A Systematic Review of the Effectiveness of Telerehabilitation Interventions for Therapeutic Purposes in the Elderly

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Abstract

Background Many elderly people suffer from chronic health conditions and mobility limitations. Therefore, they may benefit from traditional rehabilitation or telerehabilitation interventions as an alternative for this type of services.

Objective The purpose of this study was to compare the effectiveness of telerehabilitation interventions with traditional rehabilitation services for therapeutic purposes in the elderly.

Methods This systematic review was conducted in 2018. The searched databases were Cochrane Library, PubMed, Scopus, Web of Science, Embase, and ProQuest. The search was conducted with no time or language limitation. The selected papers included the randomized clinical trial studies in which elderly people aged 60 and over used telerehabilitation services for treatment purposes. The quality of the studies was evaluated by using the physiotherapy evidence database (PEDro) scale. Data were extracted by using a data extraction form and findings were narratively synthesized.

Results After screening the retrieved papers, eight articles were selected to be included in the study. According to the findings, telerehabilitation was used for the elderly after stroke, chronic obstructive pulmonary disease (COPD), total knee replacement, and in patients with the comorbidity of COPD and chronic heart failure. Overall, in most studies, there was no significant difference between the intervention and control groups and the level of improvements was similar for most outcomes.

Conclusion Telerehabilitation services can be regarded as an alternative to traditional rehabilitation approaches to reduce outpatient resource utilization and improve quality of life. However, more rigorous studies are suggested to investigate the effectiveness of telerehabilitation services for specific diseases or health conditions.

Keywords

- systematic review
- telerehabilitation
- rehabilitation
- elderly
- randomized clinical trial

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Introduction

The world population is currently aging and the number of people over 60 years old is increasing faster than other age groups.[1] The number of people aged 60 years and older is expected to increase by more than 65% between 2015 and 2030, rising from 901 million to 1.4 billion individuals. It is also predicted that in 2050, the number of elderly will reach more than twice the number presented in 2015, which will be ~2.1 billion people.[2] Aging can adversely affect individual performance and may lead to chronic diseases which, in turn, necessitate greater use of healthcare services, such as rehabilitation.[2,3] There are also other factors, such as rising public expectations, increasing the number of comorbidities and acute conditions like heart attacks and brain injuries that may drive an increased demand for rehabilitation services.[4] This is a challenging situation for healthcare systems to meet the needs of patients who are looking for longer, independent, and high-quality life.[5] In recent years, information and communication technology (ICT) has been greatly used in the healthcare environment.[1,6] Telerehabilitation is an example of using ICT in the field of rehabilitation that saves time and costs and aims to provide the vulnerable populations, for example,, the elderly and disabled people with easier and continued access to healthcare services.[6]

Telerehabilitation has been widely used in the treatment of various diseases and health conditions, such as heart attacks, brain injuries, spinal cord injuries, multiple sclerosis (MS), dysphagia, auditory and mental disorders,[7] and several criteria have been examined in different studies to demonstrate the effectiveness of this type of services. For example, telerehabilitation was found effective for patients with MS, as it improved quality of life and functional activities and reduced long-term symptoms and psychological consequences. Similarly, it assisted patients with cancer to improve their clinical outcomes and reduce depression.[8–10] In stroke patients, telerehabilitation helped to improve their ability to do daily works and reduced costs and the duration of rehabilitation programs.[11]

Although the effectiveness of telerehabilitation interventions has been investigated in the treatment of stroke,[12–14] Parkinson's disease,[15] musculoskeletal disorders,[16,17] injuries and lesions,[18–20] and chronic diseases,[21] it is not clear how using this technology is effective compared with using traditional rehabilitation for therapeutic purposes in the elderly. Therefore, the present study aimed to answer the following research question: how effective are telerehabilitation interventions compared with traditional rehabilitation services for therapeutic purposes in the elderly.

Methods

This research was a systematic review conducted in 2018. A systematic review is a means of identifying, evaluating, and interpreting all available studies relevant to a specific research question, or a subject of interest. A systematic review involves several activities that can be summarized into three main phases: planning the review (identifying the need for a review and developing a protocol), conducting the review (identifying studies, paper selection, study quality assessment, data extraction, and synthesis), and reporting the review.[22] These phases are described below.

Planning the Review

Prior to undertaking the systematic review, the researchers agreed several activities that should be completed during the study. These included determining the research question, search terms, and resources to be searched that included databases, specific journals, and conference proceedings, study selection criteria, data extraction, and synthesis.

Conducting the Review

Conducting the review included identifying relevant studies, paper selection, quality assessment of the studies, data extraction, and synthesis.

Identifying Relevant Studies

To identify the relevant studies, a search strategy was developed. Initially, several keywords were selected by using Medical Subject Headings and the keywords of the related papers.[23–27] The databases used for searching papers were Cochrane library, PubMed, Scopus, Web of Science, Embase, and ProQuest. Google scholar was also searched to ensure that no article was missed. Finally, the reference list of all included papers was hand-searched to identify any additional articles. A sample of search strategy was ((telerehab* OR tele-rehab* OR remote rehab* OR virtual rehab*) AND (elderly OR aged OR aging OR aging OR old adult OR frail elderly)). No time or language limitation was considered when searching databases. The retrieved papers were managed by using Endnote X9, and all duplicates were removed.

Paper Selection/Inclusion and Exclusion Criteria

Once the relevant primary studies were obtained, they were assessed for their actual relevance. In this study, PICO criteria were applied as follows:

Population: Elderly people aged 60 and over who used telerehabilitation services after surgical interventions or for therapeutic purposes were included. The subjects aged under 60 years old and people who used telerehabilitation services for other purposes were excluded.

Intervention: Online or offline telerehabilitation interventions for treatment purposes were included and routine telecoaching or teleexercises were excluded.

Comparison: Telerehabilitation interventions were compared with the traditional rehabilitation services. All studies in which there was no comparison between two approaches or the type of the study was not clinical trial were excluded.

Outcome: All clinical and individual outcomes that could be related to the effectiveness of the intervention were considered.

Screening of the studies was conducted in three separate phases based on the title, abstract, and full text of the articles. The papers were screened by two authors (F.V) and (M.H) and disagreements were resolved by H.A.

Quality Assessment

In addition to inclusion and exclusion criteria, it is important to assess the "quality" of the primary studies.[22] Therefore, PEDro scale was used to assess the quality of the selected studies.[28,29] The scale scores are categorized as follows:

High quality= PEDro score (6–10)

Fair quality= PEDro score (4–5)

Poor quality= PEDro score ≤ 3

The result of quality assessment was acceptable, and no study was excluded because of poor quality.

Data Extraction

A data extraction form was designed to collect the needed information to address the review question. The form included the name of the authors, country, research objective, study design, sample size, type of intervention, intervention group, control group, and outcome.

Data Synthesis

Data synthesis involves collating and summarizing the results of the included studies and can be descriptive.[22] Therefore, the findings of the current study were descriptively synthesized and meta-analysis was not conducted due to the heterogeneity of the outcome measures.

Results

The preliminary results of searching databases were 2,744 articles of which 1,880 articles were included in the study after removing duplicates. Then, the number of the articles was reduced to 465 after screening the titles. In the next step, the abstract of the remaining articles was reviewed and 57 articles were selected to be entered into the study. However, 49 articles were excluded, as five studies were not clinical trials, and in 44 studies, the participants and their age were different from the inclusion criteria set for the current study. Ultimately, eight studies were selected to be included in this research. ►Fig. 1 shows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

A summary of data extracted from the selected studies is presented in ►Table 1.

According to the literature, research about telerehabilitation has increased gradually since 2007. It received more attention between 2009 and 2014, and following a reduction period, the publications have increased again since 2016 to present.[30,31] The results showed that the selected papers were published between 2003 and 2017. These studies were conducted in Australia,[25,26] Italy,[27,32] Spain,[33] the United States of America,[34] Taiwan,[35] and the Netherlands.[36] The diseases and health conditions included total knee replacement,[26,33,34] chronic stroke, and stroke-related disorders,[27,35] chronic obstructive pulmonary disease (COPD),[26,36] and the comorbidity of COPD and chronic heart failure (CHF).[32] As the results showed, the diseases of the target groups were different and a variety of telerehabilitation interventions were used (►Table 1). The interventions were different in terms of the purpose, the number of sessions, and the length of the intervention as well as the reported outcomes. Therefore, meta-analysis was not conducted in the present study due to the heterogeneity of the studies and their outcomes. In the following sections, the effectiveness of the telerehabilitation interventions used for therapeutic purposes in the elderly is reviewed.

Telerehabilitation for Patients with Post-Stroke Disorder

The telerehabilitation program was used for patients with post-stroke disorder in two studies.[27,35] In the study conducted by Piron et al, the elderly suffered from mild hand impairment induced by ischemic stroke in the middle cerebral artery. The telerehabilitation system used in this study included a virtual reality-based system delivered via the Internet. According to the results, although the intervention group showed better outcome in terms of the upper limb movement, Ashworth scale was the same for both groups and ABILHAND scale (a measure of manual ability for adults with upper limb impairments) showed the effectiveness of the intervention at the end of the treatment period ($p = 0.01$).[27]

In the study conducted by Lin et al, a bidirectional and multiuser telerehabilitation system was used for the elderly suffered from chronic stroke. A physiotherapist was on one side and an elderly person was on the other side, and a data center collected the data. According to the results, there was no statistically significant difference between two groups in terms of Berg Balance Scale, Barthel Index outcomes, and patient satisfaction with the rehabilitation services.[35]

Telerehabilitation for Patients with the Comorbidity of COPD and CHF

In Bernocchi et al's study, the elderly suffered from the comorbidity of COPD and CHF. The telerehabilitation system was a home-based telerehabilitation program (Telereab-HBP) and contained a telemonitoring system for cardiorespiratory parameters, weekly phone calls by nurses, and weekly rehabilitation programs by physiotherapists for 4 months. In this study, significant differences were found between two groups in terms of the outcomes of 6-Min Walk Test (6MWT) ($p < 0.001$), dyspnea ($p = 0.05$), quality of life by Minnesota Living with Heart Failure Questionnaire ($p < 0.001$), physical activity profile ($p < 0.001$), BARTHEL ($p < 0.001$), and COPD Assessment Test (CT) ($p < 0.01$) 4 months after the intervention. The effectiveness sustained for all outcomes 6 months after the follow-up, and the elderly were satisfied with the intervention.[32]

Post-Knee Surgery Telerehabilitation

In three studies, the elderly had total knee replacement. The telerehabilitation systems designed for these studies included an interactive virtual rehabilitation system, an Internet-based telerehabilitation with a low bandwidth, and an asynchronous smartphone video software.[25,33,34]

In these studies, no statistically significant difference was found between the intervention and control groups, and improvements in the functional variables were similar in both groups.[25,33,34] In one study, active knee extension range showed a high level of effectiveness of intervention 5 days after surgery ($p = 0.04$); however, 3 months later, the effectiveness faded away.[33]

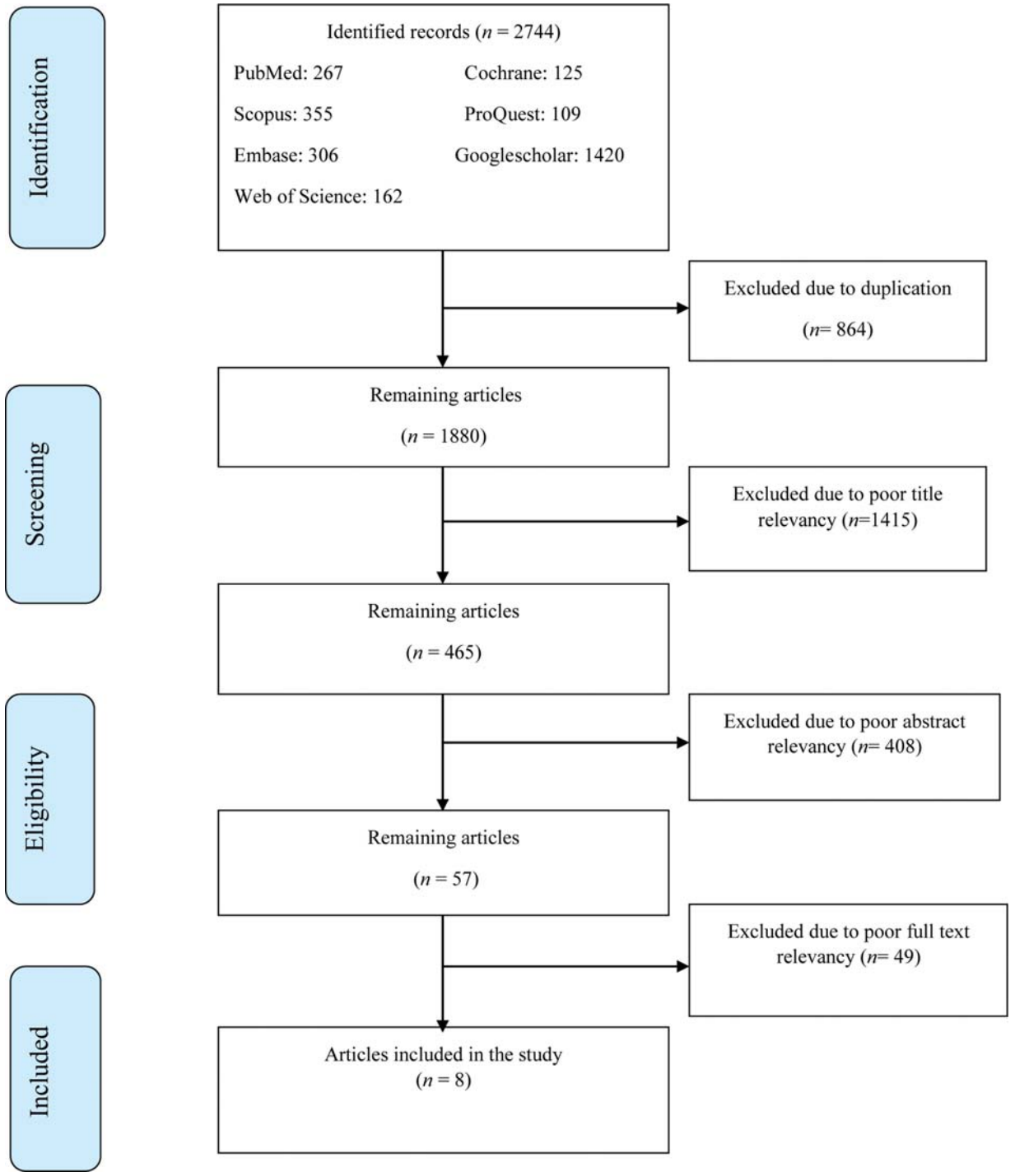

Fig. 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

Telerehabilitation for the Patients with COPD

In two studies, telerehabilitation was used for patients with COPD.[26,36] In Tsai et al's study, telerehabilitation was used three times per week for 8 weeks for physical exercises via supervised, home-based, real-time video conference sessions. The elderly could visit the physiotherapist or other patients and talk to them via video conferencing. In this study, there was no statistically significant difference between two groups in terms of the mean 6MWT, Incremental Shuttle Walk Test, quality of life, and COPD Assessment Test (CT). However, a statistically significant difference was found between the mean value of Endurance Shuttle Walk Test ($p = 0.001$) in the intervention and control groups. Moreover, a significant reduction in the anxiety ($p = 0.04$) and the depression ($p = 0.001$) of the intervention group was reported.[26] In another study, Tabak et al used a smartphone-based application of telerehabilitation with three-dimensional accelerometer to record motor activities and timely feedback. In this study, patients' cooperation and activity as well as their feedback were statistically significant in the first and second weeks after the intervention ($p = 0.03$). In addition, the health status within the intervention group

was improved ($p = 0.05$). Overall, the elderly were satisfied with the intervention ($p = 0.03$).[36]

Discussion

In the present study, the effectiveness of telerehabilitation interventions was compared with traditional rehabilitation services for therapeutic purposes in the elderly. The results showed that few clinical trial studies examined the effectiveness of telerehabilitation interventions in the elderly since 2010.[25–27,32–36] Most of these studies were conducted in the developed countries, such as the United States of America,[34] Spain,[33] Italy,[27,32] Australia,[25,26] and the Netherlands.[36] It seems that the accessibility of different types of technology, strong information technology infrastructure, and the high level of patients' computer literacy are the main reasons for paying more attention to telerehabilitation technology in the developed countries.[37]

According to the results, a wide range of telerehabilitation interventions was used for therapeutic purposes in the elderly. In some studies, a few outcomes were improved after telerehabilitation interventions and there was a statistically significant difference between two groups. For example, the use of telerehabilitation in patients who suffered from post-stroke motor impairment improved their upper limb function.[27] Similarly, the results of the studies conducted by Piron et al showed that telerehabilitation was useful for improving upper limb functions.[38,39] In another study, the use of telerehabilitation services in patients with the comorbidity of CHF and COPD was examined that helped to improve their health status, quality of life, and motor functions.[32] This service was also useful for the elderly with COPD to reduce their anxiety and depression.[26] The effectiveness of telerehabilitation interventions could be related to the accessibility of telerehabilitation equipment at home[33] or the level of in-person training that can lead to better exercises and increases the skills of the elderly to use telerehabilitation services. This, in turn, helps patients to feel empowered and motivates them to use telerehabilitation services.[25] However, as the type of illness overwhelms the patient's recovery and treatment, more studies should be conducted on using telerehabilitation in the elderly with the comorbidity of two or more diseases.

Overall, the findings showed that in most studies, there was no statistically significant difference between the effectiveness of telerehabilitation interventions and the traditional rehabilitation services for therapeutic purposes in the elderly. The results are in line with the findings of other studies. For example, Chen et al reported that there was no statistically significant difference between the effectiveness of telerehabilitation intervention and the traditional rehabilitation programs in terms of the patients' balance function and the ability of the elderly to carry out their daily activities.[40] Russell et al found that there was no statistically significant difference between the use of telerehabilitation and traditional rehabilitation in terms of reducing pain, stiffness, or knee function in patients with total knee replacement.[17] Similarly, the results of Bourne et al's study revealed that in patients with COPD, there was no statistically significant difference between using telerehabilitation and traditional rehabilitation in terms of improving their physical functions.[41] Therefore, the results suggested that telerehabilitation can be considered as an alternative for traditional rehabilitation services to improve the accessibility of healthcare services and quality of care. In particular, asynchronous systems provide patients with getting more access to care at any time and any place.[34] However, further studies are necessary to examine different aspects of telerehabilitation services in terms of clinical effectiveness, cost–benefit analysis, and user satisfaction.[26,36]

Limitations of the Study

The present study had some limitations. First of all, after applying the inclusion and exclusion criteria, only a few papers were selected. The limited number of the selected papers was mainly related to the type of research which was clinical trial. Therefore, future research can include other types of research. Moreover, as the outcome measurements and scales were different in the selected papers, meta-analysis was not conducted and the results were reported as a descriptive synthesis. In future, more research can be conducted to compare the results of the specific tests or outcome measurements.

Conclusion

In this study, several papers were reviewed to compare the effectiveness of telerehabilitation interventions with the traditional rehabilitation approaches for therapeutic purposes in the elderly. The results indicated that a wide range of simple and complex telerehabilitation interventions were used. Overall, in most studies, there was no significant difference between the intervention and control groups and the level of improvements was similar for most outcomes. The results of this study provide evidence for regarding telerehabilitation services as an alternative to traditional rehabilitation approaches to reduce outpatient resource utilization and improve quality of life. However, more rigorous studies are suggested to compare the effectiveness of telerehabilitation services for specific diseases or health conditions. The treatment effects can also be investigated for the short- and long-term periods.

Authors' Contributions

F. V. conducted the research and drafted the manuscript. H. A. supervised the research and commented on the manuscript. M. H. helped with conducting the research and commented on the manuscript.

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Conflict of Interest

None declared.

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