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The effectiveness of home-based exercise with and without tracking for people with knee osteoarthritis: a systematic review

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KEYWORDS
Osteoarthritis; Home-based exercise; Tracking; Pain; Function.

ABSTRACT

Knee osteoarthritis (KOA) is the most common inflammatory arthritis, involving inflammation and significant structural changes in the knee joint and causing pain and disability at work. Exercise and education are often recommended for KOA patients. However, it is often not reasonable to adhere to home exercise programs in elderly. Using digital communication can be inexpensive and accessible to help promote adherence and the effects of exercise. This systematic review was to find the evidence of randomized controlled trials (RCTs) on the effectiveness of home-based exercise with tracking and home-based exercise alone for patients with KOA. We searched Cochrane, MEDLINE, PubMed, and PEDro. We selected randomized controlled trials published in the English language, which were undertaken to identify interventions that used home exercise with or without tracking for KOA. Two reviewers independently extracted data. The risk of bias in the included studies was evaluated using the Cochrane 'Risk of Bias Tool 2.0'. As a result, a total of 1868 studies were found in the search. Of these, eight studies met the inclusion criteria and were further analyzed. All studies have a low risk of bias. In these studies, home exercise programs with tracking provide significant improvements in pain and function and more adherence and changes in behavior in elderly with KOA. In conclusion, home-based exercise with tracking in people with KOA is essential for increasing adherence and improving pain and physical function compared to the untracked group.

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Introduction

Knee osteoarthritis (KOA) is the most common arthritis, involving inflammation and significant structural changes of the knee joint, causing knee pain[1], muscle weakness[2,3], and decreased knee mobility[4], resulting in decreased body function and quality of life[1,5-7]. KOA prevalence is approximately 16.7% in people aged 45 and older[8]. The incidence of the disease increases rapidly from age 50 and older[9,10], and the prevalence increases with age[8,9]. Previous studies indicated that exercises and education are often recommended for patients with KOA[11-13]. Home exercise is often recommended for people with osteoarthritis[14,15]. The home exercise aims to enhance muscle strength, balance, increase range of motion and endurance[16]. The effects of home exercise are reducing pain and improving function in adults with KOA[17]. A systematic review found that adherence to long-term home exercise program resulted in better performance outcomes[18]. The effectiveness of a home exercise program for elderly with KOA depends on the patient's ability to follow the program[19].

Consequently, consistent home-based exercise program compliance may improve functioning and reduce pain and disability[20,21]. However, adherence to home-based exercise program in the elderly is often poor[22]. This unsuccessful home-based exercise program is often caused by poor adherence and lack of motivation to exercise[23,24]. However, ongoing clinician involvement may be unfeasible or impractical for many patients due to access to service and costs such as distance, travel time, and travel costs[25]. Previous studies have found that patient follow-up during treatment increases motivational strategies and improves adherence to their exercise program[26]. Instead, digital communications may be inexpensive and accessible options to help promote exercise adherence[27].

Therefore, we performed a systematic review of randomized controlled trials (RCTs) on the effectiveness of home-based exercise with tracking and home-based exercise alone for people with KOA.

Materials and methods

Search strategy

The following electronic databases were searched from the earliest date available until April 30, 2021: Cochrane, MEDLINE, PubMed, and PEDro. We used a search strategy that combined medical subject heading (MeSH) and free keywords and connected them with Boolean conjunctions (OR/AND). The keyword terms "home-based exercise," "home exercise," "self-exercise," "exercise," and "knee osteoarthritis" were used. The limitations placed on the search included the following: English, Human Studies, and Randomized Control Trials.

Inclusion and exclusion criteria

Limits were by design as we included only randomized clinical trials (RCTs), published in the English language prior to September 1, 2014. The intervention of interest was a home-based exercise program for KOA with tracking. Trials were required to compare home exercise programs with tracking and home-based exercise without tracking. Studies that did not include home exercise programs in their interventions were excluded. The outcome measures of interest were pain, physical function, and quality of life in patients with KOA. Randomized clinical trials were excluded if the publication was in the abstract form only.

Data extraction

Two reviewers independently extracted data from authors, publication year, some participants, age, study design, diagnosis, control intervention, outcomes, included/excluded. Consensus on extracted data was reached by discussion; furthermore, conflictive data were discussed with a third member of the study team.

Assessment of methodological quality

Two reviewers independently assessed the risk of bias of the included studies using the Cochrane 'Risk of Bias Tool 2.0'[28]. Within each domain, the two reviewers answered one or more signaling questions which led to judgments of "low risk of bias," "some concerns," or "high risk of bias." The judgments within each domain lead to an overall risk-of-bias judgment for the outcome being assessed.

Statistical analysis

The outcome measures chosen for this review were continuous level aggregate data on pain, physical function, or quality of life. Mean change scores (posttreatment-baseline) were used. Standardized mean differences (SMD) with their 95% confidence intervals (CI), calculated from the change score and baseline standard deviation, for the effects of exercise intervention above control intervention were estimated for each study. The estimates were combined using a fixed-effects model.

Results

Identified studies

The initial search resulted in 1,868 research studies. Nine hundred and eighty-one studies that appeared in more than one database or did not meet predetermined inclusion criteria were excluded. A total of 887 studies were assessed for eligibility. Seven hundred and nineteen studies were eliminated because they did not match the inclusion criteria or were not available in full text (Figure 1). The final selection, made by consensus, resulted in the inclusion of eight studies in the quality assessment phase.

All eight studies have a low risk of bias, according to the Cochrane 'Risk of Bias Tool 2.0' (Figure 2).

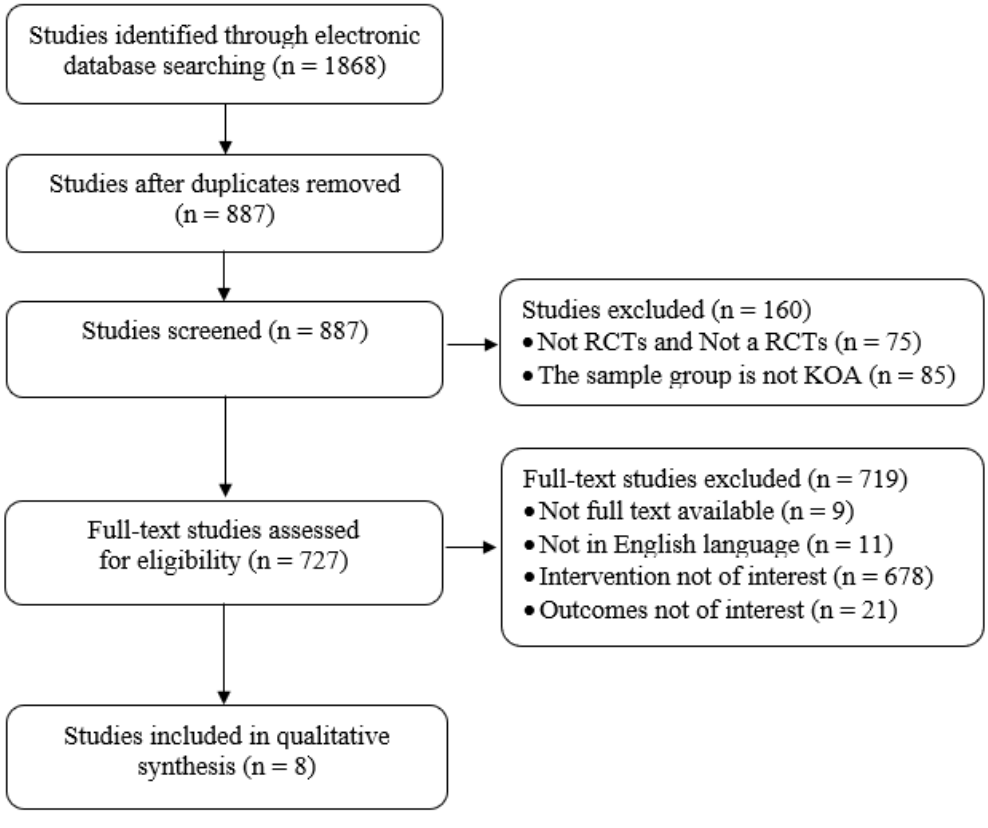

Figure 1 Flow diagram of the study procedure.

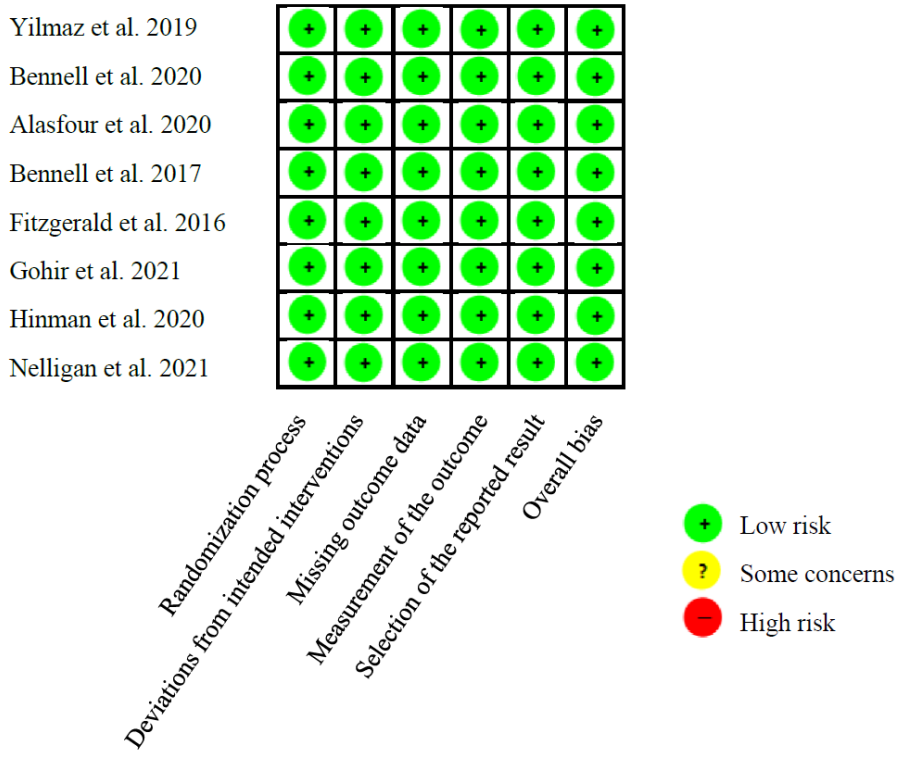

Figure 2 Risk of bias assessment according to the Cochrane Collaboration's tool (RoB 2.0) for randomized controlled trials.

General data about the selected studies

Table 1 Basic characteristics included randomized controlled clinical trials using the following information: author, subjects, design, diagnosis, intervention, tracking, control, duration, outcomes, and result. Regarding the effects found in most studies, a significant effect of home exercise programs with tracking was found on adherence rate, pain, and knee function.

Table 1 Basic characteristics of included randomized controlled clinical trials

Author	Subjects	Age - range	Diagnosis	INT	Tracking	CON	Duration	Outcomes	Main result
Yilmaz et al[17]	KOA (n = 80)	60.22 ± 9.5 years	KOA clinical criteria	Home exercise program (n = 41)	Telephone	Home exercise program (n = 39)	6 weeks	- VAS - ROM - Muscle strength - WOMAC - SF-36	INT was significantly improved in pain and function of the knee.
Bennell et al[27]	KOA (n = 110)	62.30 ± 6.75 years	Self-report	Home exercise program unsupervised (3 sessions per week) (n = 56)	SMS	Home exercise (n = 54)	24 weeks	- Adherence to prescribed home exercise - Number of days on which home exercises were completed in the past weeks - Adherence to home - Weekly NRS - NRS - KOOS - AQoL - ASES	Home exercise with the SMS greater adherence rate (mean 16.5, SD 6.5 vs mean 13.3, SD 7.0; mean difference 3.1, 95% CI 0.8-5.5; *p*-value = 0.01) than CON
Alasfour et al[29]	KOA (n = 40)	54.40 ± 4.33 years	X-ray	Home exercise on application (n = 20)	The app automatically sends alerts	Home exercise (n = 20)	6 weeks	- Self-reported exercise adherence. - ANPRS - ArWOMAC - FTSST	INT was significantly greater in adherence rate (26.60%) and pain (*p*-value = 0.015) than CON
Bennell et al[30]	KOA (n = 148)	61.15 ± 7.05 years	ACR	Home exercise (n = 74)	Skype	Home exercise and education (n = 74)	3 months and 6 months	- NRS overall - WOMAC - NRS walking - ASES -AQoL -PCS -CSQ	INT significantly greater than CON in all outcomes except coping attempt in 3 months

Table 1 Basic characteristics of included randomized controlled clinical trials (cont.)

Author	Subjects	Age - range	Diagnosis	INT	Tracking	CON	Duration	Outcomes	Main result
Fitzgerald et al[31]	KOA (n = 300)	58.35 ± 9.35 years	Self-report	Home exercise (booster) (n = 76)	Meet PT at the clinic	Home exercise (n = 75)	9 weeks and 1-yr	-WOMAC - Knee pain - TUG - 30-second chair stand - 40-meter walk test	There was no difference between groups in 9 weeks. However, there was significant booster*-times interaction for knee pain between 9 weeks and one year.
Gohir et al[32]	KOA (n = 146)	66.7 ± 9.2 years	ACR	Home exercise on application (n = 67)	Asynchronous chat	Management for KOA (n = 79)	6 weeks	- NRS - WOMAC - TUG - 30-second chair stand - MSK-HQ - Quadriceps and hamstring strength	Application for KOA management program was more excellent routine self-managed care in the primary outcome, NRS pain score, and functional performance.
Hinman et al[33]	KOA (n = 175)	65.45 ± 8.6 years	ACR and X-ray	Existing service + exercise (n = 87)	Telephone	Existing service (including exercise) (n = 88)	6 months	- NRS overall - WOMAC function scale - NRS walking - ASES -Brief Fear of Movement Scale for OA - PASE - Barriers to Physical Activity Scale - Benefits of Physical Activity Scale - AQoL- 8D	Telephone-delivered physiotherapist-led exercise advice and support resulted in improved functional outcomes at 6 months.

Table 1 Basic characteristics of included randomized controlled clinical trials (cont.)

Author	Subjects	Age - range	Diagnosis	INT	Tracking	CON	Duration	Outcomes	Main result
Nelligan et al[34]	KOA (n = 206)	60.0 ± 8.4 years	Self-report	Website access to education and home exercise (n = 103)	Automated text messages	Education and home exercise (n = 103)	24 weeks	- NRS - WOMAC - KOOS - AQoL - PASE - ASES - SEE	INT significantly greater improvement than CON in pain and function

Note: ANPRS, Arabic Numeric Pain Rating Scale; ArWOMAC, The Western Ontario and McMaster Universities Osteoarthritis Index (Arabic Version); AQoL, The Assessment of Quality of Life; ASES, Arthritis Self-Efficacy Scale; CSQ, Coping Strategies Questionnaire; CON, Control group; FTSST, Five Times Sit to Stand Test; INT, Intervention group; KOOS, Knee injury and Osteoarthritis Outcome Score; KOA, Knee osteoarthritis; NRS, numeric rating scale; PASE, Physical Activity Scale; PCS, Pain Catastrophizing Scale; SEE, Self-efficacy exercise; SF-36, Short Form -36; SMS, Short message service.

Home exercise programs included in studies

The interventions used as home exercise programs in the reviewed studies included strengthening exercise program for lower-limb muscles[17,27,29-34], muscle stretching[17,31], range of motion exercise[17], balance training,[31,32] and core exercise[31,32] as home exercise programs.

Outcome measures

The outcome measures of interest were pain and function in patients with KOA. Four studies used Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) pain score[17,30,32,33], eight studies used the Knee Pain Rating Scale (NPRS)[17,27,29-34]. Six studies used WOMAC for measuring function[17,29,30,32-34], One study used the Knee Injury and Osteoarthritis Outcome Score (KOOS)[27], and one study used Timed Up and Go (TUG), 30-second chair stand and 40-meter walk test for measuring function[31].

Program monitoring and tracking

We identified types of program monitoring and tracking: automated text messages[27,29,34], asynchronous chat via the app or telephone[32], telephone[17,33], Skype[30], and meeting physiotherapist at the clinic[31].

Main results

Adherence rate

Bennell et al[27] reported home exercise with tracking by SMS greater adherence rate (mean 16.5, SD 6.5 vs mean 13.3, SD 7.0; mean difference 3.1, 95% CI 0.8-5.5; *p*-value =0.01) than control group. Alasfour et al[29] reported home exercise with tracking by the application automatically sends alerts was significantly greater in adherence rate (26.60%) and pain (*p*-value = 0.015) than control group.

Pain

Alasfour et al[21] compared the home exercise program the application automatically sends alerts and home exercise with a hard copy sheet. The results showed that pain as measured by ANPRS was significant between groups (Mean -1.08, 22.26%, *p*-value = 0.015), with the application group having better pain improvement at the end of week 6. However, there was a significant reduction in pain scores for the application group across time, and the mean difference within-group was statistically significant (*p*-value < 0.001).

Bennell et al[21] found no difference in pain using NRS between home exercise with automated text messages and paper-based home exercise. Fitzgerald et al[31] showed no difference in pain by NRS between home exercise with booster group and home exercise only.

Five studies[17,30,32-34] showed that a home program with a tracking group improved in pain to a greater extent compared with self-home exercise by using WOMAC pain score[17,30,32,33] or NRS[34].

Function

Alasfour et al[29] showed that the mean difference between groups was insignificant (*p*-value = 0.619) at week 6 using the WOMAC score. There was a significant reduction in physical function scores for the application group across time; the mean difference was statistically significant with repeated measures ANOVA (*p*-value < 0.001).

Five studies[17,30,32-34] showed that a home program with a tracking group improved function to a more extraordinary than self-home exercise by using a WOMAC function score[17,30,32-34]. Gohir et al[24] studied the effect of home exercise encouraged by daily emails or smartphone notifications, or by the physical therapist via asynchronous chat or telephone during the study period and found that it improved statistically significantly more than the control group in function by using the 30-second sit-to-stand test (between-group difference, 3.4 [95% CI, 2.2 to 4.5]; *p*-value < 0.001) and the TUG (between-group difference, -1.8 seconds [95% CI, -3.0 to -0.5]; *p*-value = 0.007).

Fitzgerald et al[31] showed no difference in function by TUG, chair rise, and 40m walk test between home exercise with booster group and home exercise only at nine weeks or one year.

Quality of life

Bennell et al[30] showed significant between-group differences favoring the intervention in quality of life at month 3 (p-value ≤ 0.001) and month 9 (p-value = 0.003). Likewise, the study of Yilmaz et al[17] found that in the follow-up group, there was a significant change in the quality of life, and when compared between groups, there was an improvement in the tracking group greater than the control group.

Discussion

This study is the first systematic review on the effectiveness of home-based exercise with tracking and home-based exercise alone for patients with KOA. The present review evaluated eight studies (eight RCTs, 1,205 subjects with KOA) to examine evidence regarding the effectiveness of home exercise programs with or without tracking in the management of KOA on pain and physical function at short term and long term. The analysis indicated that home exercise programs with and without tracking are commonly used in KOA. The eight studies evaluated using the 'Risk of Bias Tool 2.0'[28] were considered of high methodological quality. Based on the present review, the home exercise programs with tracking used in the reviewed literature can be considered treatment possibilities for KOA individuals.

There were considerable variations in the content and duration of the exercise programs included in our systematic review. Length of intervention ranged from six weeks to one year, while the home exercise programs included exercises such as strengthening the hip, quadriceps, and hamstring muscle, stretching, and range of motion exercise. However, most high-quality studies included open and closed kinematic chain exercises as a home exercise program with consistently positive outcomes such as reduced pain and improved function[17,27,29-34]. Except for a study by Fitzgerald et al[31], the group that was followed by physical therapist visits was not significantly different from the group who did exercise alone. This may be due to the long intervals between visits to each physical therapist, so there were no differences in the long-term measurements between groups.

In our included trials, home exercise programs with tracking provide more adherence and behavior change than without tracking group when given the same home exercise program. Nicolson et al[22] found that adherence of the elderly to home-based exercise was relatively low. Previous studies have found that barriers to access, such as distance, travel time, and travel costs, contribute to the decline in adherence and motivation to exercise[25]. Each track can alert and provide more explanation about the exercise program, or serve as a communication channel between elderly and therapist that increases accessibility, adherence, and motivation for home exercise program[17,27,29,30,32-35]. In this study, it was found that in the tracking group, the rate of adherence was higher than that in the without tracking group[27,29]. Therefore, tracking during a home exercise program in people with KOA to better adhere to exercise and individual trials supported the use of motivational strategies and behavior change. In their review, Teeter et al[36] identified that telephone-based motivational interviewing could help improve medication adherence and behavior change. Each study had different channels used to track participants, and each channel can improve consistency and behavior change. On the other hand, Bennell et al[30] found that exercising at home exercise with tracking did not improve coping attempts in people with osteoarthritis in three months, but at 9-month follow-up, coping attempts showed a significant improvement. This is because this variable requires adherence and time to improve behavior.

This review highlighted the variety in the tracking of exercise programs as automated text messages[27,34], asynchronous chat via the application or telephone[29,32], telephone[17,33], Skype[30], and meeting physiotherapist at the clinic[31]. According to the reviews, each tracking channel can improve exercise adherence in elderly with osteoarthritis. In addition, remote tracking can help reduce costs, reduce travel time, and increase access to healthcare in people living in remote or rural areas[30,32,34].

The advantages of each track are as follows: automated text messages are one-way communication, often used as reminders of workout days, to add motivation or to explain more about an exercise program, which is a channel that is easy to access and reduce cost[27,34]. Bennell et al[27] used automated text messages to alert and track exercise at home in people with KOA. It was found that exercise adherence was significantly higher in the receiving message group than in the non-messaging group. However, there were no differences in pain and knee function variables. The effect of this exercise tracking may be because the automatic messaging did not provide sufficient details in the exercise content to make a difference in pain and physical function. Nelligan et al[34] using web-based exercises supported by automated text messages in subjects with KOA showed significant differences in pain, knee function, and quality of life compared to the web-based exercise with the same content without automated text messages. The website used by both groups describes how people with KOA are managed, details about exercise for those with KOA, and knowledge that is communicated both in text, image, or video formats to help participants understand better. Technology-based program applications provide guidelines for exercise performance. They are designed to appeal to the elderly and are easy to use. Exercises are shown using colorful animations to make it easier for patients to follow. The application supports exciting features, such as alerts, and monitoring systems controlled by physical therapists. This application provides an automatic recording of exercise compliance. Combining time and session completion can improve compliance with a home-based exercise program and improve the management of patients with KOA[29]. Telephone-based exercise advice for people with KOA without supervision, one-to-one, communicated only by the voice from the call alone. Hinman et al. (2019) determined the effectiveness of adding exercise advice and support by physiotherapists to an existing nurse led musculoskeletal telephone service on pain and function in adults with KOA[17]. They found that telephone-delivered physiotherapist-led exercise advice and support modestly improved physical function. Video conferencing refers to the clinical application of consultative, preventative, diagnostic, and therapeutic services via two-way interactive telecommunication technologies[35]. It enables the physiotherapist to provide individualized instructions, feedback, and training programs for each patient in real-time[35]. Bennell et al[30] evaluated the effectiveness of an innovative internet-based intervention combining physiotherapist-prescribed home exercise delivered via videoconferencing (Skype) and automated pain coping skills training (PCST) in person with KOA and found that Skype groups are improved in pain and function that is sustained for at least six months. Naeemabadi et al[35] reported that video conference–based programs can be considered as the well-established solution for the conventional rehabilitation program for the target group. Therefore, these studies reported that home-based exercise with tracking in people with KOA is essential for increasing adherence and improving pain and physical function when compared to the untracked group.

A limitation in the current study was that a meta-analysis was not performed due to the small number of studies participating and variations in the trials.

Conclusion

Based on the high quality of studies included in this systematic literature review, it can be concluded that home-based exercise with tracking in people with KOA is essential for increasing adherence and improving pain and physical function compared to the untracked group.

Take home messages

Tracking during home-based exercise program in people with KOA is essential for increasing adherence and improving pain and physical function.

Conflicts of interest

The authors declare no conflict of interest.

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