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RESEARCH

Effectiveness of a multicomponent physical exercise program in synchronous telerehabilitation mode: A systematic review with meta-analysis protocol

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ABSTRACT

INTRODUCTION Telerehabilitation has been proposed as an innovative, safe, and effective method of intervention to prevent or improve frailty. This rehabilitation modality facilitates access to opportunities and reduces gaps in healthcare. The advantages and challenges of implementing synchronous telerehabilitation programs in older people should be explored.

OBJECTIVE This protocol describes the methodology to analyze the effects of a multicomponent physical exercise program in synchronous telerehabilitation modality compared to a multicomponent physical exercise program in face-to-face modality in terms of quality of life of frail older people.

METHODS A systematic review will be performed in the following databases: Medline/PubMed, Scopus, Web of Science, CINAHL, Central, PeDRO, Lilacs, and Epistemonikos. To identify randomized clinical trials that meet the proposed eligibility criteria. The primary outcomes are quality of life and functionality, and the secondary outcomes are strength, balance, and cardiorespiratory capacity. In addition, the risk of bias will be assessed using the ROB-2 tool, and the certainty of the evidence will be assessed using the GRADE system. A meta-analysis will be performed if the procedures used to determine the results of the study are homogeneous; mean differences with a 95% confidence interval will be calculated. Otherwise, standardized mean differences will be used to determine the effect sizes.

EXPECTED RESULTS The main findings of this review and meta-analysis will contribute to clarifying the effectiveness of physical therapy applied in a synchronous remote modality. It will also identify the variables on which it has a positive effect.

PROSPERO REGISTRATION CRD42024605527

KEYWORDS Telehealth, Telerehabilitation, Physical Activity, Aged, Frailty

INTRODUCTION

Aging is frequently associated with a progressive decline in the ability to withstand stress, injury, disease, and physical function [1]. Frailty is a clinical condition associated with increasing age, characterized by a decline in function in multiple organs and their systems. It is also linked to a reduced ability to withstand stressors with a greater risk of adverse health outcomes, such as falls, hospitalization, disability, and death [2]. According to Fried's scale, a frailty phenotype is defined based on five criteria: weight loss, exhaustion, low grip strength, slow gait, and low physical activity. The presence of three or more criteria is considered frailty status, which commonly occurs secondary to an underlying pathology (musculoskeletal pathology, cardiorespiratory, cognitive impairment, or cancer) [3].

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MAIN MESSAGES

- There is a need to update knowledge on telemedicine applied to physical rehabilitation, particularly considering that after the SARS-CoV-2 pandemic, the use of telerehabilitation and its application formats increased significantly.
- Face-to-face physical exercise programs for older adults have significant access barriers, which negatively affect physical activity, increasing the risk of frailty and sarcopenia in this population. Therefore, it is necessary to examine the feasibility of new proposals to improve access to physical rehabilitation.
- This research protocol makes a concrete and structured proposal on how to collect and synthesize relevant evidence on the effects of telerehabilitation in frail older adults, through a critical analysis of the available literature.
- Relevant information will be made available to clinicians and academics, which will be helpful in decision-making by physical therapists or for future research in the area.

In Chile, exercise programs for older adults are offered at local and national levels in welfare and public health institutions, along with specialized centers for older adults [4]. One of the main prevention and promotion strategies used to maintain the functional capacities and physical fitness of older adults is the Más Adulto Mayor Autovalente program of the Chilean Ministry of Health. The program promotes autonomy in older adults through functional workshops and community training in healthy aging [5]. International and national experience reveals that most of these face-to-face programs are based on group aerobic exercises and promotion of self-care. Moreover, since time and space for participation are limited in these group exercise programs, participation rates may vary according to season and climate change [4,6]. On the other hand, transportation to access the place of exercise can be an impediment for older people to join or continue to attend exercise programs outside their home, especially in rural areas. As a consequence of these travel difficulties, older people are more likely to develop sarcopenia or frailty due to decreased physical activity [7–9]. In addition, physical exercise instructors find it more difficult to provide individual instruction to participants in their physical activity programs when these are conducted with large groups and heterogeneous health characteristics. In addition, they may have trouble providing effective feedback relevant to their cognitive characteristics [10].

Several measures have been proposed to overcome the limitations of conventional home exercise. These include analog tools such as home exercise bikes and treadmills. Some digital ones, such as exercise-related videos, unsupervised exercise services provided on the Internet, smartphone-based exercises, and fitness apps for cell phones or computers, are also considered [11]. However, since these types of unsupervised exercises do not provide a channel through which participants receive direct feedback, it is difficult for older people to benefit from such exercise programs, and the risk of injury is higher [9]. In this context, telerehabilitation emerges as an innovative, safe, and effective method to prevent or improve frailty. Telerehabilitation is the provision of rehabilitation services to patients in a remote location using information and communication technologies [12]. Interaction between the patient and rehabilitation professionals can be accomplished through a variety of technologies, such as telephone and Internet-based videoconferencing [13]. There are widely accepted advantages to the use of telerehabilitation over the more traditional, clinic-based service delivery model. This line of rehabilitation facilitates access, reduces gaps in healthcare [14], and allows patients to receive rehabilitation services in the comfort and privacy of their home [15,16]. This overcomes geographic barriers [17,18], decreases time and costs associated with transportation. In some cases, it even reduces dependence on others for mobility or the need for adapted transportation [15,19–21]. In summary, synchronous telerehabilitation uses telecommunication technologies to allow both the instructor and the participant to perform supervised training through the simultaneous transmission of two-way video and audio. To do this, they use high-speed telecommunications technologies. This would allow real-time interactions between instructors and seniors from their homes [10,22].

A recent systematic review indicates that home-based exercise programs delivered through digital health interventions (using mobile and wireless technologies) improved physical function, balance, and mobility, and reduced falls in older people [19]. In particular, randomized clinical trials have determined the effectiveness of synchronous telerehabilitation programs in older people at high risk of falls and sarcopenia, finding significant improvements in physical fitness (leg strength measured with the chair rise test), static balance (Berg Balance Scale), and decreased sarcopenia [9,10,23]. Additionally, studies on the use of health information technologies for older people have reported that telerehabilitation services can be considered an alternative to traditional rehabilitation approaches to reduce outpatient resource utilization and improve quality of life [19,20,24]. However, there are also disadvantages to implementing synchronous telerehabilitation programs, which are more evident in older adults. For example, concerns persist about the suitability of treatment programs without at least some face-to-face contact [15]. A second concern is that older people may have difficulty with telecommunication technologies [25].

And third, some patients may feel that they are missing out on the support that comes from attending sessions with others with similar conditions [26]. In the context of physical therapy

telerehabilitation sessions, clinical trials with low risk of bias that compare in-clinic and remote physical therapy services are scarce. Much of the research that exists implements a hybrid model of combined home- and clinic-based sessions, rather than only remote delivery [27]. The combination of in-person and remote services is justified by its ability to increase confidence in diagnostic accuracy and progress assessment by providing regular opportunities for physical contact and manual examination of a patient's limbs and joints. However, regardless of the implementation of combined or exclusively remote delivery, the results of studies comparing telerehabilitation and in-clinic delivery of physical therapy services consistently suggest comparable outcomes [27,28].

Based on the existing evidence, as well as the heterogeneity of forms of presentation of telerehabilitation and study population analyzed, a systematic review is needed to synthesize the evidence and analyze the effectiveness of synchronous telerehabilitation services in older adults with frailty secondary to chronic conditions.

Research question:

In older adults with frailty due to chronic conditions, is a multicomponent physical exercise program delivered via synchronous telerehabilitation as practical or more effective than a face-to-face program in improving quality of life?

Objective of the systematic review:

To evaluate the impact of a multicomponent physical exercise program on the quality of life of older adults with frailty due to chronic conditions, comparing synchronous telerehabilitation with face-to-face delivery.

METHODS

Protocol and registry

This systematic review protocol with meta-analysis was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the code CRD42024605527. It was conducted following the guidelines established by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA P) statement [29]. In addition, the methodology will follow the guidelines established in the Cochrane Handbook for Conducting Systematic Reviews of Interventions [30]. Subsequently, the systematic review derived from this protocol will be conducted following the recommendations of the most updated version of the PRISMA statement [31].

Eligibility criteria will be according to the type of participants, type of intervention, type of comparison, types of outcomes, and types of studies.

Sample

Studies on people aged 60 years or older, men and women with a diagnosis of frailty secondary to musculoskeletal pathologies, cardiorespiratory conditions, mild cognitive dysfunction, cancer, or who are at high risk of falling will be included. Frailty should be diagnosed according to Linda Fried's classification [32]. Also, during the selection process, we will judiciously assess whether it is relevant to include clinical trials that address older populations with characteristics compatible with frailty, even if they do not use the Fried classification of frailty.

On the other hand, studies will exclude individuals who have unrepaired bone fractures or acute musculoskeletal injuries, who have had a recent acute myocardial infarction (last month), or who have a cardiovascular pathology that prevents them from doing physical activity as indicated by a physician. Severe acute respiratory failure, arterial hypertension, and uncontrolled diabetes mellitus will also be exclusion criteria. In the same way, limitations to follow verbal instructions or low visual and/or hearing acuity, which prevent them from participating in the physical exercise sessions, are also excluded.

Those active in another exercise program (physical exercise, Tai Chi, yoga, swimming, gymnastics classes) during the research will also be excluded.

Intervention

Multicomponent physical exercise is a type of exercise that combines aerobic, muscular strength, flexibility, balance, and walking exercises in one session. Multicomponent physical exercise aims to maintain a level of functionality that exceeds the highest possible degree of autonomy in older adults. It is effective in improving physical capacity and cognitive function [33,34].

The selected studies should implement multicomponent physical exercise in a synchronous telerehabilitation modality, in formats such as video calls via a telecommunication platform (e.g., Zoom®), between a physiotherapist and their patient. In addition, exercise sessions should last at least eight weeks, as this is the minimum time necessary to observe clinically significant changes in functional and quality of life outcomes in older people [35].

Control

We will include randomized clinical trials in which the control group performs multicomponent physical exercise in face-to-face mode, with or without direct supervision by a healthcare professional, in group or online mode, in a health center, gym, community center, or at their homes.

Outcomes

They have been divided into primary and secondary outcomes.

Primary outcome

These include quality of life, in terms of expectations and resilience towards health or illness; socioeconomic status, age, and social support [17], which provide a measure of overall well-being that encompasses positive and negative life aspects.

This is an essential measure of successful or healthy aging [18]. This will be assessed through validated generic or specific questionnaires. Examples of these instruments are the 12-item Short Form Survey (SF-12), the 36-item Short Form Survey (SF-36), and the World Health Organization Quality of Life (WHOQOL).

Another primary outcome is functional capacity, interpreted by psychomotor, cognitive, and behavioral skills, which are basic for daily activities [36]. This will be assessed with instruments using validated generic or specific questionnaires such as the Katz index, the Barthel Scale, or the Functional Independence Measure (FIM).

Secondary outcome

As a secondary outcome, the strength assessed in the upper and lower body is considered, quantified using physical exercise tests or devices (e.g., dynamometer, FMI: the five times sit-to-stand test, sit-to-stand test in 30 seconds).

Static and dynamic balance is also considered, an ability that involves multiple body systems, including musculoskeletal, cognitive, and somatosensory. Such ability enables physical movement and activities of daily living [37]. It is measured through field tests such as the Berg Balance Scale, Timed Up and Go, Single-Leg Station Dynamic Balance, and the Tinetti Scale.

Finally, cardiorespiratory capacity is included, its best measure being maximal oxygen consumption, assessed directly or indirectly [38] through laboratory exercise tests or field tests (e.g., 6-minute walk test, 2-minute step test, or maximal oxygen consumption with incremental exercise test).

Types of studies

We will include randomized clinical trials that have investigated the effects of a multicomponent exercise program in an online modality compared with an intervention program in a face-to-face modality. Randomized crossover clinical studies will be included when they have a minimum of four weeks of washout to attenuate the residual effects of the other physical exercise program [39]. Language and year of publication restrictions will not be established.

Search strategy and database

A sensitive systematic search will be performed in the following databases:

- MEDLINE/PubMed
- Scopus
- Web of Science
- CENTRAL
- CINAHL
- PEDro
- LILACS
- Epistemonikos

To ensure completeness and transparency in the identification of relevant studies, the search strategy in the MEDLINE database was constructed according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses Statement (PRISMA) [40]. Controlled vocabulary (Medical Subject Headings, MeSH) and free terms were used for this purpose. The search syntax terms were linked using the Boolean operators "OR" and "AND". Table 1 has the search strategy in the MEDLINE database using the PubMed search engine. The table was shared in the Figshare information base (figshare.com) to make the search syntax transparent. Then the search strategy will be adapted in the other databases, using the Polyglot tool of Systematic Review Accelerator (SRA) [41].

To mitigate publication bias, a search of gray literature will be carried out in clinicaltrials.gov, clinical trial registry databases, theses, institutional repositories, scientific conferences, and congress proceedings. Likewise, a manual search will be carried out in the references of the included studies, as well as in systematic reviews, narratives, and clinical practice guidelines related to the investigated topic. In addition, authors of included studies will be contacted via e-mail, in case additional or unreadable information is needed.

Data selection and extraction process

The total number of studies found in the literature search will be uploaded to the Rayyan web application (professional plan) [42]. Duplicate articles will be eliminated with this automation tool. To identify multiple publications of the same study, we will apply the recommendations of the Cochrane handbook and consider only the article reporting the main results [30]. Subsequently, two independent and blinded authors will select the articles applying the inclusion/exclusion criteria by reading only the title and abstract. Then, the full-text papers of all studies meeting the inclusion criteria will be retrieved. In case of discrepancies, a third reviewer will make the final decision. The article selection process will be documented in the PRISMA flowchart.

The main data will be extracted independently by two researchers. The extracted data will be recorded in a previously designed and piloted Microsoft Excel spreadsheet. Relevant data will then be represented in tables and figures. The compiled information considers general characteristics of the articles (author, year, country, population, sex, intervention, variables and type of design); characteristics of the interventions (frequency, treatment, extent and duration); and description of the effects of the interventions (quality of life, functional capacity, strength, balance and cardiorespiratory capacity).

For the outcomes of interest, mean and standard deviation for continuous variables, relative risk, and odds ratio for dichotomous variables will be reported.

Risk-bias assessment

The methodological quality of the studies will be assessed using the Cochrane Risk of Bias 2.0 (ROB II) tool. This tool analyzes the studies in the six key domains:

- D1: bias arising from the randomization process.
- D2: bias due to deviations from the intended interventions.
- D3: bias due to missing outcome data.
- D4: bias in outcome measurement.
- D5: bias in the selection of the reported outcome.
- D6: overall risk of bias.

Within each domain, assessments are made for one or more elements, assigning a judgment of high, low, or unclear risk of bias. To determine the overall risk of bias for each item, the following criteria will be respected:

- Low risk of bias: all domains assessed as "low risk".
- High risk of bias: one or more domains assessed as "high risk", or multiple domains with "risk of bias of concern", affecting the credibility of the result.
- Some concerns: at least one domain with "risk of bias of concern", but no domains at "high risk" [43,44].

The ROB II tool will be applied by two assessors independently. In the case of discrepancies, discussions will be held to reach a consensus. The summary of the results will be displayed using traffic lights and bar graphs, illustrating the individual judgments per domain for each study.

Measuring the effects of the intervention

A quantitative synthesis will be performed whenever there are at least three studies with comparable data. If the studies collected have clinical heterogeneity, are insufficient, or there are not enough studies to perform a meta-analysis, a narrative synthesis of the effects of the intervention will be conducted for each variable. If the questionnaires or procedures used to evaluate the study results are homogeneous, mean differences will be calculated with a 95% confidence interval. Otherwise, standardized mean differences will be used to determine effect sizes (adjusted Hedges' G). If heterogeneity is substantial (I^2 = 50 to 90%) or considerable (I^2 = 75% to 100%), a Der Simonian & Laird random effects model will be applied. If the heterogeneity is low (I^2 = 0 to 40%) or moderate (I^2 = 30 to 60%), a Mantel-Haenszel fixed effects model [30] will be used. A p value of less than 0.05 will be considered statistically significant.

All the analyses proposed will be carried out, including all randomized clinical trials and by subgroups, according to chronic pathologies that generate frailty (musculoskeletal pathologies, cardiorespiratory conditions, mild cognitive dysfunction, cancer, or pathologies with a high risk of falling). In addition, if data permit, a subgroup analysis will be performed to examine the possible effect of follow-up time on the outcomes of interest (short intervention periods: 8 to 12 weeks, medium periods: 12 to 24 weeks, and long periods: longer than 24 weeks).

A Summary of Findings (SoF) table will be prepared according to the guidelines of the GRADE approach. This table will prioritize the main comparisons between eligible interventions, as well as the previously defined primary outcomes, considering adverse events when reported. Depending on availability, outcome data will be extracted at the following measurement points: short term (up to three months), medium term (between three and six months), and long term (more than six months).

Sensitivity analysis will be performed if clinical and methodological heterogeneity warrants it, including restricting studies with a high risk of bias or imputation of missing data in the primary analysis variables.

Any deviation from the registered protocol will be documented and justified in the final report, following the recommendations of the PRISMA guide [31]. Likewise, the corresponding information will be updated in the PROSPERO registry platform.

The Grading of Recommendations, Assessment, Development and Evaluation (GRADE) method will be used for the synthesis and evaluation of the certainty of the evidence.

EXPECTED RESULTS

The main findings of this research will clarify the effectiveness of physical therapy applied in synchronous remote modality and help identify the variables that promote positive and significant effects. In addition, the results will be presented in tables and figures. They will be interpreted carefully, considering the risks of bias and certainty of the evidence from the selected primary studies.

In this line, publication bias will be assessed by examining funnel plots and using the method proposed by Egger [45]. Reporting bias will be evaluated by identifying discrepancies

Table 1. Search strategy.

Database	Search terms
MEDLINE/Pubmed	*#1 (Telecommunication* or telemed* or tele?med* or telemetry or telerehab* or tele?rehab* or Telehealth* or tele?health* or Teleconsult*or tele?consult* or Teleconference* or tele?conference* or tele?home* ortelehome* or tele?coach or telecoach* or tele?care* or telecare* ortele?screen* or telescreen* or tele?therap* or teletherap* or tele?mentor*or telementor*)*
	#2 (frail OR frail elderly OR physical frailty)*
	#3 (elderly OR older adult OR older people OR geriatric OR aged)*
	#4 (Clinical trial OR Intervention Study OR Randomized Controlled Trial OR controlled clinical trial OR Randomized Trial OR trial)
	#1 AND #2 AND #3 AND #4

Notes: https://doi.org/10.6084/m9.figshare.28106015.v1
Source: Prepared by the authors.

between published data and the registered protocols of each study. If necessary, we will contact the authors via e-mail to clarify any uncertainties regarding the information [45].

Finally, the certainty of the evidence will be assessed using the GRADE methodology through the GRADEpro CDT software (https://gdt.gradepro.org/app/). The confidence in the evidence will initially be considered high for randomized clinical trials. It may be downgraded based on five factors or domains: risk of bias, inconsistency of results, indirectness of evidence, imprecision of estimates, and publication bias. For each outcome, the quality of evidence will be rated at one of four levels: high, moderate, low, or very low [46].

Contributor roles IC: conceptualization, methodology, research, resources, project management, and fund acquisition. IC, DR-M, GL-A, SJ, FV-R, CR-H, RZ-L, and MP-R: writing, preparation of the original draft. IC, DR-M, GL-A, SJ, FV-R, CR-H, RZ-L, and MP-R: writing, revising, and editing. All authors have read and accepted the published version of the manuscript.

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Efectividad de un programa de ejercicio físico multicomponente en modalidad telerrehabilitación sincrónica: protocolo de una revisión sistemática con metaanálisis

RESUMEN

INTRODUCCIÓN La telerrehabilitación se ha propuesto como un método innovador, seguro y efectivo de intervención para prevenir o mejorar la fragilidad. Esta modalidad de rehabilitación facilita el acceso a oportunidades y reduce las brechas en la atención médica. Las ventajas y desafíos de la implementación de programas de telerrehabilitación sincrónica en personas mayores deben ser explorados.

OBJETIVO Este protocolo describe la metodología para analizar los efectos de un programa de ejercicio físico multicomponente en modalidad telerrehabilitación sincrónica, en comparación con un programa de ejercicio físico multicomponente en modalidad presencial. Esto, en términos de calidad de vida de personas mayores frágiles.

MÉTODOS Se realizará una revisión sistemática en las siguientes bases de datos: MEDLINE/PubMed, Scopus, Web of Sciences, CINAHL, CENTRAL, PEDro, LILACS y Epistemonikos. Para identificar ensayos clínicos aleatorizados que cumplan los criterios de elegibilidad propuestos. Los desenlaces primarios son calidad de vida y funcionalidad. Los secundarios son fuerza, equilibrio y capacidad cardiorrespiratoria. Además, se evaluará el riesgo de sesgo con la herramienta ROB-2 y la certeza de la evidencia con el sistema GRADE. Se realizará un metaanálisis si los procedimientos utilizados para evaluar los resultados del estudio son homogéneos, para ello se calcularán diferencias de medias con un intervalo de confianza del 95%. En caso contrario, se utilizarán diferencias de medias estandarizadas para determinar los tamaños del efecto.

RESULTADOS ESPERADOS Los principales hallazgos de esta revisión y metaanálisis contribuirán a tener más claridad sobre la efectividad de la terapia física aplicada en modalidad remota sincrónica. También identificará las variables en las cuales propicia efectos positivos.

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