



Opinions on Remote Treatment Programs for Patients with Knee Osteoarthritis: A Systematic Review

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Abstract

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BACKGROUND: As older adults increasingly use mobile devices and high-speed internet, telerehabilitation has become a potential model for improving the clinical management of individuals with knee osteoarthritis (KOA).

AIM: The main objective is to determine the perception of telerehabilitation programs by patients and physiotherapists.

METHODS: In the systematic literature review, search terms such as KOA, perception, satisfaction, telerehabilitation, and physiotherapy were used in the PubMed (N = 18), MEDLINE (N = 36), SCOPUS (N = 145), and PEDro (N = 0) databases in October 2023. Only original articles written in English and published during the past 10 years were included in the search. After screening according to the inclusion and exclusion criteria, 16 articles were included in the systematic review.

RESULTS: Online resources were used to provide interventions for KOA patients, including websites, mobile apps, phone calls, text messaging, social media, videoconferencing, and dedicated multi-technology systems. Overall, KOA patients used telerehabilitation very differently in terms of the type and application of this technology. Studies suggest that telerehabilitation is seen as a cost- and time-saver, characterized by anonymity, accessibility, and flexibility. Both physiotherapists and KOA patients expressed positive attitudes towards telerehabilitation, while patients expressed concerns about the lack of personal interaction with physiotherapists and the need for technical support, privacy, and security. Physiotherapists additionally expressed a lack of technical and communication skills, as well as financial concerns.

CONCLUSION: Numerous studies have shown that KOA patients and physiotherapists have a positive attitude toward telerehabilitation. In addition to the technology-based exercise program, self-directed telerehabilitation should include patient monitoring, biofeedback, or person-specific motivational messages.

Introduction

Cartilage damage to the knee joint is currently one of the most common musculoskeletal disorders in industrialized countries [1], [2], mainly due to the aging of the population and the increasing proportion of people who are overweight [3]. It is estimated that cartilage defects of the knee joint have a prevalence of 10–12% in the general population [1], [2]. The incidence of asymptomatic and symptomatic full-thickness cartilage injuries is higher in athletes, with an observed incidence of 36–59% [3], [4]. The prevalence of osteoarthritis (OA) or arthrosis of the knee, ranging from mild chondrosis to severe joint disease, is very high, occurring in 60–70% of adults aged 65 years and older [5], [6], [7].

Knee osteoarthritis (KOA) represents a significant burden for both the individual patient and society. OA is a progressive, degenerative disease of the joints that mainly affects the elderly population. It primarily affects the articular cartilage and often leads to joint pain and functional limitations. Among all the joints, the knee is one of the most affected, which is why KOA receives significant attention both in the

clinical environment and in research [8]. KOA, due to its increasing prevalence and associated morbidity, places a significant economic burden on health-care systems and patients, both in terms of direct costs, such as diagnostic tests, outpatient visits, hospitalization, medications, surgery and rehabilitation, and indirect costs, such as lost productivity due to work absenteeism, early retirement, and increased disability benefits [9]. The impact on healthcare is usually surgical, as total knee arthroplasty (TKA) is a commonly recommended procedure for advanced knee OA, with numbers increasing annually [10]. Rehabilitation and post-operative care, as rehabilitation after TKA is essential to restore joint function, are incurring costs both in inpatient settings and for extended outpatient therapies [11]. The consequences for patients are physical, as patients with KOA often suffer from pain, stiffness, swelling, and restricted range of motion, which can lead to limited mobility and reduced physical function; psychological, due to chronic pain and functional limitations, with patients often reporting symptoms such as depression, anxiety and reduced self-efficacy; and quality-of-life-related, as KOA has been shown to significantly reduce patients' quality of life, which includes aspects such as daily activities, social interaction, and sleep

quality [12]. Therefore, scientists urge greater focus on early KOA, that is, a stage when symptoms are mild and manageable, while cartilage changes are still mild. At this stage, the degenerative processes are just beginning, and with timely treatment, the cartilage retains some of its regenerative capacity, which is permanently lost in moderate and severe KOA [13].

A 2021 systematic review of existing studies on the quality of care for patients with KOA found that only one in three KOA patients receive treatment options that include an evidence-based effective intervention according to OA research society international with the following key elements: (1) Dry physiotherapy (strengthening, cardio, balance, neuromuscular, and mental/physical exercises), (2) patient education, (3) self-management of symptoms in the form of lifestyle changes, for example, increasing physical activity, independent exercise and weight control, and (4) nutritional counseling for overweight or obese individuals [14]. Studies show that most patients referred to an orthopedic surgeon had not previously received adequate conservative treatment [15].

The prevailing modern lifestyle, characterized by a lack of time and heavy use of the internet and mobile devices by school-aged and working individuals [16], demonstrates the need for remote physiotherapy or telerehabilitation. Numerous studies have attempted to determine the benefits of telerehabilitation programs for KOA patients and to solve the problem of accessibility to physiotherapy [17]. Many systematic reviews have been conducted, concluding that there is some evidence of the effectiveness of telerehabilitation programs that may improve pain, particularly in patients with chronic pain [18], [19], [20], [21], but not physical function in patients with KOA [21]. Latif-Zade *et al.* [22] found that there were no statistically significant differences between telerehabilitation and inpatient rehabilitation, with their results showing an overall reduction in pain in both groups from baseline to the end of the study, as the clinical effectiveness of each intervention depended on the exercise protocol itself rather than the method of delivery. Thus, this review suggests that the efficacy of telerehabilitation in improving Western Ontario and McMaster Universities Osteoarthritis Index score parameters in patients with KOA is like that of inpatient rehabilitation interventions [22]. The meta-analysis on the effectiveness of telemedicine exercise interventions on pain, physical function, and quality of life in patients with KOA showed that telemedicine exercise interventions were an effective strategy for the management of KOA during the COVID-19 epidemic, that they were significantly better than usual care in reducing knee pain and improving physical function, and that they were able to match the effects of traditional face-to-face exercise treatment. Although duration and mode of administration have been associated with the effect of the intervention, in practice, patient preference and acceptability need

to be considered. Regarding quality of life, this study found an insignificant effect [23]. However, a previous review showed that the technology-assisted exercise program can produce small but statistically significant improvements in quality of life in KOA patients [24]. Use of remote exercise programs based on data collection, visualization, and communication between the patient and health-care professional will improve patients' access to therapies [25], as patients in Slovenia and in other comparable health-care systems have significant problems with access to physiotherapists in the public health-care system [26].

A narrative review of the use of digital health technologies shows that while the number of studies is limited, it suggests that digital healthcare can be cost-effective for these populations, especially when travel costs are considered. Although patients with KOA and clinicians were positive about digital health, concerns were raised by patients and clinicians about privacy and security, as well as concerns about logistics and training. All digital interventions that included cognitive behavioral therapy or similar psychological treatments were reported to result in significant improvements in KOA patients compared to no treatment or traditional treatments. Overall, technologies that were combined and included communication with clinicians as well as biofeedback or patient monitoring showed favorable outcomes [27].

Given the difficulty of enrolling and retaining KOA patients in self-management programs, it is important to examine patients' and physiotherapists' perceptions of telerehabilitation programs, as knowledge of their perceptions may improve participation and retention, and thus health outcomes [26]. As there are few studies addressing the views of patients and physiotherapists on telerehabilitation for KOA patients, this study aimed to fill this research gap. By systematically reviewing existing studies on patients' and physiotherapists' perceptions of telerehabilitation programs, we aimed to gain new insights that may be helpful in the implementation of telerehabilitation programs. Therefore, the main objective is to determine the perception of telerehabilitation programs by patients and physiotherapists.

Methods

This systematic review of literature was conducted in accordance with the preferred reporting items for systematic review and meta-analysis (PRISMA) guidelines [25]. Four databases, including PubMed, MEDLINE, SCOPUS, and PEDro, were searched from 01 October to 01 November 2023. The keywords used for the search at all 4 time points were: KOA, perception, satisfaction, telerehabilitation, and physiotherapy. The

National Library of Medicine PubMed showed us 18 hits based on the restriction criteria when the keywords were entered. The MEDLINE bibliographic database gave 36 hits when we entered the restriction criteria. The literature search in the SCOPUS database gave us 154 results when we entered the restriction criteria. The PEDro database gave us no hits.

The inclusion criteria were (1) original studies published in the English language, (2) studies published in the past 10 years, and (3) technologies used for the rehabilitation of KOA. Studies that investigated the use of technology for diagnosis, decision aid, informed consent, or movement assessments were excluded from this review. Furthermore, duplicates, conference abstracts, protocol papers, and previously published reviews, including systematic reviews, were excluded from the study. One of the researchers (PK) initially screened the titles of the studies in the search results against the inclusion and exclusion criteria, removing studies that were not relevant to the review. The remaining studies were reviewed by a researcher (KE) who read the abstracts of each study to determine whether they should be included in the review. For the included studies, one of the authors (PK) extracted pertinent information as applicable, including objective, design, intervention characteristics, outcomes and findings, and limitations. We screened for internal validity, equal treatment of patients aside from the allocated intervention, and unbiased practices based on the 2005 Oxford standard [28]. In cases of disagreements regarding the texts used, a discussion and consultation were held with the leader of the project.

The study is part of the project "Usefulness, efficacy, and satisfaction with a web-based integrated clinical pathway for patients with knee cartilage damage with emphasis on an online exercise program," funded by the Slovenian Agency for Research and Innovation and Artros.

According to PRISMA's guidelines, a total of 208 articles (PubMed – 18, MEDLINE – 36,

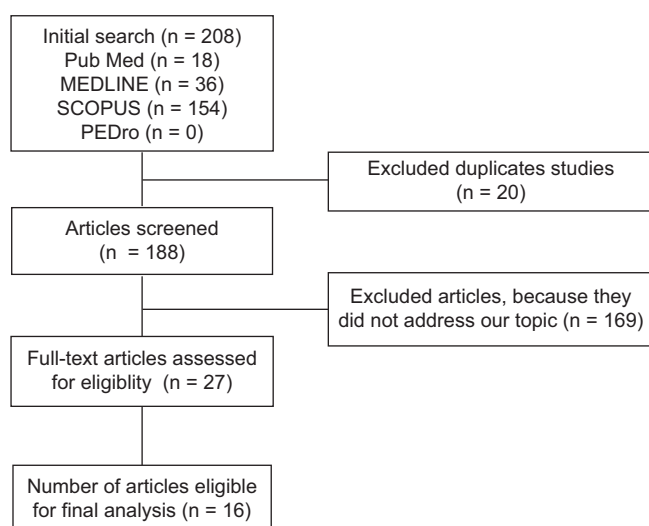


Figure 1: Flow diagram of the search process

SCOPUS – 154, and PEDro – 0) were found. Twenty duplicates were removed, leaving 188 articles. After initial screening, 169 articles were excluded as they did not address our topic (the article did not address the population of patients with KOA at all). Subsequently, the remaining 27 studies were screened according to our inclusion and exclusion criteria. The remaining 16 articles were critically appraised and included in our systematic review (Figure 1).

Results

As indicated in Table 1, the first paper on the topic analyzed was published by Brooks *et al.* [29], in which they analyzed the use of an online therapeutic exercise information center based on an 8-week program. The study showed that the online program was feasible and effective in improving clinical outcomes in patients with mild or moderate KOA. Another paper by Pearson *et al.* [30] investigated how an online version of the program can improve the physical and psychosocial well-being of patients with KOA. They found that older people use the internet as a source of health information but have concerns about the safe use and quality of the information. Users need a credible website that provides customized information, support, follow-up, and feedback. Ackerman *et al.* [31] investigated the usefulness and accessibility of different ways of providing education and support in relation to KOA, and Hinman *et al.* [32] included patients and physiotherapists in a qualitative study. Patients received advice on exercises and support from a physiotherapist through Skype. Both patients and physiotherapists expressed a mostly positive attitude toward the use of Skype as a service model for physiotherapy-supported exercise management in moderate KOA. Lawford *et al.* [33] investigated the perception of remote exercise performance in patients with hip and/or knee OA. The study showed that patients' perceptions of telerehabilitation were predominantly positive, but they were concerned about the lack of physical contact with the therapist.

In a web-based survey of Australian physiotherapists, Lawford *et al.* [34] concluded that they agree that telerehabilitation offers time-saving and privacy benefits for KOA patients. They considered video-based care to be more advantageous than services provided by telephone. In a survey by Zheng *et al.* [35], sixteen patients and three clinics were interviewed about mobile health (mHealth) technologies. Patients preferred single-touch user interfaces over multi-touch or slider user interfaces and a vertical arrangement of questions over a horizontal one. Lawford *et al.* [36] interviewed 20 patients who had received exercise advice and support from a

Table 1: Opinion (perception and satisfaction) regarding telerehabilitation in people with KOA

Study	Design	E-intervention	Sample size	Comparator or comparators		(Primary) outcome findings
				Description	Sample size	
Brooks <i>et al.</i> , 2014 [29]	RCT, satisfaction survey	Web-based 8-week TR	52 patients with mild/moderate KOA, 25 years and older, USA	N/A	N/A	Participants found a high degree of satisfaction with the programme
Pearson <i>et al.</i> , 2016 [30]	Postal survey and focus group interviews with TR	Web-based ESCAPE-pain program	200 patients (survey), 11 patients (focus group), UK	6-week educational and exercise programme	13 patients	Older people use the internet as a source of health information but have concerns about safe use and quality of information, and require a credible website with personalized information, support, monitoring, and feedback Social media was perceived as least useful and least accessible
Ackerman <i>et al.</i> , 2017 [31]	Survey	Explore the usefulness and accessibility of different delivery modes of disease-related education and support, as perceived by younger people with KOA	147 young patients, Australia	N/A	N/A	
Hinman <i>et al.</i> , 2017 [32]	Qualitative with RCT	Received exercise advice and support from physiotherapist over Skype (<i>n</i> = 8)	12 patients, 8 physical therapists, Australia	N/A	N/A	Patients and physical therapists expressed mostly a positive perception of using Skype as a service delivery model for physical-therapist-supervised exercise management of moderate KOA
Lawford <i>et al.</i> , 2017 [33]	Survey with patients	Investigate the perceptions of people with hip and/or knee OA about the remote delivery of exercise therapy by a physical therapist	330 patients aged ≥ 45 years, Australia	N/A	N/A	Participants hold mostly positive perceptions of telerehabilitation with concern about the lack of physical contact with the therapist
Lawford <i>et al.</i> , 2017 [34]	Survey with physiotherapists	Investigate physical therapists' perceptions of, and willingness to use, telephone- and internet-mediated service models for exercise therapy for people with knee and/or hip OA	217 physical therapists, Australia	N/A	N/A	Telephone is less acceptable than videoconferencing; Lack of visual cues; Requires training
Zheng <i>et al.</i> , 2017 [35]	Qualitative study with RCT	Mobile app	16 patients, three clinicians, USA	N/A	N/A	Patients preferred easy-tap user interfaces to multitap or slider methods, and vertical question layout to horizontal orientation
Lawford <i>et al.</i> , 2018 [36]	Qualitative study with RCT	Received exercise advice and support from physiotherapist via telephone	20 patients, Australia	N/A	N/A	Positive perception and experiences – convenience and accessibility with desired visual contacts (including a videoconferencing call or in-person visit)
Barber <i>et al.</i> , 2019 [37]	Qualitative study with RCT	Mobile health application	four family physicians, five patients, Canada	N/A	N/A	While patients were supportive of the app, physicians were sceptical of its use and focused more on accountability and patient resources
Cronström <i>et al.</i> , 2019 [38]	Qualitative study with RCT	6-week website-based programme with support from physical therapist	19 patients, Sweden	N/A	N/A	Good perception: Easy access, exercising at one's own convenience, flexible options, daily follow-up, and support by a physical therapist
Hinman <i>et al.</i> , 2019 [39]	RCT	Telephone-delivered exercise advice vs. existing service (6 and 12 months)	88 patients, Australia	Telephone-delivered exercise advice and support by physiotherapist	87 patients	High satisfaction rates with the telephone-delivered exercise intervention
Lawford <i>et al.</i> , 2019 [40]	Qualitative study with RCT	Telephone-delivered care	eight physiotherapists, Australia	N/A	eight physiotherapists, Australia	More acceptable after first-hand experience; Telephone is less acceptable than videoconferencing; Requires training
Aily <i>et al.</i> , 2020 [41]	Feasibility study, pre-post intervention	12-week TR exercise	13 patients (aged 40–50 years), 16 patients (aged > 70 years), Brazil	12-week TR exercise	N/A	Telerehabilitation was well accepted by middle-aged and elderly patients: good overall adherence, satisfaction, and acceptability
Nelligan <i>et al.</i> , 2020 [42]	Qualitative study with RCT	24-week eHealth intervention (website, SMS)	16 patients, Australia	N/A	N/A	Mostly positive experiences with and attitudes towards the emphasis on the importance of human relationships in the context of the eHealth intervention
Aily <i>et al.</i> , 2023 [43]	RCT	Experimental group, 14 weeks of circuit training delivered via telerehabilitation	50 patients (aged ≥ 50 years), Brazil	Control group received the same face-to-face training programme	50 patients (aged ≥ 50)	Both groups reported good perceptions of their intervention
Tore <i>et al.</i> , 2023 [44]	RCT	Compare effects of TR programme (8 weeks) with the presence of physiotherapists vs. physiotherapy through a brochure	24 patients with mild/moderate KOA, Turkey	Home-based exercise programme	24 patients with mild/moderate KOA	The level of satisfaction with the treatment of the telerehabilitation group was statistically significantly higher than of the control group

RCT: Randomised control trial, TR: Telerehabilitation, N/A: Not applicable, KOA: Knee osteoarthritis.

physiotherapist over the telephone about their views. Patients reported positive perceptions and experiences (including a video conference call or face-to-face visit). In a qualitative study, Barber *et al.* [37] sought the opinions of physicians and patients about the mobile health app. Patients were supportive of the app, while physicians were sceptical of its use and focused more on accountability and resources for patients.

In a qualitative study by Cronström *et al.* [38] on a 6-week online program with physiotherapy support, it was found that it was easily accessible, that people could exercise at their convenience, and that there were flexible options, daily monitoring, and physiotherapy support. On the other hand, a study by Hinman *et al.* [39] investigated the satisfaction of KOA patients who received telephone physiotherapy

advice on exercise, with high levels of satisfaction with telephone training. Lawford *et al.* [40] investigated the perceptions of physiotherapists before and after telephone exercise counseling for patients with KOA. Although the physiotherapists were initially sceptical about the effectiveness of telephone service models for patients with KOA, their opinion changed. After some experience, they realized that the telephone was less acceptable than video conferencing and that training was required. In the 12-week training program in the study by Aily *et al.* [41], middle-aged and elderly KOA patients received individualized instructions on exercise therapy, along with a booklet and videos. Participants also received six motivational telephone calls. Telerehabilitation was recognized as effective. Nelligan *et al.* [42] investigated the views and experiences of patients with KOA based on a 24-week e-health intervention. They found predominantly positive experiences and attitudes during the intervention. Aily *et al.* [43] compared the effects of telerehabilitation in the experimental and control groups. Both groups of patients reported a good perception of the intervention. They found that the results of telerehabilitation were not worse than those of conventional rehabilitation. Tore *et al.* [44] found that at an 8-week follow-up of telerehabilitation, the satisfaction rate was higher in the telerehabilitation group than in the control group, who received physiotherapy through a booklet.

A systematic review of the literature shows that the studies used different methodological approaches to measure opinions on telerehabilitation in people with KOA. Most studies were quantitative and determined opinions with a survey [29], [30], [31], [33], [34]; some studies conducted in-depth interviews with patients [30], [36], [38] and with physiotherapists [40]; and some combined a quantitative survey and qualitative in-depth or focus group interviews [29], [30], [32], [36], [37], [38], [39], [42]. The studies that measured opinions on telerehabilitation in people with KOA used different methods. Only 11 out of 16 used a control trial [29], [32], [35], [36], [37], [38], [39], [40], [42], [43], [44]; others did not include a control group [29], [31], [33], [34], [35], [36], [37], [38], [40], [42]. In some studies, only KOA patients [29], [30], [31], [33], [34], physiotherapists [34], [35], [40], or family physicians [37] were interviewed, or only interviews with physiotherapists were conducted [40].

Overall, the results of the studies analyzed show that most participants in all studies expressed good perceptions, positive experiences, and satisfaction. In their initial study, Lawford *et al.* [33] explored the perceptions of Australian KOA patients regarding telerehabilitation models for exercise prescribed by physiotherapists, finding that most of them viewed telerehabilitation through telephone or video over the internet positively, acknowledging the benefits of ease of use and time savings. However, there was uncertainty about receiving care without physical contact with the

therapist, which may affect patients' perceptions of the effectiveness of care through telerehabilitation. Using in-depth interviews with Australian participants aged 45 years and older with moderate knee pain, the same authors [36] confirmed that telerehabilitation was initially met with scepticism, with many participants criticizing the lack of visual or physical contact with the therapist. However, they emphasized that telephonic physiotherapy was convenient and efficient, allowing them to consult the physiotherapist from home or work, as well as when traveling or on holiday. Participants also commented that the home-based consultation enabled them to better integrate it into their daily lives. This was confirmed by a study by Brooks *et al.* [29] who evaluated a questionnaire with 52 patients from the USA and found that participants were very satisfied with the program. Patients reported a very positive evaluation of the RCT, with 94% stating that the website was easy to use and 90% describing the exercise animations as particularly helpful.

In most randomized control trial studies, participants in a telerehabilitation program were found to be similarly satisfied to participants in physiotherapy programs delivered in person. Using a questionnaire, Tore *et al.* [44] found that the level of satisfaction with the 8-week treatment was even statistically significantly higher in the telerehabilitation group than in the control group that received physiotherapy through a brochure. Similarly, in the recent Brazilian study [43] involving a relatively younger population under 50 years of age, which measured adherence and acceptance, both groups expressed good perceptions, that is, they accepted the protocol well, would recommend it to others, and the experimental group was even slightly more satisfied with the telerehabilitation protocol.

Some differences can be observed regarding the age of patients. For example, Pearson [30] emphasized that older people use the internet as a source of health information but have concerns about safe use and quality of information. However, the research was carried out 10 years ago.

The studies analyzed were based on interventions delivered by a range of communication and information technologies, most commonly web-based programs [29], [30], [38], [42]; multi-technology systems [41], [43]; videoconferencing through Zoom [44] or Skype [32] and telephone [36], [39], [40]; mobile applications [35], [37]; and social media [31].

Studies using simultaneous or real-time videoconferencing, such as Skype or Zoom, highlight the sense of personal and undivided attention of telerehabilitation. In in-depth interviews with 12 patients and eight physiotherapists, Hinman *et al.* [32] found overwhelmingly positive perceptions of the use of Skype as a service model for physiotherapist-supervised exercise management in moderate-to-severe KOA, highlighting the convenience and sense of personal, undivided attention, as well as the sense

of empowerment for self-management. Both groups of participants preferred real-time videoconferencing to the telephone, but pointed out that the need for technical support and lack of experience can lead to low confidence and reduced interest. The physiotherapists warned of discomfort due to the lack of physical contact.

Studies of website programs [29], [30], [38], [42] found moderate-to-high satisfaction, with particular emphasis on benefits such as cost and time savings, anonymity, accessibility, and flexibility; they were similarly preferred to in-person visits for appointments. Higher uptake among patients with support from a physiotherapist, monitoring of progress, accessing information, receiving feedback from physiotherapists, and sharing with peers. Patients preferred real avatars to animations, a native accent to a non-native accent, and wanted more contextual and culturally specific information. Pearson *et al.* [30], combining a quantitative survey and focus group interviews, concluded that users need a credible website that provides personalized information, support, monitoring, and feedback. They found that effective web-based behavior-change programs need to include behavior-change techniques that challenge people's false health beliefs about the harmful effects of physical activity on joint pain by including several steps. First, people need to be convinced of the consequences of bad health behaviors (inactivity) and good behaviors (activity). Then, they need clear, unambiguous information and instructions about what they should and should not do, as well as demonstrations of how to do certain exercises, how often, and what to expect. Knowing why and how to exercise helps to develop strong "goal setting". Unfortunately, good intentions are often not translated into action. To close this "intention gap", people need to create "action plans" (specifying what behaviors they want to do, where, when, and how) and "coping plans" that raise awareness of their personal strengths, weaknesses, and situations that might affect their behavior, and prepare a coping strategy to overcome these obstacles. Behavior change is also facilitated by people self-monitoring their behavior and comparing it to what is expected of them (their level of physical activity compared to what they should be doing), which includes factors such as goal setting, feedback, and support for performance and progress. Although information is usually provided in web-based behavior-change programs, it is more difficult to include methods to help people change their intentions, such as goal setting, action plans, interactive feedback, and support, which are therefore not included in many web-based programs.

Studies analyzing patient and physiotherapist perceptions of mobile applications for telerehabilitation programs found that patients preferred single-tap user interfaces over multitap or slider methods, and a vertical question layout over a horizontal orientation [35]. Barber *et al.* [37] found that patient participants

expressed that KOA was seriously affecting their lives and lifestyles, and they wanted their knee pain to be considered as important as other health problems. In contrast, primary care physicians uniformly considered KOA to be a relatively minor health problem, although they viewed it as a painful condition that often limited patients' activities. Consequently, they did not consider KOA to be a condition that should be treated proactively and aggressively. The discrepancy between primary care physicians' and patients' concepts of KOA and its treatment also extended to the use of a self-management app. While patients were in favor of the mobile app, primary care physicians were sceptical about its use and focused more on patient accountability and resources.

Ackerman *et al.* [31] examined patients' perceptions of the use of various technologies with regard to the usefulness and accessibility of different delivery modes of disease-related education and support as perceived by younger people with KOA. They found that web-based programs were useful, but that social media was perceived as least useful and least accessible.

In addition to the patient's perspective, some studies focused on the physiotherapist's perspective. For example, in a quantitative survey of 217 Australian physiotherapists, Lawford *et al.* [34] found that physiotherapists believe that telerehabilitation offers timesaving and privacy benefits for individuals with KOA, and that they view video care more positively than services delivered by telephone. However, most dislike the lack of physical contact in both service models. In another study, Lawford *et al.* [40] also conducted a descriptive qualitative study embedded in a randomized controlled trial including all eight physiotherapists involved in the study. The authors found that before the intervention was delivered, the physiotherapists felt that the telephone should only be used for follow-up and not as a primary form of care. After the intervention was implemented, they felt that telephone care was convenient and cost-saving for patients, provided more opportunity for patient education, and facilitated access to services, but that the lack of visual and physical contact with patients was problematic. The focus on communication allowed for more personalized conversations with patients and changed patients' expectations of care away from manual therapies and toward self-management. Many implementation considerations were made, including the need for physiotherapist training in communication skills, written resources for patients to supplement telephone conversations, and careful consideration of how to schedule telephone consultations during the usual face-to-face consultations in the clinic.

Thus, the literature review found that both patients and physiotherapists viewed telerehabilitation positively, with accessibility, practicality, individual attention, privacy, and cost savings highlighted. Other

positive aspects of the program included progress reports, feedback, self-monitoring, and improved patient-provider relationships [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39], [40], [41], [42], [43], [44]. In addition, telephone-based therapies were considered valuable and acceptable for physiotherapists' undivided attention and communication [32], [33], [40]. Nevertheless, some patients requested videoconferencing or other forms of visual monitoring [36]. Similarly, physiotherapists as health-care providers preferred video-based interventions to telephone-based ones [40]. Patients also expressed concerns about the lack of face-to-face interaction with physiotherapists and the need for technical support, privacy, and security [30], [33], [35], [37], [38], [39], [40], [42]. Implementation of telerehabilitation, lack of technical and communication skills, and loss of income were among the additional issues raised by physiotherapists [36], [37], [39].

Discussion

Measuring patients' and physiotherapists' views on telerehabilitation is crucial for developing more effective, efficient, and user-friendly rehabilitation methods that are better tailored to the needs of patients and therapists [27]. Patient education, exercise programs (self-directed, remotely monitored, or directly supervised by a physiotherapist), and physical activity have been used in telerehabilitation for KOA patients. Various forms of telerehabilitation have been used for these purposes, including websites, phone conversations, text messages, mobile apps (with or without activity monitors that provide visible feedback), real-time videoconferencing, and multi-technology systems that integrate multiple technologies into their intervention. Typically, these technologies were used to supplement or replace face-to-face clinical care. For digital interventions, it was common practice to combine various technologies (e.g., wearable sensors with websites and activity tracking with mobile apps) to take advantage of their respective capabilities. In general, there was wide variation in the types of telerehabilitation that were studied for KOA patients.

While KOA patients generally accepted the various technologies used in these studies (e.g., websites, phones, mobile apps, videoconferencing, and multi-technology systems), some participants in telephone-based interventions expressed a need for visual contact with their physical therapists [32], [33], [40]. The results show that interventions employing multiple technologies and strategies to involve the participants – for example, using a smartphone app for activity monitoring, telephone coaching, and motivational messaging – may hold more promise than those that merely rely on one modality, like a website or text messaging. Blended therapies, which

incorporate telerehabilitation strategies to supplement in-person care, may offer advantages comparable to those of in-person care for physical therapists treating individuals with KOA. To fully comprehend the potential of blended interventions, more research comparing blended, digital, and in-person care is necessary.

The review shows that telerehabilitation holds great promise for the future medical care of KOA patients. It could benefit from selecting content from reliable websites and treatment recommendations or co-creating educational materials with KOA patients to improve the readability and quality of the program. Telerehabilitation information should be reviewed by authorized physiotherapists before being given to patients. Future research should consider current patient and physiotherapist preference data when developing and implementing telerehabilitation strategies for physical activity and exercise interventions. As user engagement and adherence remain problematic in this population, offering clinical and technological support – e.g., asynchronous communication with a physiotherapist – as well as technological support – e.g., phone calls and an intuitive user interface – could be helpful.

A systematic review of the literature shows that there are only few studies based on randomized control trials. Furthermore, there is a lack of studies comparing different methods of delivering interventions with different technologies. Future research should be based on randomized control trials that use different intervention methods and allow the evaluation of telerehabilitation and face-to-face programs, as well as different information and communication technologies, as randomized control trials minimize bias and allow a clear comparison between different intervention methods by randomly assigning participants to different treatment groups [45]. Future research should incorporate different information and communication technologies, as by integrating these technologies into randomized control trials, researchers can evaluate how different tools contribute to the effectiveness of rehabilitation programs [27]. It should also include diverse patient populations with different age groups, genders, ethnicities, and types of disabilities or conditions to ensure that the results are generalizable and applicable to a wide range of individuals. It should also include longitudinal studies, as long-term follow-up studies are needed to assess the sustainability and long-term impact of rehabilitation methods [46]. We also found that interdisciplinary collaboration is important, as partnerships between health-care professionals, technicians, and researchers from different fields can improve the design, conduct, and analysis of randomized control trials [47].

The results of this review should be interpreted with some restrictions in mind. Our evaluation did not include other applications of telerehabilitation, such as

informed consent, diagnosis, and data collection, as it focused on research examining KOA telerehabilitation.

Conclusion

A systematic review of the literature on the perception of telerehabilitation programs by patients and physiotherapists shows that telerehabilitation is seen as a cost and time-saver, characterized by anonymity, accessibility, and flexibility. Both physiotherapists and KOA patients expressed positive attitudes toward telerehabilitation, while patients expressed concerns about the lack of personal interaction with physiotherapists and the need for technical support, privacy, and security. Physiotherapists also expressed a lack of technical and communication skills as well as financial concerns.

The study also shows that there are few studies based on randomized control trials. There is also a lack of studies comparing different methods of delivering interventions using different technologies. The future of telerehabilitation research should focus on well-designed randomized control trials that critically evaluate both telerehabilitation and traditional face-to-face programs. The inclusion of different information and communication technologies and ensuring diverse, inclusive participant groups are fundamental to this research. This approach will make an important contribution to the further development of rehabilitation procedures and patient care strategies.

References

- Lattermann C, Madry M, Nakamura N, Kon E. Early Osteoarthritis: State-of-the-Art Approaches to Diagnosis, Treatment and Controversies. Germany: Springer; 2022.
- Sellards RA, Nho SJ, Cole BJ. Chondral injuries. *Curr Opin Rheumatol.* 2002;14(2):134-41. <https://doi.org/10.1097/00002281-200203000-00010> PMID:11845018
- Totlis T, Fermín TM, Kalifis G, Terzidis I, Maffulli N, Papakostas E. Arthroscopic debridement for focal articular cartilage lesions of the knee: A systematic review. *Surgeon.* 2021;19(6):356-64. <https://doi.org/10.1016/j.surge.2020.11.011> PMID:33423921
- Steinmetz RG, Guth JJ, Matava MJ, Smith MV, Brophy RH. Global variation in studies of articular cartilage procedures of the knee: A systematic review. *Cartilage.* 2022;13(2):19476035221098169. <https://doi.org/10.1177/19476035221098169> PMID:35578752
- Kaplan LD, Royce B, Meier B, Hoffmann JM, Barlow JD, Lu Y, *et al.* Mechanical chondroplasty: Early metabolic consequences *in vitro*. *Arthroscopy.* 2007;23(9):923-9. <https://doi.org/10.1016/j.arthro.2007.04.005> PMID:17868830
- Blanco FJ, Silva-Díaz M, Quevedo Vila V, Seoane-Mato D, Pérez Ruiz F, Juan-Mas A, *et al.* Prevalence of symptomatic osteoarthritis in Spain: EPISER2016 study. *Reumatol Clin (Engl Ed).* 2021;17(8):461-70. <https://doi.org/10.1016/j.reumae.2020.01.005>
- Hunter DJ, Neogi T, Hochberg MC. Quality of osteoarthritis management and the need for reform in the US. *Arthritis Care Res (Hoboken).* 2011;63(1):31-8. <https://doi.org/10.1002/acr.20278> PMID:20583113
- Lawrence RC, Felson DT, Helmick CG, Arnold LM, Choi H, Deyo RA, *et al.* Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. Part II. *Arthritis Rheum.* 2008;58(1):26-35. <https://doi.org/10.1002/art.23176> PMID:18163497
- Hardenberg M, Speklé EM, Coenen P, Brus MI, Kuijjer PP. The economic burden of knee and hip osteoarthritis: Absenteeism and costs in the Dutch workforce. *BMC Musculoskelet Disord.* 2022;23(1):364. <https://doi.org/10.1186/s12891-022-05306-9> PMID:35436874
- Losina E, Paltiel AD, Weinstein AM, Yelin E, Hunter DJ, Chen SP, *et al.* Lifetime medical costs of knee osteoarthritis management in the United States: Impact of extending indications for total knee arthroplasty. *Arthritis Care Res (Hoboken).* 2015;67(2):203-15. <https://doi.org/10.1002/acr.22412> PMID:25048053
- Skou ST, Roos EM, Laursen MB, Rathleff MS, Arendt-Nielsen L, Rasmussen S, *et al.* Total knee replacement and non-surgical treatment of knee osteoarthritis: 2-year outcome from two parallel randomized controlled trials. *Osteoarthr Cartil* 2018;26:1170-80. <https://doi.org/10.1016/j.joca.2018.04.014> PMID:29723634
- Conaghan PG, Porcheret M, Kingsbury SR, Gammon A, Soni A, Hurley M, *et al.* Impact and therapy of osteoarthritis: The Arthritis Care OA Nation 2012 survey. *Clin Rheumatol.* 2015;34(9):1581-8. <https://doi.org/10.1007/s10067-014-2692-1> PMID:24889403
- Kon E, Filardo G, Marcacci M. Early osteoarthritis. *Knee Surg Sports Traumatol Arthrosc.* 2012;20(3):399-400. <https://doi.org/10.1007/s00167-011-1858-5> PMID:22205099
- Smedslund G, Kjekken I, Musial F, Sexton J, Østerås N. Interventions for osteoarthritis pain: A systematic review with network meta-analysis of existing Cochrane reviews. *Osteoarthr Cartil Open.* 2022;4(2):100242. <https://doi.org/10.1016/j.ocarto.2022.100242> PMID:36475286
- Mazzei DR, Ademola A, Abbott JH, Sajobi T, Hildebrand K, Marshall DA. Are education, exercise and diet interventions a cost-effective treatment to manage hip and knee osteoarthritis? A systematic review. *Osteoarthritis Cartilage.* 2021;29(4):456-70. <https://doi.org/10.1016/j.joca.2020.10.002> PMID:33197558
- Crouch E, Gordon NP. Prevalence and factors influencing use of internet and electronic health resources by middle-aged and older adults in a US health plan population: Cross-sectional survey study. *JMIR Aging.* 2019;2(1):e11451. <https://doi.org/10.2196/11451> PMID:31518256
- Rowland SP, Fitzgerald JE, Holme T, Powell J, McGregor A. What is the clinical value of mHealth for patients? *NPJ Digit Med.* 2020;3:1-6. <https://doi.org/10.1038/s41746-019-0206-x> PMID:31970289
- Hurley M, Dickson K, Hallett R, Grant R, Hauari H, Walsh N, *et al.* Exercise interventions and patient beliefs for people with hip, knee or hip and knee osteoarthritis: A mixed methods

- review. *Cochrane Database Syst Rev.* 2018;4(4):CD010842. <https://doi.org/10.1002/14651858.CD010842.pub2>
PMid:29664187
19. McHugh CG, Kostic AM, Katz JN, Losina E. Effectiveness of remote exercise programs in reducing pain for patients with knee osteoarthritis: A systematic review of randomized trials. *Osteoarthr Cartil Open.* 2022;4(3):100264. <https://doi.org/10.1016/j.ocarto.2022.100264>
PMid:36474946
 20. Toonders SA, van der Meer HA, van Bruxvoort T, Veenhof C, Speksnijder CM. Effectiveness of remote physiotherapeutic e-Health interventions on pain in patients with musculoskeletal disorders: A systematic review. *Disabil Rehabil.* 2022;45(22):3620-38. <https://doi.org/10.1080/09638288.2022.2135775>
PMid:36369923
 21. Xie SH, Wang Q, Wang LQ, Wang L, Song KP, He CQ. Effect of internet-based rehabilitation programs on improvement of pain and physical function in patients with knee osteoarthritis: Systematic review and meta-analysis of randomized controlled trials. *J Med Internet Res.* 2021;23(1):e21542. <https://doi.org/10.2196/21542>
PMid:33399542
 22. Latif-Zade T, Tucci B, Verbovetskaya D, Bialkin E, Ng B, Heddon S, *et al.* Systematic review shows tele-rehabilitation might achieve comparable results to office-based rehabilitation for decreasing pain in patients with knee osteoarthritis. *Medicina (Kaunas).* 2021;57(8):764. <https://doi.org/10.3390/medicina57080764>
PMid:34440970
 23. Yang Y, Li S, Cai Y, Zhang Q, Ge P, Shang S, *et al.* Effectiveness of telehealth-based exercise interventions on pain, physical function and quality of life in patients with knee osteoarthritis: A meta-analysis. *J Clin Nurs.* 2023;32(11-2):2505-20. <https://doi.org/10.1111/jocn.16388>
PMid:35872635
 24. Chen T, Or Kalun C, Chen J. Effects of technology-supported exercise programs on the knee pain, physical function, and quality of life of individuals with knee osteoarthritis and/or chronic knee pain: A systematic review and meta-analysis of randomized controlled trials. *J Am Med Inform Assoc.* 2021;28(2):414-23. <https://doi.org/10.1093/jamia/ocaa282>
PMid:33236109
 25. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, *et al.* The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *Ann Intern Med.* 2009;151(4):W65-94. <https://doi.org/10.7326/0003-4819-151-4-200908180-00136>
PMid:19622512
 26. Dobson F, Bennell KL, French SD, Nicolson PJ, Klaasman RN, Holden MA, *et al.* Barriers and facilitators to exercise participation in people with hip and/or knee osteoarthritis: Synthesis of the literature using behavior change theory. *Am J Phys Med Rehabil.* 2016;95(5):372-89. <https://doi.org/10.1097/PHM.0000000000000448>
PMid:26945211
 27. Shah N, Costello K, Mehta A, Kumar D. Applications of digital health technologies in knee osteoarthritis: Narrative review. *JMIR Rehabil.* 2022;9(2):e33489. <https://doi.org/10.2196/33489>
 28. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, *et al.* The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: Explanation and elaboration. *BMJ.* 2009;339:b2700. <https://doi.org/10.1136/bmj.b2700>
PMid:19622552
 29. Brooks MA, Beaulieu JE, Severson HH, Wille CM, Cooper D, Gau JM, *et al.* Web-based therapeutic exercise resource center as a treatment for knee osteoarthritis: A prospective cohort pilot study. *BMC Musculoskelet Disord.* 2014;15:158. <https://doi.org/10.1186/1471-2474-15-158>
PMid:24884547
 30. Pearson J, Walsh N, Carter D, Koskela S, Hurley M. Developing a web-based version of an exercise-based rehabilitation program for people with chronic knee and hip pain: A mixed methods study. *JMIR Res Protoc.* 2016;5(2):e67. <https://doi.org/10.2196/resprot.5446>
PMid:27197702
 31. Ackerman IN, Bucknill A, Page RS, Broughton NS, Roberts C, Cavka B, *et al.* Preferences for disease-related education and support among younger people with hip or knee osteoarthritis. *Arthritis Care Res (Hoboken).* 2017;69(4):499-508. <https://doi.org/10.1002/acr.22950>
PMid:27273912
 32. Hinman RS, Nelligan RK, Bennell KL, Delany C. Sounds a bit crazy, but it was almost more personal: A qualitative study of patient and clinician experiences of physical therapist-prescribed exercise for knee osteoarthritis via Skype. *Arthritis Care Res (Hoboken).* 2017;69(12):1834-44. <https://doi.org/10.1002/acr.23218>
PMid:28217864
 33. Lawford BJ, Bennell KL, Hinman RS. Consumer perceptions of and willingness to use remotely delivered service models for exercise management of knee and hip osteoarthritis: A cross-sectional survey. *Arthritis Care Res.* 2017;69(5):667-76. <https://doi.org/10.1002/acr.23122>
PMid:27813360
 34. Lawford BJ, Bennell KL, Kasza J, Hinman RS. Physical therapists' perceptions of telephone- and internet video-mediated service models for exercise management of people with osteoarthritis. *Arthritis Care Res (Hoboken).* 2018;70(3):398-408. <https://doi.org/10.1002/acr.23260>
PMid:28437566
 35. Zheng H, Tulu B, Choi W, Franklin P. Using mHealth app to support treatment decision-making for knee arthritis: Patient perspective. *EGEMS (Wash DC).* 2017;5(2):7. <https://doi.org/10.13063/2327-9214.1284>
PMid:29930969
 36. Lawford BJ, Delany C, Bennell KL, Hinman RS. "I was really sceptical...But it worked really well": A qualitative study of patient perceptions of telephone-delivered exercise therapy by physiotherapists for people with knee osteoarthritis. *Osteoarthritis Cartilage.* 2018;26(6):741-50. <https://doi.org/10.1016/j.joca.2018.02.909>
PMid:29572130
 37. Barber T, Sharif B, Teare S, Miller J, Shewchuk B, Green LA, *et al.* Qualitative study to elicit patients' and primary care physicians' perspectives on the use of a self-management mobile health application for knee osteoarthritis. *BMJ Open.* 2019;9(1):e024016. <https://doi.org/10.1136/bmjopen-2018-024016>
PMid:30782723
 38. Cronström A, Dahlberg LE, Nero H, Ericson J, Hammarlund CS. 'I would never have done it if it hadn't been digital': A qualitative study on patients' experiences of a digital management programme for hip and knee osteoarthritis in Sweden. *BMJ Open.* 2019;9(5):e028388. <https://doi.org/10.1136/bmjopen-2018-028388>
PMid:31129601
 39. Hinman RS, Campbell PK, Lawford BJ, Briggs AM, Gale J, Bills C, *et al.* Does telephone-delivered exercise advice and support by physiotherapists improve pain and/or function in people with knee osteoarthritis? *Telecare randomised*

- controlled trial. *Br J Sports Med.* 2020;54(13):790-7. <https://doi.org/10.1136/bjsports-2019-101183>
PMid:31748198
40. Lawford BJ, Delany C, Bennell KL, Hinman RS. "I was really pleasantly surprised": Firsthand experience and shifts in physical therapist perceptions of telephone-delivered exercise therapy for knee osteoarthritis-a qualitative study. *Arthritis Care Res (Hoboken).* 2019;71(4):545-57. <https://doi.org/10.1002/acr.23618>
PMid:29885026
41. Aily JB, Barton CJ, Mattiello SM, De Oliveira Silva D, De Noronha M. Telerehabilitation for knee osteoarthritis in Brazil: A feasibility study. *Int J Telerehabil.* 2020;12(2):137-48. <https://doi.org/10.5195/ijt.2020.6323>
PMid:33520101
42. Nelligan RK, Hinman RS, Teo PL, Bennell KL. Exploring attitudes and experiences of people with knee osteoarthritis toward a self-directed ehealth intervention to support exercise: Qualitative study. *JMIR Rehabil Assist Technol.* 2020;7(2):e18860. <https://doi.org/10.2196/18860>
PMid:33242021
43. Aily JB, de Noronha M, Approbato Selistre LF, Ferrari RJ, White DK, Mattiello SM. Face-to-face and telerehabilitation delivery of circuit training have similar benefits and acceptability in patients with knee osteoarthritis: A randomised trial. *J Physiother.* 2023;69(4):232-9. <https://doi.org/10.1016/j.jphys.2023.08.014>
PMid:37684147
44. Tore NG, Oskay D, Haznedaroglu S. The quality of physiotherapy and rehabilitation program and the effect of telerehabilitation on patients with knee osteoarthritis. *Clin Rheumatol.* 2023;42(3):903-15. <https://doi.org/10.1007/s10067-022-06417-3>
PMid:36279075
45. Wechsler TF, Kumpers F, Mühlberger A. Inferiority or even superiority of virtual reality exposure therapy in phobias?-a systematic review and quantitative meta-analysis on randomized controlled trials specifically comparing the efficacy of virtual reality exposure to gold standard *in vivo* exposure in agoraphobia, specific phobia, and social phobia. *Front Psychol.* 2019;10:1758. <https://doi.org/10.3389/fpsyg.2019.01758>
PMid:31551840
46. Camerini AL, Marciano L, Carrara A, Schulz PJ. Cyberbullying perpetration and victimization among children and adolescents: A systematic review of longitudinal studies. *Telemat Inform.* 2020;49:101362. <https://doi.org/10.1016/j.tele.2020.101362>
47. Walton V, Hogden A, Long JC, Johnson JK, Greenfield D. How do interprofessional healthcare teams perceive the benefits and challenges of interdisciplinary ward rounds. *J Multidiscip Healthc.* 2019;12:1023-32. <https://doi.org/10.2147/JMDH.S226330>
PMid:31849478