International Journal of Public Health Science (IJPHS)
Vol. 15, No. 2, June 2026, pp. 330~336
ISSN: 2252-8806, DOI: 10.11591/ijphs.v15i2.26860

Effectiveness of telerehabilitation versus home exercise in knee osteoarthritis: a quasi-experimental study in Indonesia

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Article Info

Article history:

Received Sep 28, 2025
Revised Apr 26, 2026
Accepted May 22, 2026

Keywords:

eHealth
Exercise
Osteoarthritis
Pain
Rehabilitation

ABSTRACT

In Indonesia, osteoarthritis affects about 7.30% of the population, with its occurrence rising markedly as people age. The condition is found in 11.08% of individuals aged 45–54 years and increases to 18.85% among those older than 75 years. A large proportion of individuals with knee osteoarthritis (KOA) lead inactive lifestyles and often lack adequate encouragement to engage in physical activity. Exercise is known to be beneficial, as it helps regulate cytokine activity in synovial fluid while reducing inflammation and oxidative stress. This research aimed to evaluate the comparative effectiveness of telerehabilitation and home-based exercise interventions for individuals with KOA. A quasi-experimental approach with pre- and post-intervention assessments and a control group was applied. The study involved 120 participants diagnosed with osteoarthritis, who were assigned to either an intervention group receiving an 8-week telerehabilitation program or a control group performing standard exercises independently. Outcome measures: 30-CST, pain intensity, physical activity levels assessed using IPAQ, fear of movement measured by the Tampa Kinesiophobia Scale, and FSS. These variables were assessed before and after the intervention. Additionally, adherence to exercise (EARS) and patient satisfaction were recorded. Statistical analysis was conducted using the Mann-Whitney test and the Wilcoxon signed-rank test.

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1. INTRODUCTION

Knee osteoarthritis is a degenerative joint disorder that gradually worsens over time and is commonly associated with persistent pain and reduced physical function. Based on findings from the 2017 Global Burden of Disease report, this condition represents a significant global health concern. Among individuals aged over 60 years, symptomatic osteoarthritis affects approximately 9.6% of men and 18% of women. Around 80% of those with knee osteoarthritis experience mobility restrictions, while about one-quarter are unable to carry out essential daily tasks [1]. Globally, an estimated 250 million people live with osteoarthritis, with knee involvement being the most prevalent form. In the age group of 50 to 75 years, the prevalence of knee osteoarthritis ranges between 16% and 17% [2]. Furthermore, it is recognized as one of the primary contributors to disability among older adults, significantly impacting both independence and overall quality of life [3].

Pain in the joints is the main factor contributing to reduced function and disability in individuals with knee osteoarthritis (KOA) [4]. In addition to joint-related symptoms, patients often experience other conditions such as fatigue, anxiety, depression, fear of movement, decreased activity levels, and reduced muscle strength, all of which further worsen functional limitations [5], [6]. These combined effects ultimately lead to a decline in patients' overall well-being and life quality [7]. To slow disease progression and manage symptoms, lifestyle adjustments are widely recommended in clinical guidelines. These include engaging in regular physical activity, adopting self-management strategies, and improving knowledge about the condition [8].

Exercise has a crucial role in maintaining joint health, particularly by regulating cytokine activity in synovial fluid and reducing both inflammation and oxidative stress [2]. Over the past decade and a half, a growing body of research has demonstrated the effectiveness of exercise in managing KOA [9], [10]. Evidence from randomized controlled trials indicates that strengthening exercises and range-of-motion training can alleviate pain and enhance functional ability, even when adherence is not optimal [11], [12]. As a result, exercise is considered a key non-pharmacological approach and a central component of conservative treatment for this chronic condition [10].

Despite these benefits, sustaining lifestyle changes after hospital discharge remains difficult for many patients [13]. Limited supervision and lack of feedback from healthcare professionals often lead to reduced engagement in rehabilitation programs, thereby decreasing treatment effectiveness [14]. Moreover, access to healthcare services is often restricted in rural areas, where older populations tend to have poorer health-related quality of life [15]. Based on these challenges, this study was conducted to evaluate and compare the effectiveness of telerehabilitation and home-based exercise programs in individuals with knee osteoarthritis.

2. METHOD

This research adopted a quasi-experimental design utilizing both pre-intervention and post-intervention assessments with a control group for comparison. The study was conducted within the service area of the Tapanrejo Community Health Center in Banyuwangi Regency. A total of 120 individuals diagnosed with osteoarthritis were recruited based on specific eligibility criteria. Participants were required to voluntarily agree to join the study, live independently, ambulate without assistive devices, and possess and operate a smartphone, tablet, or computer with internet access. Exclusion criteria included the presence of other systemic rheumatic conditions, participation in physiotherapy or rehabilitation within the previous six months, a history of knee surgery, recent ligament or meniscal injuries, frequent falls (more than twice in six months), recent or planned knee injections, illiteracy, cognitive impairment, visual disturbances, or hearing difficulties.

Eligible participants were assigned to either an intervention group or a control group. The intervention group received telerehabilitation sessions conducted via video conferencing using the Zoom platform under the supervision of a physiotherapist. Meanwhile, individuals in the control group were provided with printed instructional materials outlining the exercises and their proper execution. Participants were also informed about accessing online sessions through Google Meet, and meeting links were shared via messaging. The telerehabilitation program consisted of 24 sessions, and additional education was delivered following evaluations through online meetings.

The exercise regimen included movements such as seated knee extension and flexion, hip flexion, chair sit-ups, isometric strengthening of the quadriceps and hip adductors, straight leg raises in a supine position, hip abduction and adduction in a side-lying position, squats with varying stance widths, and single-leg standing exercises. Stretching routines targeting the hamstrings and quadriceps were performed after completing the main exercises. Exercise intensity and repetitions were progressively increased each week. The intervention was carried out three times per week, with each session lasting 45–60 minutes over a period of eight weeks. In contrast, the control group performed the same exercises independently without supervision.

Several outcome measures were used in this study. The 30-second chair stand test (30-CST) was employed to assess lower limb strength and dynamic balance. Participants were seated on a standard chair (approximately 44 cm high) without armrests, with the chair stabilized against a wall. With arms crossed over the chest, participants were instructed to stand and sit repeatedly for 30 seconds, and performance was recorded [16]. Pain intensity was measured using the numeric rating scale (NRS), ranging from 0 (no pain) to 10 (worst imaginable pain) [17]. Physical activity levels were evaluated using the International Physical Activity Questionnaire (IPAQ), which consists of nine items [18]. Fear of movement was assessed with the 17-item Tampa Kinesiophobia Scale (TKS) [19]. Exercise adherence was measured using the 16-item exercise adherence rating scale (EARS) [20], while fatigue was assessed with the fatigue severity scale (FSS), which reflects fatigue experienced over the past month [21]. Patient satisfaction was evaluated using a 5-point Likert scale, ranging from "not satisfied at all" to "very satisfied" [22]. Data analysis was conducted using non-parametric statistical tests, specifically the Mann–Whitney test and the Wilcoxon Signed Rank test.

3. RESULTS AND DISCUSSION

A total of 120 respondents have completed participating in this study. The mean age of patients in the intervention group was 55.60 years, and 55.53 years in the control group. There were 31 (51.7%) women in the intervention group, and 35 (58.3%) women in the control group. There were no significant differences between the groups in terms of sex and age before treatment. Most of the patients in both groups were graduates of the first and working high schools. The average basic demographic and clinical characteristics are presented in Table 1. These variables were similar for patients in both groups.

Table 2 shows the analysis of the Mann-Whitney U test. The intervention group showed significant improvements in 30 CST, knee pain on NRS, FSS score, and IPAQ-SF score. The control group showed significant improvements in 30 CST and TKS scores. Mean change from baseline to 8 weeks showed that 30 CST ($p \leq 0.001$); knee pain in NRS ($p \leq 0.001$), FSS scores ($p \leq 0.001$), and IPAQ-SF scores ($p \leq 0.001$) showed a significant improvement in outcomes in the telerehabilitation group compared to the control group (Table 2). No serious adverse events were reported in either group.

The parameters evaluated only after the end of the intervention are shown in Table 3. After 8 weeks of treatment, it was determined that there was a statistically significant difference in the EARS variables in the intervention group compared to the control group. When the treatment satisfaction levels of the groups were compared, it was found that there were statistically significant differences in the intervention group compared to the control group.

Table 1. Respondent characteristics

Characteristics		Respondent	
		Intervention (n = 60)	Control (n = 60)
Age, year (mean)		55.60	55.53
Gender, No (%)	Female	31 (51.7%)	35 (58.3%)
	Male	29 (48.3%)	25 (41.7%)
	BMI, kg/m^2 (mean)	32.53	32.83
Education	Primary education	13 (21.7%)	16 (26.7%)
	Junior high school education	17 (28.3%)	16 (26.7%)
	Senior high school education	15 (25%)	12 (20%)
	Higher education	15 (25%)	16 (26.6%)
Employment status	Employed	35 (58.3%)	38 (63.3)
	Unemployed	25 (41.7)	22 (36.7)
	Duration of illness, years (mean)	5.73	5.52
	30 CST (mean)	14.05	14.33
	NRS (mean)	4.90	5.02
	Tampa Kinesiophobia (mean)	41.72	44.13
	FSS (mean)	5.27	4.63
IPAQ-SF, category	High	60 (100%)	40 (66.7)
	Low	0 (0%)	20 (33.3)

Table 2. Change in primary and secondary outcomes

Variabel	Intervention group		Control group		p-value
	Pre	Post	Pre	Post	
30 CST	14.05	16.20	14.33	15.43	<0.001
NRS	4.9	0.45	5.01	5.03	<0.001
Tampa Kinesiophobia	41.71	35.15	44.13	39.01	<0.001
FSS	5.26	3.00	4.63	3.55	<0.001
IPAQ-SF, MET-min/week	568.83	1225.15	646.91	726.85	<0.001

Table 3. Parameters evaluated after treatment only

Characteristics		Intervention group	Control group
Exercise compliance	Compliant	47 (78.3%)	39 (65%)
	Non-compliant	13 (21.7%)	21 (35%)
Satisfaction with the exercise program	Very satisfied	26 (43.3%)	-
	Satisied	34 (56.7%)	25 (41.7%)
	Neither satisfied nor dissatisfied	-	35 (58.3%
	Disatisied	-	-
	Not satisfied at all	-	-

A large proportion of individuals with knee osteoarthritis (KOA) continue to lead sedentary lifestyles and often lack sufficient encouragement or support to become more physically active. Since regular physical activity has been associated with reduced pain and enhanced functional capacity, there is a clear

need for accessible and effective physiotherapy interventions [23]. In response to this need, the present study aimed to evaluate the effectiveness of telerehabilitation in comparison with conventional home-based exercise. Specifically, it examined its impact on physical performance, pain levels, functional and emotional status, fear of movement, and physical activity, as well as exercise adherence and patient satisfaction. The findings demonstrated notable improvements across these variables in the group receiving telerehabilitation.

Previous research has indicated that KOA occurs more frequently in women than in men [24]. Consistent with this, female participants constituted the majority in both groups in this study. This gender distribution aligns with earlier studies [25]–[27]. Additionally, KOA is recognized as one of the leading causes of disability among individuals over the age of 50, significantly affecting independence and quality of life. The average age of participants in both groups in this study was also above 50 years, which is consistent with existing literature [28]–[30].

Excess body weight is widely acknowledged as a major risk factor for KOA. Increased body mass places excessive mechanical load on the knee joint, which may alter cartilage structure and contribute to its degeneration. In this study, participants in both groups had average BMI values indicating obesity. These findings are consistent with prior studies reporting BMI values above 30 in similar populations [29], [31], further supporting the relationship between obesity and KOA development.

Pain is one of the most prominent symptoms experienced by individuals with KOA [32]. In this study, pain intensity was measured using the NRS. Baseline pain levels were comparable between the two groups. Although both groups showed reductions in pain after the intervention, the decrease in the control group was not statistically significant. In contrast, the reduction observed in the telerehabilitation group was significantly greater. This outcome may be explained by the fact that participants in the intervention group performed their exercises under professional supervision via video sessions, ensuring correct technique and consistency. Meanwhile, participants in the control group relied solely on written instructions without monitoring or reminders, making it uncertain whether exercises were performed correctly or regularly. These findings are in line with previous studies reporting that telerehabilitation-based exercise programs effectively reduce pain in KOA patients [25], [27], [28], [30], [31], [33]–[35].

Functional ability is often compromised in individuals with KOA due to pain and other symptoms. In this study, physical performance was assessed using the 30-second chair stand test (30-CST). Both groups had similar baseline scores, and improvements were observed after the intervention. However, the improvement in the control group did not reach clinical significance, whereas the telerehabilitation group showed a significantly greater increase. This difference may again be attributed to supervised exercise sessions, which ensured proper execution and adherence. Progressive strengthening exercises are known to enhance muscle strength, which is reflected in improved 30-CST scores [36]. While some previous studies have reported mixed results regarding functional improvement with telerehabilitation, the findings of this study are consistent with those of Nero *et al*. [27] and Gohir *et al*. [31].

Kinesiophobia, or fear of movement, has been associated with increased pain, psychological distress, and disability [37]. It is also commonly observed in individuals with KOA. In this study, kinesiophobia was measured using TKS. Initial scores indicated severe levels of fear in both groups. After the intervention, both groups showed improvement; however, the reduction was significantly greater in the telerehabilitation group. This improvement may be linked to decreased pain and enhanced physical and emotional functioning. Notably, limited research has explored the effect of telerehabilitation on kinesiophobia in KOA, making this study a valuable contribution to the field.

Fatigue is another frequent complaint among individuals with osteoarthritis and is influenced by factors such as pain, reduced activity, and psychological conditions. In this study, fatigue was assessed using the FSS. Baseline fatigue levels were similar between groups. Following the intervention, a significant reduction in fatigue was observed only in the telerehabilitation group. This improvement may be attributed to better pain management and enhanced physical and functional capacity in this group. The findings are consistent with previous studies that have evaluated fatigue using similar measures [25], [30].

Levels of physical activity in individuals with KOA are often influenced by pain, fear of movement, and fatigue. In this study, physical activity was measured using the IPAQ-SF. While baseline levels were comparable, only the telerehabilitation group demonstrated a significant increase after the intervention. This improvement may be explained by reduced symptoms and increased motivation, supported by continuous interaction with a physiotherapist. The results align with long-term findings from previous studies [25], [38], although some studies have reported no significant changes in activity levels [26]. Differences in outcomes may be related to patient education and the level of professional guidance provided during the intervention.

Exercise adherence, assessed using the EARS, was significantly higher in the telerehabilitation group compared to the control group. This is expected, as supervised programs tend to improve compliance. Similar findings have been reported in previous studies using both EARS and other adherence measures [35], [39]. Patient satisfaction was also higher in the telerehabilitation group. All participants in this group reported being satisfied or very satisfied with their treatment, compared to a lower proportion in the control group.

This result is consistent with findings from Brooks *et al*. [40], although it differs from Bennell *et al*. [39], possibly due to differences in intervention duration, with the present study lasting 8 weeks compared to shorter durations in other research.

4. CONCLUSION

The results of this study indicate that telerehabilitation is more effective than self-directed management approaches. No adverse effects were observed in either group throughout the study period. The evidence suggests that telerehabilitation is a valuable and reliable intervention capable of alleviating symptoms in individuals with this condition. Consequently, these findings are expected to not only enrich existing scientific knowledge but also offer practical insights for healthcare professionals. Future research is recommended to further investigate the cost-effectiveness and overall impact of physiotherapist-guided telerehabilitation on healthcare systems.

ACKNOWLEDGMENTS

The researcher would like to thank all respondents who have participated in this study and the Ministry of Higher Education, Science and Technology.

FUNDING INFORMATION

The article was funded by the Ministry of Higher Education, Science and Technology.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
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Va : **Va**lidation
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I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

ETHICAL APPROVAL

Ethical clearance for this study was obtained from the Health Research Ethics Committee of STIKes Rustida (Approval No: 0001/EC/KEPK/IX/2025).

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [GA]. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.

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