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Telerehabilitation in musculoskeletal disorders: a systematic review and meta-analysis

Telerreabilitação nos distúrbios musculoesqueléticos: uma revisão sistemática e meta-análise

Telerehabilitación en trastornos musculoesqueléticos: una revisión sistemática y metanálisis

Lucyana de Miranda Moreira[1], Alessandro Pereira Silva[2], Terigi Augusto Scardovelli[3], Silvia Cristina Martini[4], Silvia Regina Matos da Silva Boschi[5]

ABSTRACT

Objective: To evaluate the effectiveness of telerehabilitation for musculoskeletal disorders compared to treatment as usual, no treatment, waiting lists, any form of education and counseling (remote or in-person), or a similar in-person intervention, in terms of pain and disability. Method: A literature search was conducted using PubMed, EMBASE, and PEDro. Randomized controlled trials involving an intervention group receiving telerehabilitation and a control group receiving any other form of intervention were included. Results: Eight articles met the inclusion criteria and were generally of high to moderate methodological quality. There is evidence suggesting that telerehabilitation is more effective than any form of education and counseling (remote or in-person), but not more effective in-person treatment. Conclusion: Telerehabilitation was more effective than other short- and medium-term pain interventions.

Keywords: Telerehabilitation, Telemedicine, eHealth, Telehealth.

RESUMO

Objetivo: Desenvolver e validar a plataforma digital ApneIA Conecte como recurso adjuvante no acompanhamento fisioterapêutico Objetivo: avaliar a eficácia da telerreabilitação em distúrbios musculoesqueléticos em comparação com o tratamento usual, nenhum tratamento, listas de espera, qualquer forma de educação e aconselhamento (remoto ou presencial), ou uma intervenção presencial semelhante, na intensidade da dor e na incapacidade. Método: Foi realizada uma pesquisa bibliográfica utilizando PubMed, EMBASE e PEDro. Foram incluídos ensaios clínicos randomizados envolvendo um grupo de intervenção que recebeu telerreabilitação e um grupo de controle que recebeu qualquer outra forma de intervenção. Resultados: Oito artigos atenderam aos critérios de inclusão e, no geral, apresentaram qualidade metodológica alta a moderada. Existem evidências que sugerem que a telerreabilitação é mais eficaz do que qualquer forma de educação e aconselhamento (remoto ou presencial), mas não o tratamento presencial. Conclusão: A telerreabilitação foi mais eficaz do que outras intervenções para dor de curto e médio prazo, podendo ser uma aliada no tratamentos desses pacientes.

Descritores: Telerreabilitação, Telemedicina, eSaúde, Telessaúde.

RESUMEN

Objetivo: Evaluar la efectividad de la telerehabilitación en los trastornos musculoesqueléticos en comparación con el tratamiento habitual, ningún tratamiento, listas de espera, cualquier forma de educación y asesoramiento (remoto o en persona), o una intervención presencial similar, en la intensidad del dolor y la discapacidad. Método: Se realizó una búsqueda bibliográfica mediante PubMed, EMBASE y PEDro. Se incluyeron ensayos controlados aleatorios que incluyeron un grupo de intervención que recibió telerehabilitación y un grupo de control que recibió cualquier otra forma de intervención. Resultados: Ocho artículos cumplieron los criterios de inclusión y, en general, tuvieron una calidad metodológica alta a moderada. Existe evidencia que sugiere que la telerehabilitación es más efectiva que cualquier forma de educación y asesoramiento (remoto o en persona), pero no el tratamiento en persona. Conclusión: La telerehabilitación fue más efectiva que otras intervenciones para el dolor a corto y mediano plazo.

Descriptores: Telerehabilitación, Telemedicina, eSalud, Telesalud.

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INTRODUCTION

The Global Burden of Disease (GBD) study comprehensively assesses the incidence, prevalence and years lived with disability (YLD). In its latest report, musculoskeletal disorders were among the main causes of years lived with disability, as they are associated with pain, mobility disorders, increased risk of falls and fractures, and compromised ability or inability to carry out activities of daily living, causing a considerable economic and social impact[1].

Physiotherapy is seen as a key component in the management of musculoskeletal disorders, as it can reduce pain and disability. However, access to physiotherapy services may be limited in some countries due to public funding issues, geographic barriers, and, more recently, restrictions imposed by the coronavirus pandemic[2].

Studies show that waiting for care can affect the outcome of treatment in terms of pain intensity and disability, drastically affecting the quality of life of these patients[3].

Currently, telerehabilitation (TR) is part of the physiotherapist's scope of care[4]. TR is promising and highlighted that for individuals unable to attend traditional in-person services, particularly after elective orthopedic surgical procedures, TR should be considered a viable option in managing musculoskeletal disorders[5].

Studies with TR interventions must continue and improve methodologically, addressing new diseases and orienting themselves towards results that can be validated, standardized, and integrated into health policies.

Therefore, the aim of this review is to evaluate the benefits and harms of TR in musculoskeletal disorders compared with treatment as usual, no treatment, waiting lists, any form of education and counseling (remote or in-person), or similar in-person interventions in terms of intensity of pain.

METHODS

This systematic review was reported according to PRISMA[6] guidelines and protocols were prospectively registered in the PROSPERO database with registration number CRD42022368889.

The primary objective was to evaluate the effectiveness of TR in musculoskeletal disorders, compared with treatment as usual, no treatment, waiting list, any form of education and counseling (remote or in-person), or a similar in-person intervention, on pain intensity, and disability. There was no restriction on the date of publication, the language searched was English and only randomized clinical trials (RCTs) were included.

Electronic search strategies were developed with the help of a librarian. The Boolean operators "AND" and "OR" were used to combine the search terms. Firstly, a search was carried out in the Cochrane Central Register of Controlled Trials (CENTRAL, The Cochrane Library) and then in the electronic databases: Pubmed, EMBASE, and the Physiotherapy Evidence Database (PEDro). The search strategies were ((((synchronous) OR (asynchronous)) AND (telehealth)) OR (telerehabilitation)) AND (musculoskeletal physiotherapy) (figure 1).

Figure 1. Use of Boolean descriptors in the bibliographic search.

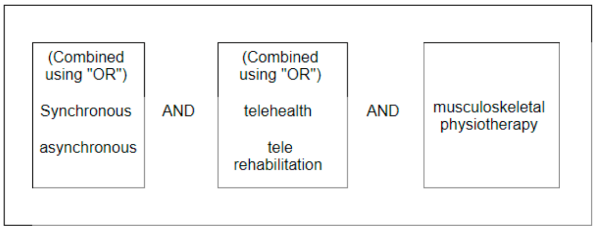


Table 1 illustrates the inclusion and exclusion criteria that guided the literature search. The search strategies were carried out from February 23, 2023, to April 30, 2023, in 4 health databases. The search was updated in the database on April 30, 2023.

Table 1: Inclusion and exclusion criteria.

Inclusion criteria	*Exclusion criteria*
The population included eligible adults participating in rehabilitation for musculoskeletal disorders. *Included interventions utilized some form of TR.* *It should have measured the change in the outcome of pain or disability.* *No publication date restriction.* *No publication language restriction.* *Published in a peer-reviewed journal.* *Must be a randomized controlled trial (RCT) with clearly reported true randomization methods, crossover RCTs, and cluster RCTs.*	*Studies in which TR was not used in the intervention group.* *Studies whose underlying diseases are not of musculoskeletal origin (for example: diabetic polyneuropathy).* *Study designs that are not RCTs, including systematic reviews and non-randomized pilot trials.* *Studies published only as abstracts.* *Studies whose data have not been made publicly available.*

End Note Web was used to identify duplicate articles and an Excel spreadsheet was used to extract data and describe study characteristics and results. Both in the article selection process and in data collection, disagreements were resolved by consensus. The data were then

transferred to a single file and checked again.

The risk of bias assessment was carried out using the PEDro scale (7), the most commonly used in the rehabilitation area and has a total score of up to 10 points, including internal validity assessment criteria and presentation of the statistical analysis used. For each criterion defined in the scale, one point (1) is assigned to the presence of indicators of the quality of the evidence presented, and zero points (0) are assigned to the absence of these indicators. This was done independently by two review authors (LM and SM). Disagreements were resolved by discussion or arbitration by a third author (SB).

Primary outcomes (i.e., pain intensity and disability) were analyzed and presented on a continuous scale (ranging from 0 to 10) as mean differences, standard deviations, or 95% confidence intervals (CIs).

For secondary outcomes, they were presented as continuous measures (e.g., health-related quality of life), with combined effects expressed as standardized mean difference and 95% CIs (Confidence Intervals).

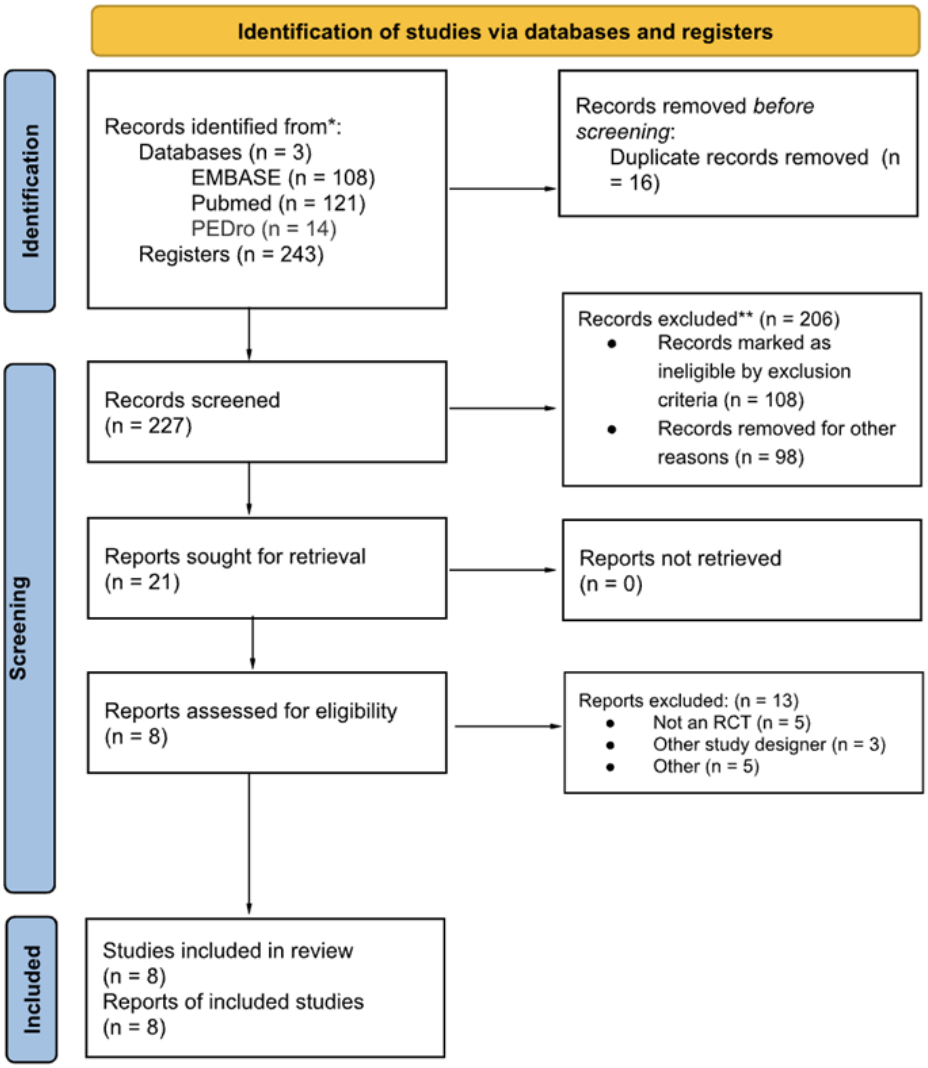
The evidence was assessed using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) criteria, which uses the domains of study design limitations, inconsistency, indirectness, and imprecision in results.

TR was compared with combined therapies and usual care, minimal interventions (e.g., no treatment, counseling on activities of daily living, and pain education), and similar in-person interventions (e.g., exercise). The included articles were displayed in alphabetical order.

RESULTS

A total of 243 references were identified, and 8 articles were included in the review. The main reasons for excluding potential full texts were duplicate texts (16), not meeting the inclusion criteria (108), not randomized clinical trials (13), and other reasons, such as lack of population of interest (98). The flowchart that describes the selection of studies is in Figure 2.

Figure 2: PRISMA flow diagram



Fonte: Page et al. [8]

Table 2 summarizes the characteristics of all articles included in this review.

Table 2: Characteristics of the articles included.

Author	Population	Intervention - Tele rehabilitation	Control	Follow up	Outcomes	Results
Aslant et al., 2023[9]	n= 60. Women with patellofemoral pain, divided into 3 groups of 20 people each.	Online supervised exercises 3 days a week for 6 weeks.	In 2 groups: no intervention and with exercises no supervised to do at home 3 days a week for 6 weeks.	The tests were repeated after 6 weeks of intervention.	Pain, range of motion (ROM) of the knee joint, muscle strength, and other.	All score were better in the OSE group than in the control group (home exercise and no intervention).
de Oliveira Silva, 2020[10]	n= 26. Participants who had anterior or retro patellar pain.	Up to 8 sessions with your physiotherapists, via Skype, to receive guidance on education and exercise therapy.	Up to 8 sessions with your physiotherapists, in person, to receive guidance on education and exercise therapy.	There were 2 phases. First follow-up at 6 weeks. After this, the intervention groups was tested after 12 weeks of intervention.	Pain is the primary outcome.	In phase 2, when the clinical trial intervention took place, there were similar results between face-to-face physiotherapy and tele rehabilitation.
Fioratti et al., 2022[11]	n=64. Participants with chronic musculoskeletal pain.	Patients had access to do the exercises 3 days a week for 8 weeks on the website developed for the study. Content included videos and animations based on pain education, promotion of physical activity, and general exercise.	Participants had access to a booklet containing general information about chronic pain self--management and received a phone call in week 4 and motivational text messages once a week throughout the study period.	It was 8 weeks.	Primary the program suitability, secondary, function and Pain.	Both groups reported a decrease in pain intensity and improvement in function after 8 weeks.
Hinman et al., 2020[12]	n=175. Participants with knee osteoarthritis.	This group had an action plan that included a structured program of home strengthening exercises, a physical activity plan and received phone calls from a physiotherapist.	The control group received information about OA, treatments and self-management strategies, and other orientations. And then, received a call from a nurse.	Done at 6 and 12 months after the start of the study.	Pain, function, physical activity, and quality of life.	Both groups demonstrated clinically important improvements in pain and function at 6 and 12 months.
Malliaras et al., 2020[13]	n=36. Participants with shoulder pain related to the rotator cuff.	Interventions included text, infographics, videos and a weekly TR session with a physiotherapist by Zoom.	It was made up of 2 different groups, one with general advice and another with the same advice, plus recommendations and exercises as suggestions for what to do.	It was at 6 weeks and 12 weeks.	Functionality, Pain, Kinesiophobia, Catastrophizing, Self-efficacy and Quality of Life.	The intervention proved to be more effective when compared to the control group at both the 6-week and 12-week follow-ups.

Odole et al., 201314	n=50. Participants with knee osteoarthritis.	Physiotherapists monitored and trained patients in this group via cell phone guidance three times a week for 6 weeks.	Participants were treated in person at the physical therapy clinic for 6 weeks.	It was at 2, 4 and 6 weeks.	Pain and Functionality	There were no significant differences between the TR group and the clinical physical therapy group.
Ozden et al., 202215	n=50. Participants with low back pain.	The home exercise program was guided through the TR platform, to perform exercises once a day for 8 weeks.	After a face-to-face guidance session, participants received a printed booklet containing exercises to be performed alone at home.	After 8 weeks of intervention.	Pain, function, kinesiophobia, quality of life, satisfaction, and Quality of Life, Satisfaction and Motivation.	The TR group achieved significant improvements in pain, function, quality of life, kinesiophobia, satisfaction, and motivation compared to the conventional rehabilitation group.
Pastora-Bernal et al., 201816	n=18. Participants who had arthroscopic sub acromial decompression.	Patients received a customized exercise program through a web application. The intervention lasted 12 weeks (5 days per week).	Received in-person physical therapy in a 12-week program (5 days per week).	It was at 4, 8 and 12 weeks.	Pain, function, muscle strength, and range of motion	Improvements were similar after 12 weeks for pain in both group.

All 8 included articles were published between 2013 and 2023. In 62.5% of RCTs (n=5), synchronous resources (e.g., video conferencing software and telephone) were used. 37.5% (n=3), asynchronous resources were used (e.g., software developed for the study with a library of videos of physiotherapy exercises). All TR exercise programs included in this review were carried out in the participants' homes. The duration varied from 4 to 12 weeks, with the weekly frequency and duration of each session varying from 2 to 7 times per week. Follow-ups ranged from 2 weeks to 12 months.

The programs included strength, mobility, and stretching exercises combined or not with aerobic exercises. The initial assessment of participants was carried out in all articles. After the initial assessment, six articles (9,10,12,13,14,16) reported that participants had the supervision of a physiotherapist to set goals, carry out the supervised exercise program, and verify the correct use of TR devices. Two articles (11,15) did not report any type of supervision.

Four articles (9,10,12,14) with 311 participants studied the knee joint (2 RCTs had included participants with knee osteoarthritis (12,14) and 2 with patellofemoral pain (9,10). Two articles (13,17) with 54 participants studied the shoulder joint with two different characteristics (pain (13) and postoperative arthroscopic subacromial decompression (16)). One article (15) with 50 participants, aimed to include people with low back pain, and another (11) with 64 participants with chronic musculoskeletal pain.

Three articles (10,14,16) with 94 participants compared TR with in-person physiotherapy. Five articles (9,11,12,13,15) with 385 participants compared TR with no intervention or guidance alone, that is, they used digital or printed booklets as a means of information, an informative platform, and advice offered by the physiotherapist.

Only one article (12) carried out a medium-term follow-up (12 months), the others (9,10,11,13,14,15,16) carried out short-term follow-ups, lasting a maximum of 12 weeks.

The quality of the methods in the included articles ranged from 4 to 8 points on the PEDro scale of 0 to 10 (table 3). All articles reported random allocation, differences between groups, point measures, and measures of variability.

Six (75%) of the 8 clinical trials included scored above 6 points on the PEDro scale (9,10,11,12,15,16). The main reasons for the downgrading of methodological quality were the lack of blinding of the therapist (8/8,

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Table 3: Results from the PEDro scale checklist for included studies.

Study	1 (does not appear in the final score)	2	3	4	5	6	7	8	9	10	11	Final score
Aslant et al., 20239	Y	Y	Y	Y	N	N	N	Y	N	Y	Y	6
de Oliveira Silva, 202010	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	7
Fioratti et al., 202211	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	6
Hinman et al., 202012	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Malliaras et al., 202013	Y	Y	Y	N	N	N	N	Y	N	N	Y	4
Odole et al., 201314	Y	Y	N	Y	N	N	N	Y	N	Y	Y	5
Ozden et al., 202215	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Pastora-Bernal et al., 201816	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	6

(Y=Yes, N = No)

Primary Outcomes

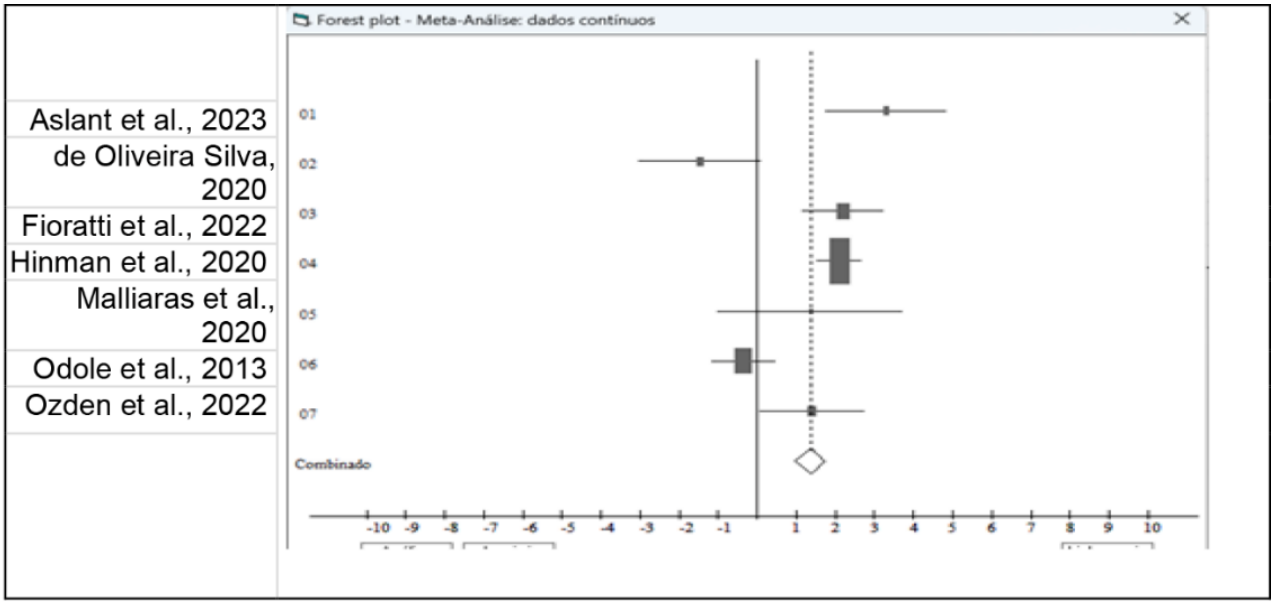
The objective of this review was to evaluate the benefits and harms of TR for musculoskeletal disorders in terms of pain intensity and disability. For disability, this comparison was not possible, as the articles included addressed different body regions, therefore using different measuring instruments. Given the small samples, it was not possible to categorize the study by subgroups.

Therefore, we present the quantitative results only for the pain outcome, which used the Visual Pain Scale (VAS), since for the functionality outcome, as there were different areas of the body, the questionnaires were different, making it impossible to compare the data. Of the 8 studies, 7 were considered for meta-analysis (9,10,11,12,13,14,15). One article (16) was excluded from the meta-analysis as it was not clear how many participants were allocated to the intervention group and how many were in the control group.

The present study reported that there was a highly significant difference between the two treatments, and it can be said that the average pain coefficients of patients who had the usual treatment, no treatment, a waiting list, any form of education and counseling (remotely or in person)), or an in-person intervention were inferior to those obtained with TR (p-value = 0.0001) (CI: 0.9771 to 1.7435) (Figure 3).

When observing the data more closely, we can see that TR, when compared to counseling with guidance on access to the TR platform and booklet, with or without guidance (9,11,12,13,15), appears to be much superior, but not more effective than face-to-face treatment (10,14).

Figure 3: General effects of TR on pain



All articles assessed functionality, but as the regions of the body differed between studies, each clinical trial used a different scale. For example, 4 evaluated the knee, but with different instruments (Kujala Scale, Previous Knee Pain Scale, Ibadan Knee/Hip Osteoarthritis Outcome Measure).

Another region evaluated was the shoulder, in two different health conditions. One article[13] evaluated shoulder pain related to the rotator cuff using the Shoulder Pain and Disability Index (SPADI), which is a quality-of-life questionnaire developed to evaluate pain and disability associated with shoulder dysfunctions. The other article[16] evaluated patients after arthroscopic surgical intervention for subacromial decompression using the Constant-Murley Scale (CMS), which is a non-specific scale that covers different domains of shoulder function (pain, activities of daily living, range of motion, and power).

In addition to pain and functionality, 5 studies assessed participants' quality of life; 4 studies considered kinesiophobia as an outcome factor; and 2 studies measured pain catastrophizing.

To assess kinesiophobia, 4 articles[9,10,13,15] used the Tampa Scale for Kinesiophobia, and for this outcome, 2 studies[9,13] reported that TR provides improvements comparable to face-to-face physiotherapy and TR. In the other 2 articles[10,15], TR had a slightly better effect than conventional therapy.

Quality of life as assessed using different questionnaires: SF-36[9,16]; Knee Injury and Osteoarthritis Outcome Score-Quality of Life[10]; Assessment of Quality of Life (AQoL)[12]; EQ5D: EuroQol 5D-5L[13]. All articles reported improvements in scores for both the control group and the TR group.

Two articles[10,13] used the Pain Catastrophizing Scale (PCS) and both showed a better effect in the TR group when compared to the control group.

Grading the Quality of Evidence

The set of articles in this study suggested a moderate risk of publication bias. In other words, the findings of this review should be interpreted with caution due to the potential risk of publication bias. Most of the included studies presented positive or non-inferiority results, while the small sample size and short follow-up period may have inflated the treatment effects. Furthermore,

the absence of clearly negative trials raises the possibility that studies with neutral or unfavorable results were less likely to be published.

DISCUSSION

This is the first systematic review with meta-analysis that investigated the effects of telerehabilitation in randomized studies of patients with musculoskeletal disorders, when compared with usual care, no treatment, waiting list, any form of education and counseling (remote or in-person), or a similar in-person intervention, on pain intensity and disability.

In this study, high- to moderate-quality evidence showed that RT was as effective as in-clinic physiotherapy and more effective than other interventions for short- and medium-term pain. Therefore, we are confident that TR can be an alternative to treating people with musculoskeletal disorders.

Previous systematic reviews corroborate that TR is superior to usual care, minimal intervention, or waitlist controls and comparable to in-person interventions in reducing pain and improving function in patients with musculoskeletal disorders. TR also appears to provide similar results to in-person intervention and usual care in improving quality of life[17].

This review suggests that the type of intervention (e.g., education, exercise, physical therapy, or self-management), the mode of delivery (synchronous or asynchronous), or the telecommunications technology (e.g., telephone, text messaging, video conferencing, apps, website) does not affect the estimates.

These findings are consistent with previous studies that focused on the effectiveness of TR interventions in patients with chronic low back pain. Therefore, despite some limitations, there appear to be clear benefits of distance physiotherapy, regardless of the TR technique it offers[18].

Care must be taken when generalizing the results to the management of all musculoskeletal conditions. There is study that have had intervention following common elective orthopedic surgical procedures in which some level of recovery from pain and improvement in function is expected regardless of the intervention provided [19].

One author[15] treated lowback pain with a home exercise program guided through the TR platform, where participants were asked to perform the exercises once a day. After 8 weeks, TR group achieved significant improvements in pain, function, quality of life, kinesiophobia, satisfaction, and motivation.

These results were corroborated by Cottrel et al.[20], who demonstrated that TR provides clinically meaningful improvements that are statistically similar to standard in-person care in the pragmatic treatment of patients with chronic musculoskeletal spinal diseases.

For Lara-Palomo et al.[17], TR interventions based on self-maintenance and education are as effective in reducing pain and the specific functional status of low back pain as other face-to-face or home interventions in patients with chronic low back pain, with moderate scientific evidence.

In addition, evidence shows that TR could improve functionality in patients with knee osteoarthritis, in addition to improving the quality of life in patients with knee osteoarthritis and total knee and hip arthroplasty[21].

In some randomized clinical trials included in this review, TR was compared with in-person care and did not prove to be superior, however, when compared with counseling, guidance on accessing the TR platform, a guidance booklet, or no guidance, it proved to be much superior.

Another study by Cottrel et al.[22] provided preliminary evidence that TR is a clinically viable option, particularly for those patients who do not have access to in-person services in their local community and, as such, allows equitable access to healthcare services.

Deslauriers et al.[3] carried out a systematic review addressing the effects of waiting for an outpatient physiotherapy service on people with musculoskeletal disorders and provided mixed evidence on the health effects of waiting time on these patients in terms of pain, disability, quality of life, and psychological symptoms. More specifically, most studies that addressed clinical outcomes after treatment found a negative effect of waiting time on at least one clinical outcome.

Therefore, in general, patients living in remote locations where traditional rehabilitation services may not be easily accessible can benefit from this technology. However, certain disadvantages of TR, including skepticism on the part of patients due to remote interaction with their doctors or rehabilitators, should not be underestimated[23].

There are several limitations to our review. Many articles did not perform sample calculations a priori, which may increase the risk of low-power (false-negative) results. The clinical trials used varying outcome measures for functionality, which limited the pooling of results. It is necessary to reach a consensus on a set of appropriate outcome measures for future studies. Furthermore, long-term follow-up is insufficient to guarantee long-term effects or safety. Finally, a common risk of study bias is the lack of blindness of participants and therapists.

CONCLUSION

After carrying out this systematic review, it was possible to synthesize the therapeutic potential of using TR in musculoskeletal physiotherapy. The positive impact on the outcomes was observed in randomized clinical trials with interventions for different musculoskeletal conditions. High- or moderate-quality evidence showed that TR was more effective than other interventions for short- and medium-term pain management.

According to this research, it can be concluded that, through a comparison of results, the widespread use of TR can be a viable option for musculoskeletal physiotherapy services, which can be applied either solely remotely or in combination with in-person care to increase the positive effect of this type of care. Therefore, simultaneous TR and usual care interventions may be a promising approach worth considering.

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