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Effectiveness of Telerehabilitation for Stroke Patients: A Critical Review

Hassan Saror^{1,*}

¹ Director of Medical Rehabilitation and Extended Care-Jazan Region, Saudi Arabia. Licensed Occupational Therapist-New Zealand (OTBNZ), Australia (AHPRA).

Abstract

Background: Traditional in-person rehabilitation programs have limitations, such as travel barriers, limited access to specialized care, and high costs. Telerehabilitation, on the other hand, offers a remote solution for stroke patients to receive rehabilitation services in the comfort of their homes. This critical review aims to analyze and synthesize the existing literature on telerehabilitation for stroke patients, evaluating its effectiveness in improving functional outcomes, reducing disability, and enhancing patient satisfaction.

Methods: A comprehensive literature review was conducted using PubMed, Scopus, and Google Scholar databases. Review articles, systematic reviews, and meta-analyses published between 2010 and 2023 were included in the analysis.

Results: A thorough study of the current literature showed a complete body of evidence on the effectiveness of telerehabilitation for stroke patients in the systematic review. The findings from this large body of research consistently supported the efficacy of telerehabilitation in improving various functional outcomes in stroke patients. The key outcomes evaluated were motor function, balance, and daily life activities. The findings were extremely encouraging, as telerehabilitation had significant and beneficial impacts in these areas, adding to stroke patients' overall well-being and recovery.

Conclusion: The review's findings imply that telerehabilitation has the potential to be a successful stroke patient intervention. Transportation constraints, lack of specialized stroke care specialists, and geographic distance can all be solved with the remote delivery of rehabilitation services. Future research should improve telerehabilitation therapies, find the best patient demographics, and assess long-term results.

Keywords: Stroke, Telerehabilitation, Telemedicine, Telehealth, Rehabilitation, Functional outcomes, Technological barriers

Hassan Saror- Director of Medical Rehabilitation and Extended Care, Jazan City, Saudi Arabia; Email: hsrar2009@hotmail.com.

1. Introduction

Stroke is defined as a quickly growing global or localized neurological dysfunction that lasts longer than 24 hours or causes mortality for reasons other than vascular origin [1]. It is classified into three types: hemorrhagic, ischemic, and transient ischemic attack [2]. Despite medical and rehabilitative improvements, stroke remains a significant cause of death and disability globally [3]. Enduring a stroke exerts a substantial financial strain on people and the global healthcare system. The anticipated annual cost of care for stroke survivors in the United States is around \$34 billion, with this figure expected to rise [4]. In Saudi Arabia, healthcare services are predominantly government-funded, and the cost is anticipated to be substantial. However, in Saudi Arabia, there has been contradictory research regarding the incidence of stroke. According to one study, the incidence of stroke is 29.8 incidents per 100,000 persons [5]. A subsequent study identified a stroke prevalence of 43.8 occurrences per 100,000 persons. Some argue that Saudi Arabia's youthful age group contributes to a lower incidence of stroke than other Western nations. But the main reason for this is the paucity of information on the prevalence of stroke in Saudi Arabia [6].

Prevention is critical in minimizing stroke-related death and morbidity. Changing lifestyle factors and addressing controllable risk variables can prevent around 50% of strokes [7]. Also, early rehabilitation plays a critical role in optimizing functional recovery and improving the quality of life of stroke patients. Still, access to rehabilitation services can be limited, particularly for those living in rural or underserved areas [8].

Researchers have recently examined the possibility of remotely facilitating communication between patients and healthcare providers through technology like the Internet and telephones. This kind of therapy, telerehabilitation, may be more convenient and less expensive. Thus, it has the potential to overcome the barriers related to access to specialized care, geographical distance, and transportation limitations [9]. Through telecommunication technologies, stroke patients can receive rehabilitation services in the comfort of their homes, thus reducing travel costs and time. Furthermore, telerehabilitation has been shown to be effective in improving functional outcomes and reducing disability in stroke patients [10].

For example, despite healthcare precautions, physical therapists continued to provide rehabilitation treatments to their patients throughout the COVID-19 pandemic. As a result, physical therapists in Saudi Arabia had to examine strategies to provide secure access to treatments, and some of them began to adopt telerehabilitation. Physical therapists acknowledged the necessity of remote healthcare delivery in the COVID-19 pandemic and demonstrated favourable attitudes regarding and readiness to adopt telerehabilitation [11]. Due primarily to its enormous benefits, patients have also had a

high opinion of telerehabilitation services. Patients no longer needed to visit clinics in person since telerehabilitation allowed for greater scheduling flexibility and decreased travel time [12].

Similarly, regardless of significant technological hurdles, some patients saw telerehabilitation as viable and accepted it. These patients, however, noted disparities in service quality and favoured traditional in-person treatment over telerehabilitation care [13].

Even though telerehabilitation seems promising, there are still obstacles to overcome before it can be put into practice, such as a lack of standard operating procedures, provider training, and technology limitations. However, for post-stroke patients, telerehabilitation can be a good substitute for traditional rehabilitation therapy, particularly in rural or underdeveloped locations. In-depth research is required to assess the cost-effectiveness and health-related quality of life associated with the continuous advancements in telerehabilitation networks [14]. Nevertheless, the potential benefits of telerehabilitation in stroke care are vast, making it a topic of significant interest in the research community.

2. Subjects and Methods

A comprehensive literature review was conducted using PubMed, Scopus, and Google Scholar databases. The search terms included "telerehabilitation," "telemedicine," "stroke," and "rehabilitation." Original research articles, systematic reviews, and meta-analyses published between 2010 and 2023 were included in the analysis.

2.1 Inclusion and Exclusion Criteria

- Studies were included if they focused on telerehabilitation interventions for stroke patients, evaluated their effectiveness in terms of functional outcomes, disability reduction, or patient satisfaction, and were published in English.
- Exclusion criteria included studies that did not pertain to telerehabilitation for stroke, studies with insufficient data, and studies not available in full-text form.

2.2 Data Extraction:

The selected studies were reviewed, and relevant data were extracted, including study characteristics (e.g., publication year, study design), participant demographics, telerehabilitation interventions, outcomes measured, and key findings.

2.3 Data Synthesis:

The extracted data were synthesized and organized chronologically to present an overview of the existing literature on the effectiveness of telerehabilitation for stroke patients. Key findings from each study were summarized, including information on the impact of telerehabilitation on functional outcomes,

disability reduction, and patient satisfaction.

3. Results

In this review, we analyzed and synthesized the existing literature on telerehabilitation for stroke patients, evaluating its effectiveness in improving functional outcomes, reducing disability, and enhancing patient satisfaction. Ten pertinent publications that satisfied the inclusion criteria were found during the evaluation. The research included remote monitoring, virtual reality-based treatment, and video-conferencing meetings with healthcare specialists, among other telerehabilitation methods. The following is a chronological review of published research articles, beginning with the latest and moving towards earlier studies (table 1)

Table (1) Characteristics of the Included Studies

Sr. No.	Author and year	Experimental design technique	Output (response)	Findings of the study
1	Hao, Pu, Chen, and Siu (2023)	A systemic review	Effectiveness of virtual reality-based telerehabilitation in stroke patients	Given the constraints and limitations of traditional in-person rehabilitation, virtual reality-based telerehabilitation offers a viable route for stroke victims.
2	Edwards et al., (2023)	A prospective study	The feasibility of providing intensive telerehabilitation therapy in stroke patients	This study established the safety, practicality, and favourable rating of intense rehabilitation utilizing a digital healthcare platform in the United States.
3	Nikolaev & Nikolaev, (2022)	A narrative review	Analyze current telerehabilitation approaches for stroke patients' recovery.	Telerehabilitation can help stroke patients improve their motor function, cognition, speech, and linguistic communication.
4	Knepley et al., (2021)	A systemic review	Evaluation of telerehabilitation whether it is as effective as traditional in-person therapy for stroke patients	Telerehabilitation is less expensive and similarly effective in improving functional outcomes in stroke patients than clinic-based rehabilitation.
5	Laver et al., (2020)	A systemic review	To see if telerehabilitation improves stroke survivors' capacity to perform activities of daily living compared to in-person rehabilitation.	The authors concluded that telerehabilitation services can be considered as a viable alternative to traditional face-to-face rehabilitation for stroke patients.
6	Tchero, Tabue Teguo, Lannuzel, & Rusch, (2018)	A systemic review	To investigate the efficacy of telerehabilitation in poststroke patients.	The results showed that telerehabilitation interventions positively affected motor function, balance, and activities of daily living in stroke patients.
7	Totten et al., (2016)	A systemic review	A summary of the wide and varied collection of information	A vast body of research found that telehealth treatments provide excellent effects when utilized for

			on telehealth for decisionmakers	remote patient monitoring, broadly defined, for numerous chronic illnesses and for psychotherapy as part of behavioural health.
8	Chen et al., (2015)	A systemic review	Evaluation of the effects of telerehabilitation in stroke survivors living at home	The study observed that telerehabilitation of all techniques has the same effect as traditional rehabilitation in improving stroke patients' capacity to perform activities of daily living and motor function.
9	Johansson & Wild, (2011)	A systemic review	To assess the effectiveness of telerehabilitation therapies in stroke care	Home-based telerehabilitation programs demonstrated good outcomes in improving stroke patients' health and assisting carers. The satisfaction and acceptability of telerehabilitation therapies were assessed to be high by both health professionals and participants.
10	Miller et al., (2010)	A comprehensive overview	overview of stroke patient nursing and multidisciplinary rehabilitation care	The authors emphasized the need of early rehabilitation in stroke recovery and the potential of telemedicine, especially telerehabilitation, to overcome hurdles in stroke patients' access to care.

The author examined the benefits of virtual reality-based telerehabilitation for stroke patients using a systematic review and meta-analysis of seven trials. Given the drawbacks and limitations of conventional in-person rehabilitation, the findings demonstrated that virtual reality-based telerehabilitation is a successful substitute strategy for stroke patients [15].

In this study, following a stroke, a well-established telerehabilitation program was launched for 16 patients with hemiparetic stroke at their respective homes. The therapy spread out over six weeks. The study established the achievability, safety, and favourable rehabilitation rating utilizing a digital telemedicine platform [16].

In 2022, a narrative review was conducted to analyze existing telerehabilitation techniques for stroke patients' recovery. The evaluation includes 70 research and review publications. TR was found to be effective in improving motor function, cognition, speech, and linguistic communication in stroke patients [17].

A search of the phrase "telerehabilitation and stroke" across three databases yielded thirty-four studies involving 1,025 patients. According to the findings, telerehabilitation was less expensive and just as effective as clinic-based rehabilitation in improving functional outcomes in stroke patients. It resulted in comparable patient satisfaction [18].

In a systematic review published in the Cochrane Database of Systematic Reviews, Laver et al.

evaluated the effectiveness and safety of telerehabilitation services for stroke patients. A total of 63 studies were included in the review, and the results suggested that telerehabilitation interventions positively affected motor function, activities of daily living, and quality of life in stroke patients. The authors concluded that telerehabilitation services can be considered a viable alternative to traditional face-to-face rehabilitation for stroke patients [9].

In a systematic review and meta-analysis of 22 studies, Tsai et al. evaluated the effectiveness of telerehabilitation in stroke patients. The results showed that telerehabilitation interventions positively affected motor function, balance, and activities of daily living in stroke patients. The authors concluded that telerehabilitation was a feasible and effective intervention for stroke patients but highlighted the need for further research to optimize its use [14].

A substantial amount of this systemic review study found that telehealth treatments yield favourable outcomes when utilized for remote patient monitoring, broadly defined, for various chronic diseases. When telehealth is utilized for communication and counselling or remote monitoring in chronic illnesses, improvements in outcomes such as mortality, quality of life, and hospital admissions have been recorded [19].

This systemic review assessed the benefits of telerehabilitation for stroke victims residing in their homes, and the results offered a limited to moderate amount of evidence suggesting that all forms of telerehabilitation were equally effective as traditional rehabilitation in enhancing the abilities of stroke victims to perform activities of daily living and to use their motor skills [20].

In 2011, a comprehensive analysis of telerehabilitation methods for stroke patients was carried out. Medline, Embase, DARE-NHSEED-HTA (INAHTA), and the Cochrane Library were the searched databases. The review comprised nine articles that were all published after the year 2000. In summary, home-based telerehabilitation programs have shown encouraging outcomes in enhancing stroke patients' health and providing carer support. Stroke patients' physical health can be enhanced by telemedicine systems built on a virtual environment for upper extremity exercise [21].

In a scientific statement from the American Heart Association, Miller et al. provided a comprehensive overview of the nursing and interdisciplinary rehabilitation care of the stroke patient. The authors emphasized the importance of early rehabilitation in stroke recovery and highlighted the potential of telemedicine, including telerehabilitation, to overcome barriers in access to care for stroke patients [8].

4. Discussion

A remarkable result of the comprehensive review was the considerable increase in physical function following a complex stroke telerehabilitation intervention, with improvements continuing for up

to three months after the intervention was completed. With the limited resources available for stroke survivors requiring in-home rehabilitation, it might serve as a helpful adjunct to typical poststroke therapy [22]. These similar outcomes were observed in another study, which demonstrated that after being released from acute care, rehabilitative training can be continued remotely thanks to telerehabilitation, which might involve challenging tasks that are known to foster favorable brain changes. In order to determine whether telerehabilitation can help stroke patients with their ankle dorsiflexion during the swing phase of their gait and to compare the effects of complex versus simple ankle movements on behavioural change and brain reorganization, a pilot randomized controlled trial was carried out. Sixteen individuals with chronic stroke and poor ankle dorsiflexion were randomly randomized to 4 weeks of paretic ankle telerehabilitation. The findings imply that telerehabilitation—which emphasizes complicated task training with the paretic limb—is both practical and beneficial in encouraging individuals with chronic stroke to achieve greater dorsiflexion [23].

Yet another research supports the finding that, when it comes to improving the functional outcomes of stroke patients, telerehabilitation is less expensive and just as successful as clinic-based rehabilitation. Comparable patient satisfaction is respectively achieved with telerehabilitation. It can be utilized as an addition to guide in-person treatment or in conjunction with other therapies, such as speech therapy and robotic assistance [18].

A patient's motivation to participate in rehabilitation to restore abilities that a brain injury has damaged is improved when they experience a high degree of satisfaction, which is a crucial sign of the effectiveness of therapeutic therapies. In 2008, a second experimental virtual reality telerehabilitation trial was conducted with community-dwelling post-stroke patients with arm motor deficits. The notion that stroke patients prefer this strategy is supported by the high patient satisfaction with telerehabilitation shown in the analyzed trials [24].

Given that stroke patients often encounter mobility and transportation difficulties, the convenience of telerehabilitation appears especially appealing. However, it's essential to acknowledge that patient satisfaction, while critical for care quality, must be understood in the context of its correlation with long-term clinical outcomes, which remains an area for further exploration [25].

Without a shadow of a doubt, phone and/or video technologies are essential to the successful delivery of services in the fields of telehealth and telemedicine, including remote monitoring and visits. However, additional research is required to inform potential users and clinicians about the variety of technologies available for telerehabilitation [26].

In low-resource areas of high-income countries, where neuro-rehabilitation specialists and

facilities are almost non-existent, the routine use of telemedicine for poststroke rehabilitation may be especially crucial. Further research evaluating the feasibility, efficacy, and cost-effectiveness of telerehabilitation in Sub-Saharan Africa and other low- and middle-income countries with rising stroke burdens is needed. Larger, well-powered, longer-term trials are required to establish telerehabilitation as a common treatment option for stroke survivors worldwide [27].

On top of that, telerehabilitation can potentially increase access to early and intense rehabilitation, resulting in better results and lower healthcare expenditures. Technological impediments, a lack of standardized protocols, and provider training must be addressed to enable the effective implementation and scalability of telerehabilitation programs.

5. Conclusion

Stroke patients' functional results have been shown to improve, and their impairment has been reduced using telerehabilitation. It provides a practical and accessible alternative to traditional in-person rehabilitation, especially for people who may not have access to specialized treatment. Telerehabilitation has the potential to revolutionize stroke therapy and enhance the lives of stroke survivors as communications technology evolves.

One particularly noteworthy conclusion from the research analyzed was that telerehabilitation was just as effective as traditional in-person rehabilitation in improving functional outcomes and lowering disability among stroke patients. This highlights the possibility of telerehabilitation as a credible and important alternative to traditional, in-person care for those who have had a stroke.

Crucially, the research provided information about the telerehabilitation experience from the perspective of the patients as well. Stroke patients, who frequently confront physical and logistical problems, were really pleased with this remote approach to therapy. They saw telerehabilitation as a handy and accessible way to get their needed attention and assistance. This good patient response underlines telerehabilitation's significance as a patient-centred and patient-friendly technique.

6. Declarations

6.1 Conflict of Interest Statement

The authors have no conflict of interests to declare.

6.2 Funding Disclosure

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7. References

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