

Synchronous Versus Asynchronous Telephysiotherapy for GLA:D Exercise in Primary Knee Osteoarthritis: A Pilot Study

Yohanes Deo Fau¹, Angria Pradita², Sartoyo³, Ahmad Abdilah Iqbal⁴, Ester Popy Bove⁵

¹⁻⁵Department of Physiotherapy, Faculty of Health Science, Institute of Science and Health Technology dr. Soepraoen Hospital, Malang, Indonesia

Corresponding author:

Name: Yohanes Deo Fau

E-mail: yohanes.deo@itsk-soepraoen.ac.id

Phone: +62 822 2906 1028

Received 20 August 2026; Revised 4 September 2026; Accepted 5 September 2026; Published 30 September 2026

©2026 The Authors. Published by the Physiotherapy Study Program, Faculty of Medicine, Udayana University, in collaboration with the Indonesian Physiotherapy Association (Ikatan Fisioterapi Indonesia). This is an open-access article distributed under the terms of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).

Abstract

Background: Knee osteoarthritis (OA) causes pain, stiffness, and functional limitations. GLA:D Exercise can be delivered through telephysiotherapy, but direct comparisons between synchronous and asynchronous delivery remain limited.

Objective: To compare changes in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores following GLA:D Exercise delivered through synchronous versus asynchronous telephysiotherapy in women with primary knee OA.

Methods: This pilot quasi-experimental pretest-posttest two-group study included 30 women, with 15 participants per group. Both groups received the same GLA:D Exercise program three times weekly for 8 weeks, with 30 minutes of planned exercise per session. The synchronous group received approximately 15 minutes of real-time physiotherapist supervision through Zoom, whereas the asynchronous group followed exercise videos through WhatsApp with family assistance. WOMAC was assessed before and after the intervention.

Results: WOMAC scores decreased from 45.20 ± 8.90 to 40.33 ± 9.39 in the asynchronous group ($p=0.001$) and from 39.27 ± 8.36 to 27.40 ± 8.14 in the synchronous group ($p<0.001$). Mean reductions were 4.87 ± 4.45 and 11.87 ± 6.65 points, respectively. The between-group difference in change was 7.00 points (95% CI, 2.77 to 11.24; $p=0.002$), with a large standardized effect (Hedges' $g=1.20$; approximate 95% CI, 0.44 to 1.97).

Conclusion: Both delivery modes were associated with lower WOMAC scores after 8 weeks, with a larger observed reduction in the synchronous group. Given the nonrandomized design and small sample, this difference should not be interpreted as evidence of causal superiority.

Keywords

Osteoarthritis, Knee; Exercise Therapy; Telemedicine; Patient Outcome Assessment

Introduction

Osteoarthritis (OA) is a chronic joint disorder and a major cause of pain, disability, and reduced physical function worldwide. The global burden of OA has continued to increase, with knee OA accounting for a substantial proportion of this burden and disproportionately affecting women.¹ The clinical consequences of primary knee OA extend beyond pain and stiffness, as persistent symptoms may restrict physical activity, impair daily functioning, and reduce health related quality of life.² These consequences emphasize the need for effective and accessible management strategies that can support symptom control and functional maintenance over time.

Current evidence-based recommendations identify nonpharmacological management as a core component of care for individuals with hip and knee OA.² Exercise, patient education, and self-management support are recommended to reduce symptoms and maintain or improve physical function.² Exercise should be appropriately dosed, individualized, and progressed according to functional capacity, patient preferences, and clinical needs. Home based exercise interventions have also demonstrated beneficial effects on pain, physical function, and quality of life in individuals with knee OA.³ Consequently, the way exercise is delivered may be clinically relevant, particularly for patients who experience barriers to conventional face to face rehabilitation.

Good Life with osteoArthritis in Denmark (GLA:D) is a structured OA management program that combines patient education with supervised neuromuscular exercise delivered by trained physiotherapists.⁴ The program aims to improve movement control and functional capacity while supporting patients in the self-management of OA.⁴ Longitudinal data from large international cohorts have demonstrated improvements in clinical outcomes following participation in GLA:D.⁴ Previous research has also examined online delivery of GLA:D and reported outcomes that were broadly comparable with conventional onsite care, although differences in baseline characteristics and the nonrandomized design require cautious interpretation.⁵ These findings support the feasibility of remote GLA:D delivery but do not establish whether different modes of telephysiotherapy provide equivalent outcomes when the underlying exercise program is the same.

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is a widely used patient reported outcome measure for assessing pain, stiffness, and physical function in individuals with hip or knee OA.⁶ Its multidimensional structure enables assessment of several clinically relevant consequences of OA within a single outcome measure. Changes in WOMAC scores have therefore been used to evaluate responses to nonsurgical interventions and exercise-based management.⁷ In the context of remotely delivered exercise, WOMAC provides a relevant measure for evaluating changes in overall OA related symptoms and functional limitations following intervention.

Access to conventional rehabilitation may be restricted by geographical distance, transportation requirements, mobility limitations, time constraints, and the availability of rehabilitation services.^{8,9} Telephysiotherapy provides an alternative approach in which assessment, education, exercise instruction, monitoring, and follow up can be delivered through digital communication technologies.^{8,9} Evidence from systematic reviews indicates that telerehabilitation and remotely delivered physiotherapy can be

feasible and acceptable and may provide beneficial clinical outcomes in selected patient populations.^{8,9} Home based and digitally supported exercise interventions have similarly demonstrated potential benefits for people with knee OA. However, telephysiotherapy is not a uniform intervention because the amount, timing, and nature of interaction between patients and physiotherapists may differ substantially between delivery models.

Telephysiotherapy can generally be delivered through synchronous or asynchronous approaches. Synchronous delivery involves real time interaction between the patient and physiotherapist, allowing exercise instruction, observation, correction, and feedback during performance. In contrast, asynchronous delivery enables patients to access previously prepared exercise materials and perform the exercises independently at a convenient time, without continuous real time supervision. These approaches therefore differ in the level and timing of professional contact, opportunities for immediate feedback, and degree of supervision during exercise. Such differences may influence exercise execution, motivation, accountability, and adherence, although they should not be interpreted as evidence that one delivery approach is inherently superior.

Adherence is an important consideration in exercise-based rehabilitation because sustained participation may influence the effectiveness of physiotherapy interventions.¹⁰ Previous evidence has identified several factors associated with long term adherence to physiotherapy exercise among individuals with lower limb OA. Digital exercise delivery may help reduce logistical barriers to participation, but its effectiveness may also depend on the clarity of instructional materials, patient understanding, ability to perform exercises independently, technological access, and available support.¹¹ In synchronous delivery, direct interaction with a physiotherapist may provide additional opportunities for immediate correction and reinforcement, whereas asynchronous delivery may offer greater flexibility and autonomy. Whether these differences in delivery characteristics translate into different patient reported outcomes remains uncertain.

Previous studies have investigated the effectiveness of exercise for knee OA, remote delivery of physiotherapy, and online implementation of GLA:D compared with conventional onsite care. However, direct evidence comparing synchronous and asynchronous telephysiotherapy for delivery of the same GLA:D Exercise program remains limited. This gap is clinically relevant because both approaches may increase access to structured rehabilitation while providing different levels of professional supervision and scheduling flexibility. A direct comparison may therefore help clarify whether the mode of remote delivery is associated with different changes in patient reported outcomes. Accordingly, this pilot study aimed to compare changes in WOMAC scores following the same GLA:D Exercise program delivered through synchronous versus asynchronous telephysiotherapy among women with primary knee OA.

Methods

This pilot quasi-experimental study used a pretest-posttest two-group design to compare changes in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores following the same GLA:D Exercise program delivered through asynchronous and synchronous telephysiotherapy. The study was conducted remotely from March to May 2026. The independent variable was the mode of telephysiotherapy delivery, namely asynchronous or synchronous, and the primary outcome was the total WOMAC score, which assesses pain, stiffness, and physical function. The study was designed as a pilot study and was not preceded by an *a priori* sample size calculation. The final sample consisted of 30 participants, with 15 participants allocated to each intervention group.

A total of 38 potential participants were recruited through physiotherapy service facilities collaborating with the research team. Participants were selected using purposive sampling. Eligibility criteria were age 45 to 75 years, clinically and/or radiographically diagnosed primary knee osteoarthritis (OA), knee pain for at least 3 months, ability to participate in an online GLA:D Exercise program, and provision of written informed consent. Participants were excluded if they had secondary knee OA associated with trauma or systemic disease, had undergone knee surgery within the previous 6 months, had neurological or cognitive impairment that could interfere with exercise participation, or were concurrently participating in another knee exercise program. Eight participants were excluded before study participation: two were hospitalized because of hypertension, two decided to undergo total knee replacement, two had hearing problems, one had no family member available to provide assistance at home, and one had concentration difficulties. No participant withdrew or was lost to follow-up after entering the study.

The 30 eligible participants were allocated to asynchronous and synchronous groups by the researcher. The authors described the allocation procedure as single blind, and participants did not meet each other during the research process. However, because the researcher determined group allocation and no independent allocation procedure or allocation concealment was documented, the possibility of selection bias cannot be excluded. Participants underwent baseline WOMAC assessment before commencing the intervention. The asynchronous group received GLA:D Exercise videos through a WhatsApp group and performed the exercises independently with assistance from a family member who had previously been instructed to supervise the exercises. The synchronous group performed the same exercise program through real-time Zoom sessions under physiotherapist supervision.

Both groups received the same exercise content, exercise dose, instructional videos, and initial educational information. The exercise program consisted of step-up exercise (3 sets of 10 repetitions), seated leg extension using a resistance band at the lightest resistance (3 sets of 10 repetitions), sit-to-stand exercise (3 sets of 10 repetitions), and heel slides performed posteriorly and laterally (2 sets of 10 repetitions for each direction). The exercises were planned three times per week for 8 weeks, resulting in 24 planned sessions. During the initial consultation, participants received education regarding knee OA, OA risk factors, and the importance of exercise for OA management. Participants subsequently received the exercise video as a guide throughout the intervention period. No systematic dose progression was implemented during the study. When necessary, exercise performance was adjusted according to the participant's ability and tolerance.

The planned exercise duration was 30 minutes per session in both groups. However, the documented real-time synchronous interaction through Zoom lasted approximately 15 minutes per session. This period was used for direct supervision while participants performed the exercises, including instruction, observation, movement correction, and immediate feedback from the physiotherapist. Thus, the 30-minute duration represented the planned exercise duration, whereas approximately 15 minutes represented the documented synchronous physiotherapist interaction. The asynchronous group performed the exercises using the same prepared videos, with family assistance for supervision. The exercise videos and instructions were not formally standardized beyond the materials prepared by the researcher. Intervention fidelity was monitored directly by the physiotherapist in the synchronous group, whereas performance in the asynchronous group was documented by the participant's companion or family member and reported for each session. Detailed therapist qualifications, previous experience, and formal fidelity procedures were not documented.

Adherence was monitored throughout the intervention. Each participant's exercise sessions were recorded. One participant in the synchronous group missed one Zoom session because of an unstable internet connection, while one participant in the

asynchronous group missed one video exercise session because the family member who provided assistance was unavailable at the scheduled time. Neither event resulted in withdrawal from the study, and both participants continued the intervention during subsequent sessions. Accordingly, 23 of 24 planned sessions were completed in the synchronous group and 23 of 24 in the asynchronous group, corresponding to an overall session completion proportion of 95.8% in each group. No participant discontinued the study.

The primary outcome was the total WOMAC score, ranging from 0 to 96, with lower scores indicating better clinical status.⁶ WOMAC was assessed immediately before the intervention and after completion of the 8-week program. The Indonesian version of WOMAC used in the study has been reported to demonstrate validity coefficients ranging from 0.809 to 0.964 and excellent internal consistency, with a Cronbach's alpha of 0.992.⁶ WOMAC data were collected using a hardcopy questionnaire administered by an interviewer. The researcher was responsible for data collection and confirmed the responses with the participant and accompanying family member. The same approach was used for preintervention and postintervention assessments. All 30 participants had complete preintervention and postintervention WOMAC data, and no outcome data required imputation.

Baseline characteristics were summarized using mean and standard deviation for continuous variables and frequency and percentage for categorical variables. Baseline variables included age, height, weight, body mass index (BMI), Kellgren–Lawrence radiographic grade, and baseline WOMAC score. Recorded clinical and practical characteristics also included hypertension, cardiovascular disease, obesity based on the study's BMI classification, and inability to use a digital device independently. The study documented 27 participants with hypertension, 16 classified as obese according to the study criterion of BMI >27 kg/m², 11 with cardiovascular disease, and 5 who were unable to use a gadget independently. These variables were considered relevant contextual characteristics when interpreting between-group differences.

Statistical analyses were performed using IBM SPSS Statistics version 26. The distribution of continuous variables was assessed using the Shapiro–Wilk test because each group contained fewer than 50 participants, with the Kolmogorov–Smirnov test with Lilliefors correction also available as a comparative assessment. Homogeneity of variance between groups was assessed using Levene's test. The statistical output reported that the relevant variance assumptions were satisfied for the variables assessed by Levene's test, with $p > 0.05$. Categorical baseline variables were initially examined using Pearson's chi-square test. Because several contingency tables contained sparse expected frequencies, Fisher's exact test was used for 2×2 comparisons and the Freeman–Halton extension of Fisher's exact test was used for 3×2 comparisons.

Within-group changes in WOMAC scores were assessed using paired-samples t-tests. Postintervention WOMAC scores between groups were compared using the Mann–Whitney test, consistent with the original analysis. Between-group differences in change scores were assessed using an independent-samples t-test, with change calculated as baseline WOMAC minus postintervention WOMAC, such that positive values represented improvement. The between-group mean difference was reported with a 95% confidence interval, and Hedges' g was calculated to quantify the standardized magnitude of the between-group difference in change scores. A baseline-adjusted analysis was additionally performed using analysis of covariance (ANCOVA), with postintervention WOMAC score as the dependent variable, intervention group as the factor, and baseline WOMAC score as the covariate. Baseline WOMAC was selected for adjustment because the groups differed numerically at baseline and baseline WOMAC was strongly correlated with postintervention WOMAC ($r = 0.79$, $p < 0.001$). All statistical tests were two-sided, with $p < 0.05$ considered statistically significant.

The study received ethical approval from the Health Research Ethics Committee of ITSK dr Soepraoen Malang under approval number KEPK-EC/676/II/2026. Ethical approval was issued on February 13, 2026, and was valid from February 13, 2026, to February 12, 2027. The approval therefore preceded the reported recruitment and data collection period beginning in March 2026. All participants provided written informed consent before participation.

Results

A total of 38 participants were initially recruited and screened for eligibility. Eight participants were excluded before entering the study: two were hospitalized because of hypertension, two decided to undergo total knee replacement, two had hearing problems, one had no family member available to provide assistance at home, and one had concentration difficulties. Thirty eligible participants subsequently entered the study, with 15 allocated to the asynchronous group and 15 to the synchronous group. No participant withdrew or was lost to follow up after group allocation. All 30 participants completed the preintervention and postintervention WOMAC assessments and were included in the final analysis. The participant trajectory from recruitment through final analysis is presented in Figure 1.

The baseline characteristics of the participants are presented in Table 1. The mean age was 65.20 ± 4.13 years in the asynchronous group and 66.40 ± 3.85 years in the synchronous group. Most participants in both groups were aged 60 to 69 years. Mean body mass index (BMI) was 25.48 ± 2.97 kg/m² in the asynchronous group and 26.59 ± 2.69 kg/m² in the synchronous group. According to the BMI classification used in the study, obesity was the most frequent category in both groups. The distribution of Kellgren–Lawrence grades was identical between groups, with 10 participants classified as grade II and five as grade III in each group.

Baseline WOMAC scores were higher in the asynchronous group than in the synchronous group, with mean scores of 45.20 ± 8.90 and 39.27 ± 8.36 , respectively. The between group difference was not statistically significant ($p = 0.070$). Nevertheless, the numerical difference was retained as an important baseline characteristic because of the nonrandomized allocation. Additional documented characteristics included hypertension in 27 participants (90.0%), obesity according to the study criterion of BMI >27 kg/m² in 16 participants (53.3%), cardiovascular disease in 11 participants (36.7%), and inability to use a digital device independently in five participants (16.7%). These characteristics were recorded as relevant participant factors but were not included as additional covariates in the reported adjusted analysis.

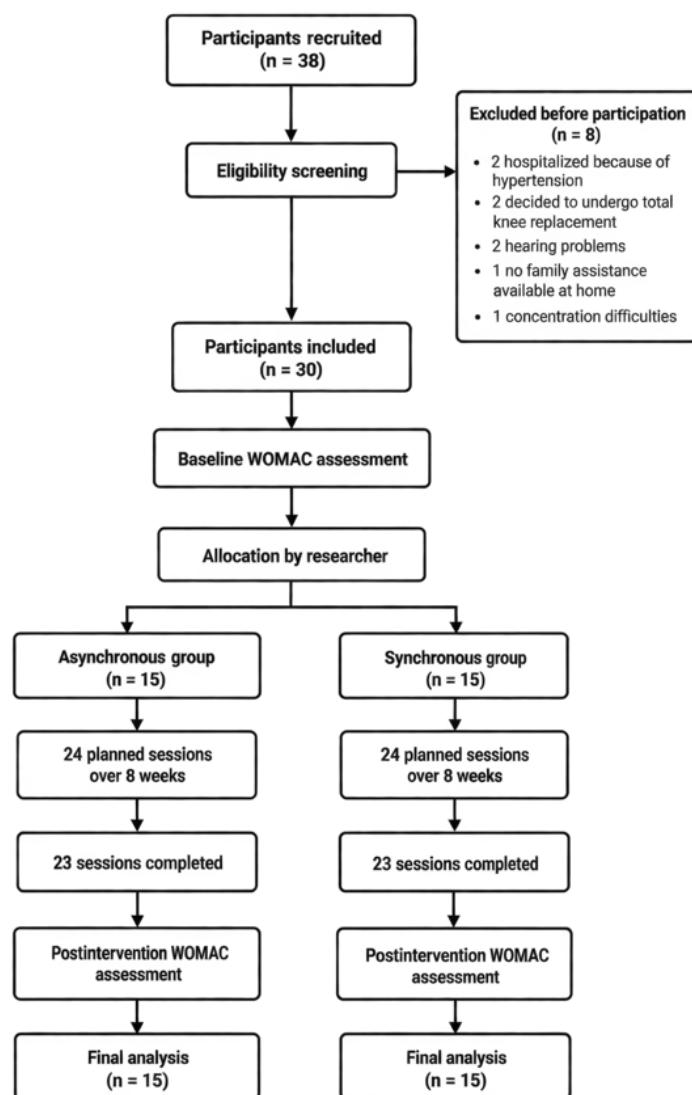


Figure 1. Participant flow through the study

Table 1. Baseline characteristics of participants

Characteristic	Asynchronous (n=15)	Synchronous (n=15)	p value
Age, years	65.20 ± 4.13	66.40 ± 3.85	0.417
<60 years	0 (0.0)	1 (6.7)	0.505*
60 to 69 years	13 (86.7)	11 (73.3)	
≥70 years	2 (13.3)	3 (20.0)	
Height, cm	157.27 ± 5.80	158.93 ± 5.31	0.419
Weight, kg	62.87 ± 6.65	66.93 ± 4.79	0.065
BMI, kg/m ²	25.48 ± 2.97	26.59 ± 2.69	0.294
Normal	3 (20.0)	0 (0.0)	0.097*
Overweight	3 (20.0)	7 (46.7)	
Obesity	9 (60.0)	8 (53.3)	
Kellgren–Lawrence grade II	10 (66.7)	10 (66.7)	1.000*
Kellgren–Lawrence grade III	5 (33.3)	5 (33.3)	
Baseline WOMAC score	45.20 ± 8.90	39.27 ± 8.36	0.070

Values are presented as mean ± standard deviation or n (%). BMI, body mass index; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index. Continuous variables were analyzed using the independent samples t test. Categorical comparisons were evaluated using Fisher's exact test or the Freeman–Halton extension of Fisher's exact test, as appropriate for the table structure and expected frequencies.

Following the 8-week intervention, WOMAC scores decreased in both groups. In the asynchronous group, the mean WOMAC score decreased from 45.20 ± 8.90 at baseline to 40.33 ± 9.39 after intervention, representing a mean reduction of 4.87 ± 4.45 points (p=0.001). In the synchronous group, the mean score decreased from 39.27 ± 8.36 to 27.40 ± 8.14, representing a mean reduction of 11.87 ± 6.65 points (p<0.001). Thus, the numerical reduction was greater in the synchronous group.

The between group comparison of change scores demonstrated a mean difference of −7.00 points, with a 95% confidence interval of −11.24 to −2.77 (p=0.002), favoring the synchronous group. The standardized between group effect was large (Hedges' g=1.20), with an approximate 95% confidence interval of 0.44 to 1.97. Postintervention WOMAC scores were also significantly different between groups according to the Mann Whitney test (p=0.001). The separate statistical comparisons are summarized in Table 2 to distinguish baseline, postintervention, within group, and between group analyses.

Table 2. Changes in WOMAC scores before and after the intervention

Outcome	Asynchronous (n=15)	Synchronous (n=15)	Between group value	p	Statistical comparison
Baseline WOMAC	45.20 ± 8.90	39.27 ± 8.36	0.070		Independent samples t test
Postintervention WOMAC	40.33 ± 9.39	27.40 ± 8.14	0.001		Mann Whitney test
Mean change in WOMAC	4.87 ± 4.45	11.87 ± 6.65	0.002		Independent samples t test
95% CI for between group difference in change		-11.24 to -2.77			
Hedges' g		1.20†			
Within group p value	0.001	<0.001			Paired samples t test

Values are presented as mean ± standard deviation. WOMAC change was calculated as baseline score minus postintervention score; therefore, a positive value indicates a reduction in WOMAC score. CI, confidence interval. †Hedges' g was calculated from the reported group mean changes and pooled standard deviation; the approximate 95% confidence interval was 0.44 to 1.97.

Adherence was high in both groups. Each participant was scheduled to complete 24 sessions over 8 weeks. One participant in the asynchronous group missed one session because the family member who provided assistance was unavailable, while one participant in the synchronous group missed one Zoom session because of unstable internet connectivity. Both participants continued the intervention during subsequent sessions. Therefore, 23 of 24 planned sessions were completed in each group, corresponding to a session completion proportion of 95.8% per group. No participant discontinued the study.

The baseline WOMAC score was strongly correlated with the postintervention WOMAC score ($r=0.79$, $p<0.001$). Because of the numerical baseline difference between groups and this strong baseline to postintervention correlation, an additional analysis of covariance (ANCOVA) was performed using postintervention WOMAC as the dependent variable, intervention group as the factor, and baseline WOMAC as the covariate. However, the available study documentation does not provide the numerical ANCOVA output, including the adjusted group estimates, F statistic, p value, or confidence interval. Therefore, these results should be inserted from the original statistical output before submission and should not be inferred from the unadjusted analyses.

Overall, both groups demonstrated lower WOMAC scores after the intervention, with a larger observed reduction in the synchronous group. The unadjusted between group difference was statistically significant and associated with a large standardized effect. However, these findings represent an observed group difference and should be interpreted in the context of the nonrandomized allocation, baseline WOMAC imbalance, small sample size, and the need to report the complete ANCOVA output.

Discussion

This pilot study compared changes in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores following the same GLA:D Exercise program delivered through asynchronous and synchronous telephysiotherapy in women with primary knee osteoarthritis (OA). Both groups demonstrated statistically significant reductions in WOMAC scores after 8 weeks, indicating improvement in the combined domains assessed by the instrument. The synchronous group showed a greater mean reduction than the asynchronous group, with a statistically significant between group difference in change scores and a large standardized effect. However, because participants were allocated by the researcher in a nonrandomized design, these findings should be interpreted as an observed difference between delivery approaches rather than evidence that synchronous telephysiotherapy caused greater improvement. The small sample and baseline difference in WOMAC scores further limit the strength of causal interpretation.

The improvement observed in both groups is consistent with the established role of exercise as a core component of nonpharmacological management for knee OA.² Current recommendations emphasize individualized exercise with appropriate dosage and progression according to patient needs, functional capacity, and preferences. Evidence from home-based exercise interventions also supports beneficial effects on pain, physical function, and quality of life in individuals with knee OA.³ The present findings therefore support the feasibility of delivering a structured exercise program remotely through either asynchronous or synchronous telephysiotherapy. Nevertheless, the study does not establish whether the observed improvement resulted solely from the exercise intervention because there was no nonexercise control group.

The reduction in WOMAC observed in the asynchronous group indicates that digitally delivered exercise materials can be accompanied by improvement even without continuous real time physiotherapist supervision. This approach may offer practical advantages by allowing participants to perform exercises at a convenient time and potentially reducing barriers related to travel, scheduling, and geographical access. Telephysiotherapy has been described as a feasible approach for providing physiotherapy remotely, and evidence supports its potential usefulness across different clinical settings.^{8,9} However, asynchronous delivery requires participants to interpret instructions and perform exercises with less immediate professional feedback. Its effectiveness may therefore depend on the quality and clarity of instructional materials, participant understanding, ability to exercise independently, family support, and adherence. In the present study, asynchronous participants were supported by family members who had previously received instructions for exercise supervision, which may have contributed to the feasibility of this approach.

The larger reduction in WOMAC in the synchronous group may plausibly be related to the greater opportunity for direct interaction between participants and the physiotherapist. Real time supervision permits immediate instruction, observation of movement, correction of exercise technique, and feedback during exercise performance. These characteristics may be particularly relevant for an exercise program involving neuromuscular and functional movements. However, the present study did not directly measure exercise quality, frequency or content of therapist feedback, participant motivation, treatment fidelity, or other potential mediators. Therefore, these mechanisms remain plausible explanations rather than demonstrated causes of the between group difference. The study also cannot determine whether the additional real time contact itself, rather than differences in adherence or other participant characteristics, accounted for the larger observed reduction.

The findings are broadly consistent with previous research examining remote delivery of GLA:D and other digitally supported exercise interventions.^{4,12} GLA:D was developed as a structured program combining education with supervised neuromuscular exercise and has demonstrated improvements in clinical outcomes across large international cohorts. Previous research comparing online and onsite GLA:D delivery has suggested that remotely supervised delivery can achieve outcomes comparable with conventional care, although the nonrandomized design and baseline differences require cautious interpretation. Evidence from telehealth supported exercise interventions in knee OA similarly suggests potential improvements in pain and physical function,

although intervention characteristics and effects vary substantially between studies. The present study extends this literature by comparing two different modes of remote delivery of the same exercise program rather than comparing telehealth with onsite treatment.

The observed between group difference in WOMAC change was 7.00 points, with a 95% confidence interval indicating that the unadjusted difference excluded zero. The corresponding Hedges' g of 1.20 indicates a large standardized difference, although the approximate confidence interval was relatively wide. These findings indicate a potentially meaningful difference in outcome magnitude, but statistical significance and standardized effect size should not be equated with clinical importance.⁷ The study did not prespecify or collect a minimally important difference or other clinical importance threshold for total WOMAC. Consequently, the available results do not permit a definitive conclusion that the 7-point difference represents a clinically important advantage of synchronous delivery.⁷ A validated threshold appropriate to the population, WOMAC version, and intervention context should be considered in future studies.

The baseline WOMAC scores also require careful consideration. The asynchronous group had a higher baseline mean score than the synchronous group, although the difference was not statistically significant. In a small nonrandomized study, however, statistical nonsignificance does not establish baseline equivalence. The baseline WOMAC score was strongly correlated with the postintervention score, supporting the use of baseline adjustment when comparing postintervention outcomes. An ANCOVA was therefore performed with postintervention WOMAC as the dependent variable, treatment group as the factor, and baseline WOMAC as the covariate. The complete adjusted statistical output should be reported alongside the unadjusted analysis to determine whether the observed group difference remains after accounting for baseline WOMAC. Because the numerical ANCOVA results are not available in the present documentation, no conclusion regarding the adjusted effect can be made at this stage.

Several methodological limitations should be considered. First, the study used purposive sampling and nonrandomized allocation, with the researcher determining group assignment. This introduces a potential risk of selection bias and residual confounding. Second, the sample was small, with only 15 participants per group, limiting precision and generalizability. Third, the intervention materials and instructions were not formally standardized, and no systematic progression of exercise dose was implemented. Fourth, although adherence was high based on recorded session completion, one session was missed in each group, and the study did not quantify other aspects of exercise exposure or engagement. Fifth, the synchronous group received approximately 15 minutes of documented real time physiotherapist interaction within the planned 30-minute exercise session, making the effective professional contact time different from the total planned exercise duration. These characteristics should be considered when interpreting the difference between delivery modes.

The study population also limits generalizability because all participants were women aged 45 to 75 years with primary knee OA. In addition, the study documented substantial comorbidity and practical factors, including hypertension, cardiovascular disease, obesity, and inability to use digital devices independently. These characteristics may influence exercise participation and the feasibility of telephysiotherapy, but the small sample did not allow their independent effects to be reliably evaluated. Future studies should prospectively collect and incorporate clinically relevant confounders, use transparent allocation procedures, and recruit sufficiently large samples to permit appropriately adjusted analyses. Longer follow up would also be useful to determine whether improvements are maintained after the intervention period.

Despite these limitations, the study provides preliminary evidence that both synchronous and asynchronous telephysiotherapy can be used to deliver GLA:D Exercise to women with primary knee OA. The greater observed reduction in WOMAC in the synchronous group indicates a potential benefit associated with real time professional interaction, but this finding remains exploratory. Future adequately powered randomized studies should directly compare delivery modes using standardized intervention protocols, concealed or independent allocation procedures, adherence monitoring, intervention fidelity assessment, baseline adjusted analyses, and predefined measures of clinical importance. Such studies would help determine whether differences in outcomes are attributable to delivery mode itself or to supervision, adherence, participant characteristics, or other treatment related factors.

Conclusion

Both asynchronous and synchronous telephysiotherapy delivery of GLA:D Exercise was associated with reduced WOMAC scores after 8 weeks in women with primary knee osteoarthritis. The synchronous group demonstrated a greater mean reduction in WOMAC scores than the asynchronous group, with a statistically significant unadjusted between group difference and a large standardized effect.

These findings indicate that both delivery approaches may be feasible options for providing structured exercise remotely, particularly when access to conventional face to face rehabilitation is limited. The larger observed reduction in the synchronous group suggests that real time physiotherapist interaction may have potential value in supporting exercise delivery through direct instruction, observation, correction, and feedback. However, this interpretation should remain cautious because the study was nonrandomized, used a small pilot sample, and involved researcher determined group allocation.

The observed difference should therefore not be interpreted as definitive evidence that synchronous telephysiotherapy is superior to asynchronous delivery. Baseline differences in WOMAC scores and other potential confounding factors may have influenced the results. Further adequately powered randomized studies are needed to compare these delivery approaches using standardized intervention protocols, transparent allocation procedures, baseline adjusted analyses, adherence and intervention fidelity monitoring, predefined measures of clinical importance, and longer follow up.

Author Contribution

Yohanes Deo Fau: Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation, Writing Original Draft, Writing Review and Editing, Visualization, Supervision, Project Administration.

Angria Pradita: Methodology, Investigation, Data Curation, Writing Review and Editing, Supervision.

Sartoyo: Methodology, Investigation, Supervision, Writing Review and Editing.

Ahmad Abdilah Iqbal: Investigation, Data Curation, Writing Original Draft, Visualization.

Ester Popy Bove: Investigation, Data Curation, Writing Original Draft, Writing Review and Editing.

Acknowledgments

The authors would like to express their sincere gratitude to the participants who took part in this study and to the physiotherapy service facilities that supported the recruitment and implementation of the research. The authors also acknowledge the family members who assisted participants during the asynchronous exercise sessions. Their cooperation and support contributed to the successful completion of this study.

Conflict of Interest Statement

The authors declare no conflict of interest.

Funding Sources

This research received no external funding.

Ethics Statement

This study received ethical approval from the Health Research Ethics Committee of Institut Teknologi Sains dan Kesehatan dr. Soepraoen Malang under approval number KEPK-EC/676/II/2026. Ethical approval was issued on February 13, 2026, and was valid from February 13, 2026, to February 12, 2027. Ethical approval was obtained before participant recruitment and data collection. All participants provided informed consent before participation.

References

1. Safiri S, Kolahi AA, Smith E, Hill C, Bettampadi D, Mansournia MA, et al. Global, regional and national burden of osteoarthritis 1990-2017: a systematic analysis of the Global Burden of Disease Study 2017. *Ann Rheum Dis*. 2020;79(6):819-828.
2. Moseng T, Vliet Vlieland TPM, Battista S, Beckwée D, Boyadzhieva V, Conaghan PG, et al. EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis: 2023 update. *Ann Rheum Dis*. 2024;83(6):730-740.
3. Si J, Sun L, Li Z, Zhu W, Yin W, Peng L. Effectiveness of home-based exercise interventions on pain, physical function and quality of life in individuals with knee osteoarthritis: a systematic review and meta-analysis. *J Orthop Surg Res*. 2023;18(1):503.
4. Roos EM, Grønne DT, Skou ST, Zywił MG, McGlasson R, Barton CJ, et al. Immediate outcomes following the GLA:D program in Denmark, Canada and Australia: a longitudinal analysis including 28,370 patients with symptomatic knee or hip osteoarthritis. *Osteoarthritis Cartilage*. 2021;29(4):502-506.
5. Holm PM, Roos EM, Grønne DT, Skou ST. Online and onsite supervised exercise therapy and education for individuals with knee osteoarthritis: a before and after comparison of two different care delivery models. *Musculoskelet Care*. 2023;21(3):878-889.
6. Hartana PMY, Saraswati NLPKG, Utama AAGES, Kamayoga IDGA. Validation of the Indonesian version of Western Ontario and McMaster Universities osteoarthritis index in pre-elderly and elderly with osteoarthritis. *Phys Ther J Indones*. 2024;5(2):164-170.
7. Silva MDC, Perriman DM, Fearon AM, Couldrick JM, Scarvell JM. Minimal important change and difference for knee osteoarthritis outcome measurement tools after non-surgical interventions: a systematic review. *BMJ Open*. 2023;13(5):e063026.
8. Hawley-Hague H, Lasrado R, Martinez E, Stanmore E, Tyson S. A scoping review of the feasibility, acceptability, and effects of physiotherapy delivered remotely. *Disabil Rehabil*. 2023;45(23):3961-3977.
9. Seron P, Oliveros MJ, Gutierrez-Arias R, Fuentes-Aspe R, Torres-Castro RC, Merino-Osorio C, et al. Effectiveness of telerehabilitation in physical therapy: a rapid overview. *Phys Ther*. 2021;101(6):pzab053.
10. Cinthuja P, Krishnamoorthy N, Shivapatham G. Effective interventions to improve long-term physiotherapy exercise adherence among patients with lower limb osteoarthritis: a systematic review. *BMC Musculoskelet Disord*. 2022;23(1):147.
11. Ezzat AM, Kemp JL, Heerey JJ, Pazzinatto MF, De Oliveira Silva D, Dundules K, et al. Implementation of the Good Life with osteoArthritis in Denmark (GLA:D) program via telehealth in Australia: a mixed-methods program evaluation. *J Telemed Telecare*. 2025;31(1):104-120.
12. Pasqualotto E, Ferreira ROM, Migliardi LS, Silva PHF, Pasqualotto T, Campos JC, et al. The efficacy of home-based remote rehabilitation versus usual rehabilitation for patients with knee osteoarthritis: a systematic review and meta-analysis. *J Orthop Sci*. 2025;30(6):1073-1080.