening process resulted in journal articles that were eligible for further analysis. The screening resulted in 12 articles that were eligible for analysis and synthesis. Figure 1 shows the process of selecting and screening articles, following the PRISMA flow chart determined by the researcher.

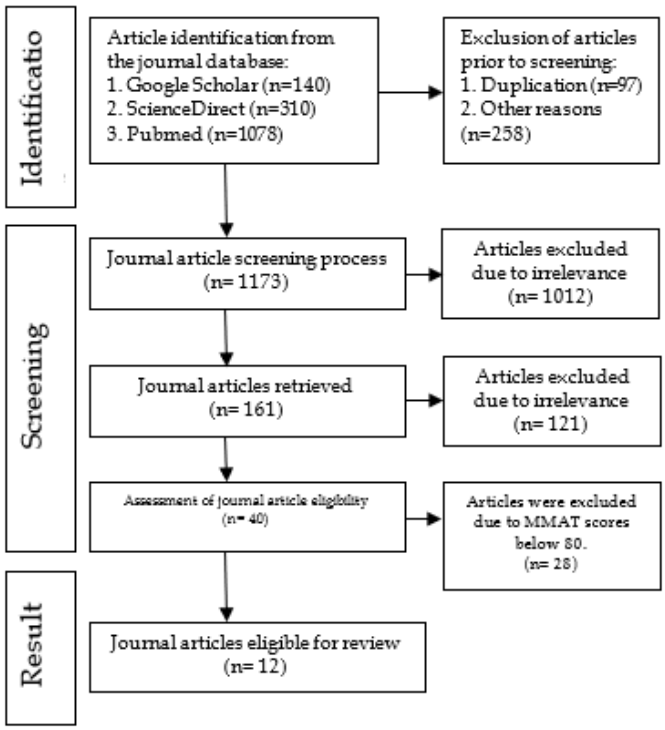

Figure 1. Screening Process of Journal Articles Obtained

Data from each journal article were analyzed and synthesized to obtain the main ideas and important data related to the application of telerehabilitation eye care in

low-, middle- and high-income countries. The identification results are as follows Table 3.

Table 3. Synthesized Table of Journal Articles that Meet the Research Criteria

Researcher	Year of Publication	Research Design	Country of Origin	MMAT Score	Overview of Telerehabilitation Services	Overview of Results
Silvestri et al	2019	Prospective study	Italia	80	The rehabilitation program is conducted using Eye-Fitness, which includes 19 customizable exercises. These exercises are designed to improve various visual functions, including: 1. Manual-ocular coordination 2. Ocular motility 3. Number matching 4. Center of the fovea 5. Image difference search 6. Reading test	The results showed a significant improvement in several visual parameters after training: Contrast sensitivity increased. Reading performance improved from 50.6 words per minute (wpm) to 67.6 wpm. Fixation stability also showed significant improvement.
Dunne, S. et al.	2020	Qualitative	English	100	Telerehabilitation is delivered through the DREX (*Durham Reading and Exploration Training*) app	Identified barriers (lack of confidence with technology, lack of face-to-face contact, limited therapist time), facilitators (clear goals, feedback, repetition), and important features of telerehabilitation.
Senjam et al	2021	Retrospective study	India	80	1. Counseling, COVID-19 education 2. Demonstration of prevention techniques, and services through phone, messaging, and video platforms	The majority of respondents were male (78.8%), main complaints: were itchy eyes (36.1%), and headache (29%), many relied on TV for COVID-19 information (59.4%). High use of telerehabilitation for consultation services
Christy, et al	2022	Retrospective study	India	80	The telerehabilitation services provided include: 1. Early intervention for children 2. Computer and social skills training 3. Access to Digital Books 4. Counseling for Mental well-being Help by phone and WhatApps	Results from the study showed that: 305 respondents were involved, with 42% being children. Most had severe visual impairment (51%) and blindness (14%). Service Success: Telerehabilitation proved to be effective in providing support to patients with eye disorders who were unable to physically

Researcher	Year of Publication	Research Design	Country of Origin	MMAT Score	Overview of Telerehabilitation Services	Overview of Results
						access rehabilitation services.
Roy et al.	2022	Retrospective study	India	89	This article discusses the concept of telerehabilitation but does not describe the specific platforms or services used.	Telerehabilitation can improve follow-up care for patients with eye disorders in remote areas by overcoming distance constraints, although economic factors are less influential.
Bittner et al	2022	*Randomized control trial* (RCT)	India	100	Video conferencing via Zoom with various technical support (e.g. phone assistance, volunteers, *remote access software*)	Users were satisfied with telerehabilitation, especially with the *remote access software* method. There was an increase in the use of magnifying devices after the training.
Bittner et al	2022	Experimental study	Amerika Serikat	100	Through videoconferencing from home, patients receive verbal instructions from a vision rehabilitation provider on tool use, viewing angles, and other adjustments to maximize near vision function.	The average reading ability improved after training within a few weeks of the telerehabilitation program. Reading speed also increased significantly by 0.18 log words per minute.
Philip et al	2023	Qualitative	India	100	Consistent monitoring, easy access to professional services, provision of resources, and parent training are key factors in supporting parents in assisting their child's rehabilitation.	The thematic analysis of the FGDs showed barriers such as lack of family support, time management, child-specific issues, and neighborhood limitations, and facilitators such as continuous monitoring, access to resources, and empowering parents through training.
Jones et al	2023	Qualitative	English	100	Visual telerehabilitation using video call technology, remote counseling, and self-training programs	Vision telerehabilitation offers greater reach and cost savings, but faces challenges related to digital skills, technical constraints, relationship impacts, limitations of virtual interventions, as well as workforce shortages, and

Researcher	Year of Publication	Research Design	Country of Origin	MMAT Score	Overview of Telerehabilitation Services	Overview of Results
						understanding of the role of vision rehabilitation.
Perasso et al	2023	Experimental study	Italia	100	1. *Online* visual training was conducted through a program of 6 weekly sessions by orthoptists using Microsoft Teams. 2. Exercises using media stored on folders distributed to patients.	The tele-rehabilitation group showed a significant decrease in response time and a greater improvement in ergoperimetric performance compared to the control group.
Beniwal & Senjam	2024	Retrospective study	India	80	1. Vision rehabilitation consultation 2. Teleconsultation 3. Information related to rehabilitation services 4. Disability certificate	The majority of calls were related to new disability certificates (16.3%), vision rehabilitation (20.2%), and eye consultations (21%).
Bittner et al	2024	Randomized control trial	United States of America	100	Telerehabilitation is done through video conferencing software (Zoom) and remote control access to provide training to patients at home.	Of the 47 respondents who completed the training, reading skills increased significantly by an average of 0.61 logits from *baseline* after 1 month of training and increased by another 0.44 logits from 1 to 4 months after training.

Telerehabilitation Effectiveness

Increased Access

The implementation of telerehabilitation in previous studies was able to overcome geographical barriers and improve access to rehabilitation services for patients with visual impairment, especially in remote areas. A review of the studies in this study consistently shows that telerehabilitation can be an effective solution in overcoming geographical barriers and improving the accessibility of rehabilitation services for patients with visual impairment, especially in remote areas. Christy et al. (2022) showed that telerehabilitation helped patients with eye disorders in remote areas of India, who previously had difficulty accessing rehabilitation services due to limited transportation and facilities. Countries with large landscapes with less economic capacity to access transportation will be greatly helped by the use of remote services based on information technology. Beniwal & Senjam (2024) through their study show the importance of telerehabilitation in providing rehabilitation services in situations that require activity restrictions, such as during the COVID-19 pandemic, when people's mobility is severely limited. Telerehabilitation allows individuals with visual impairments to still get the services they need without having to leave their homes.

Distance from residences and healthcare facilities is a major obstacle for patients with eye disorders commonly found in remote areas. Telerehabilitation has the potential to address this issue by allowing patients to receive rehabilitation services remotely (Roy et al., 2022). A study by Bittner et al. (2022) shows that telerehabilitation can be used to increase the accessibility of training activities to improve the ability to fulfill basic daily needs independently for individuals with visual impairments. With telerehabilitation, individuals no longer need to travel far to receive training.

Improved Quality of Life

Telerehabilitation is effective in improving the quality of life of patients with visual impairment through improved visual skills, independence, and mental well-

being. Telerehabilitation not only increases the accessibility of rehabilitation services but also significantly improves the quality of life of individuals with visual disabilities.

Visual Skills Enhancement:

A user-customizable digital-based rehabilitation program effectively improves visual function in patients with eye disorders due to macular degeneration through directed training (Silvestri et al., 2019). This is also supported by research from Bittner et al. (2022) that training in telerehabilitation programs can improve reading skills in patients with eye disorders using *magnification devices*. This improvement in visual skills allows individuals to be more independent in performing daily activities, such as reading, writing, and working.

Increased Independence

Telerehabilitation helps patients with eye disorders to develop essential daily living skills, such as the use of assistive technology for daily activities and navigation. This increased independence motivates self-confidence in patients and enables patients to participate more actively in society (Christy et al., 2022).

Improved Mental Wellbeing

A study from Beniwal & Senjam (2024) showed that telerehabilitation helped reduce anxiety and fear in patients with eye disorders, especially during the pandemic. This improvement in mental well-being is crucial for overall quality of life.

Flexibility

Telerehabilitation has flexibility in terms of time and place, allowing individuals to attend rehabilitation service sessions according to their schedule. One of the main advantages of telerehabilitation is the flexibility that is not available in conventional eye care. Unlike face-to-face therapy, which requires both the patient and the healthcare professional to come to a specific place at a predetermined time (Perasso et al., 2023). Telerehabilitation allows patients to attend rehabilitation sessions according to their schedule. Each patient can arrange the rehabilitation session time according to their daily activities without having to worry about missing the rehabilitation schedule which is sometimes considered rigid. This is especially beneficial for patients who have busy jobs or family activities (Roy et al., 2022).

This flexibility benefit is also very beneficial for patients who live far from healthcare facilities or in remote areas. As explained earlier, increased accessibility will have a positive impact on patient care, such as increased adherence to telerehabilitation appointments so that patients can follow various rehabilitation programs well because it is easier for patients to attend sessions regularly. Patients also do not have to worry about transportation or waiting time during rehabilitation, resulting in lower levels of individual stress and anxiety (Bittner et al., 2024; Dunne et al., 2020; Jones et al., 2024). In addition, the improvement in quality of life in patients with eye disorders increases with the flexibility of telerehabilitation. Patients can more easily balance their rehabilitation needs with the rhythm of their daily activities, such as work, family, and hobbies (Beniwal & Senjam, 2024).

Challenges in Telerehabilitation Implementation

Although telerehabilitation has several advantages in the care of patients with eye disorders, several challenges were also identified in this study. Limited access to technology, especially in remote areas, is a major barrier. Limited access to technology in remote areas is one of the biggest challenges in implementing telerehabilitation. Previous studies, such as the study by Christy et al. (2022), have shown that patients with eye disorders in remote areas often face difficulties in accessing rehabilitation services due to limited technological infrastructure, such as unstable internet connectivity and non-standardized communication tools. Lack of digital skills in both patients with eye disorders and service providers can also hinder the use of telerehabilitation (Philip et al., 2023). One of the major challenges in the implementation of telerehabilitation is the lack of digital skills that cause users of telerehabilitation systems to be unfamiliar with the communication tools used. Research conducted by Silvestri et al. (2019), shows that although computer-based rehabilitation programs are effective, their success depends largely on the individual's ability to use the technology.

Telerehabilitation involves direct interaction between individuals and technological devices such as computers or tablets. Adequate digital skills are required to operate the device, access applications, and navigate the user interface of the device. Patients with eye disorders should be able to actively participate in rehabilitation sessions, such as answering questions, performing tasks, and providing feedback. Limited digital skills may hinder this active participation. After the rehabilitation session, patients are expected to continue independent practice at home to achieve the desired proficiency or improvement in their condition. Adequate digital skills allow them to access training materials, track progress, and seek additional support independently (Dunne et al., 2020; Philip et al., 2023; Roy et al., 2022).

Unstable internet connection quality may interfere with telerehabilitation sessions. Unstable internet connection quality can cause difficulties in accessing videos, materials, or consultation sessions with doctors. Telerehabilitation involves the transmission of large amounts of data, such as video, audio, and patient data. An unstable internet connection can cause interruptions in data transmission, resulting in poor image and sound quality and intermittent communication. Interaction between therapists and patients in telerehabilitation is *real-time* (Beniwal & Senjam, 2024; Senjam et al., 2022). This means that the interaction takes place directly without any pause in processing information through other tools during the consultation. Delays in data transmission or instability of the internet connection can disrupt the flow of communication and make the therapy session ineffective. Many telerehabilitation applications require a stable internet connection to function properly. A poor connection may cause the application to *crash*, data to be lost, or certain features to be unusable (Bittner et al., 2022).

In addition, family and community involvement is essential to support successful telerehabilitation. Family and community involvement in the telerehabilitation process is a crucial factor. Previous studies, such as those conducted by Philip et al. (2023) show that the perception of patients' families, such as parents, regarding facilities in telerehabilitation programs for children with visual impairments greatly influences the success of such programs. Support from family and community can be a strong source of motivation for individuals to continue participating in rehabilitation programs. Families and communities can provide practical assistance, such as helping to schedule therapy sessions, providing needed equipment, or providing emotional support during the rehabilitation process (Perasso et al., 2023).

Another challenge in telerehabilitation services is that it is difficult to evaluate the long-term outcomes of telerehabilitation, especially for complex interventions. The diversity of components in the intervention, such as visual exercises, occupational therapy, and psychological counseling, makes it difficult for health workers to isolate the specific impact of each component on the outcome (Bittner et al., 2022). In addition, the complex interactions between various factors, both internal and external, further complicate the evaluation process. The lack of standardized evaluation standards is a significant challenge in evaluating long-term outcomes of telerehabilitation. The variety of evaluation instruments and methods used by different researchers makes these evaluations more complex. In addition, the lack of consensus on an appropriate timeframe for evaluating telerehabilitation therapy outcomes is another shortcoming of telerehabilitation services for patients with eye disorders (Jones et al., 2024).

Enabling Factors for Telerehabilitation Success

An easy-to-use and accessible telerehabilitation platform is essential to increase user acceptance of telerehabilitation. The development of a *user-friendly* telerehabilitation platform is essential to support the success of the program. The ease of use and accessibility of the platform directly impacts patient compliance with the rehabilitation program. An easy-to-use platform will encourage patients to more actively participate in the rehabilitation program. Previous studies have shown that patient adherence is an important factor in determining the success of an intervention (Bittner et al., 2022). A well-designed platform can overcome geographical and physical barriers, allowing patients with eye disorders to access rehabilitation services from anywhere and at any time. With a user-friendly platform, patients can be more independent in managing their condition and improve their overall quality of life (Krawiec & Dudycz, 2019).

Comprehensive training for service providers and users is essential to ensure the successful implementation of telerehabilitation. Comprehensive training can be used as a medium to ensure that service providers have the knowledge and skills needed to provide quality services in telerehabilitation programs. Comprehensive training is a form of long-term investment that will provide significant benefits for the success of telerehabilitation programs. By having the necessary knowledge and skills, health workers can improve the quality of service, increase patient compliance, and ultimately improve the quality of life of individuals with visual impairments (Bittner et al., 2022).

Telerehabilitation should include not only medical aspects, but also social and psychological aspects. In some studies, health workers can encourage patients to form online or offline support groups for patients with eye disorders as a medium for sharing experiences and support. This holistic approach not only affects visual function, but also the overall quality of life, including social, emotional, and psychological interactions (Hutchinson et al., 2018). To implement a holistic approach, collaboration between various professions is needed, such as ophthalmologists, optometrists, occupational therapists, psychologists, and social workers. This collaboration allows service providers to provide integrated care and meet all patient needs. A holistic approach to telerehabilitation is an important step in providing comprehensive and effective care for individuals with visual impairments (Roy et al., 2022). By addressing medical, social, and psychological

aspects, telerehabilitation can help individuals reach their full potential and improve overall quality of life.

Conclusion

This study aims to evaluate the effectiveness of telerehabilitation in improving access and quality of life for individuals with visual impairment in various countries. Through a systematic analysis of 12 journal articles, this study shows that telerehabilitation has been proven effective in overcoming geographical barriers, increasing accessibility of rehabilitation services, and improving patients' quality of life. Telerehabilitation not only improves visual skills but also supports patients' independence and mental well-being. However, the implementation of telerehabilitation still faces several challenges, such as limited access to technology, lack of digital skills, and unstable internet connection quality. This study also shows that social support, program quality, and comprehensive training in supporting the success of telerehabilitation are very important aspects. Further research is expected to focus more on the development of more personalized telerehabilitation interventions, long-term evaluation of the effectiveness of telerehabilitation, and programs that can be used to overcome challenges related to technology access and digital readiness of telerehabilitation services.

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The authors declare no conflict of interest.

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