Effects of home-based prehabilitation on pre and postoperative outcomes following total hip and knee arthroplasty: a systematic review and meta-analysis

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ABSTRACT

Aims

The aim of this study was to determine the effectiveness of home-based prehabilitation on pre and postoperative outcomes in participants awaiting total knee (TKA) and hip arthroplasty (THA).

Methods

A systematic review with meta-analysis of randomised controlled trials (RCTs) of prehabilitation interventions for TKA and THA. MEDLINE, CINAHL, ProQuest, Pubmed, Cochrane Library and Google Scholar databases were searched from inception to October 2022. Evidence was assessed by the PEDro scale and the Cochrane risk-of-bias (ROB2) tool.

Results

Twenty-two RCTs (1601 participants) were identified with good overall quality and low risk of bias. Prehabilitation significantly improved pain prior to TKA (mean difference (MD) -1.02: p = 0.00), with non-significant improvements for function before (MD -0.48; p = 0.06) and after TKA (MD -0.69, p = 0.25). Small preoperative improvements were observed for pain (MD -0.02; p = 0.87) and function (MD-0.18; p = 0.16) prior to THA but no post THA effect was found for pain (MD 0.19; p = 0.44) and function (MD 0.14; p= 0.68). A trend favouring usual care for improving quality of life (QoL) prior to TKA (MD 0.61; p = 0.34), but no effect on QoL prior (MD 0.03; p = 0.87) or post THA (MD -0.05; p = 0.83) was found. Prehabilitation significantly reduced hospital length of stay (LOS) for TKA (MD -0.43 days; p < 0.00) but not for THA (MD, -0.24; p = 0.12). Compliance was only reported in 11 studies and was excellent with a mean value of 90.5%.

Conclusions

Prehabilitation interventions improve pain and function prior TKA and THA, and reduce hospital LOS, though it is unclear if these effects enhance outcomes postoperatively.

KEYWORDS

Prehabilitation; exercise; hip; knee; arthroplasty; home-based;

TAKE HOME MESSAGE

Home-based prehabilitation prior to arthroplasty may improve pain and function before surgery which can lead to reduced hospital LOS.

These conclusions are based on short hospital waiting times and it may be, in the current climate of prolonged waiting times before surgery, that prehabilitation has an important role in maintaining patient function.

INTRODUCTION

Patients awaiting joint arthroplasty suffer considerable pain and functional disability [1] and prolonged waiting times contribute to poorer quality of life (QoL) [2]. A recent study assessing the QoL of patients with osteoarthritis suggested that 22% and 45% of patients awaiting TKA and THA respectively are in a health state "worse than death" [3]. Although specific comorbidities contribute to this, pain and functional limitations appear to be key determinants [4]. Comorbidities may have a larger impact than age alone on postoperative outcomes, which may be associated with increased complications, longer hospital stays and readmissions in older patients awaiting TKA and THA [5-7]. Poor preoperative physical function [8, 9] and mental health [10] are associated with inferior postoperative functional recovery. Outcome trajectories have been linked to several factors. Poor responders present at lower baseline physical health status with marked functional limitations and seem to have reduced reduced coping ability and preoperative expectations of pain[11]. Good responders seem to have a combination of enhanced QoL factors such as good clinical, psychosocial and mental health [11]. As such the long-term effectiveness of surgery and rehabilitation is reduced for patients with poorer preoperative status in comparison to those with better preoperative physical function and mental health [12].

Patients with osteoarthritis often decrease their physical activity when faced with pain, leading to an overly sedentary lifestyle, excess weight gain, and increased muscle weakness, all of which contribute to a further increase in pain and disability [13]. Exercise as a means of managing pain, improving function and overall QoL in patients with osteoarthritis is well established [14]. International guidelines recommend exercise for the management of pain and function in hip and knee osteoarthritis [15]. Emerging evidence suggests that preoperative optimisation may improve patient disposition for surgery and reduce hospital length of stay (LOS) [16-18]. Prehabilitation aims to enhance patients' functional capacity before surgery to reduce postoperative pain, prevent complications, and reduce hospital LOS [19, 20]. Prehabilitation for those awaiting joint arthroplasty is increasingly recommended and may have benefits before and after surgery [21].

The effectiveness of prehabilitation to improve outcomes following hip and knee arthroplasty has been examined by several systematic reviews with varying conclusions [22-30]. Most reviews assess only postoperative outcomes which may be affected by surgery quality, postoperative complications, pain, mismatch of expectations and motivation to return to rehabilitation[31]. Prehabilitation varies substantially in content and is currently predominantly home-based. No previous reviews have examined the effects of home-based exercise programmes but include studies with heterogeneous interventions. This study aims to systematically review and meta-analyse randomised control trials (RCT) of home-based prehabilitation on pre and postoperative outcomes in participants awaiting TKA and THA.

METHODS

A systematic review of RCTs was undertaken and is reported in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [32, 33], and in accordance with the pre-registered protocol [https://doi.org/10.17605/OSF.IO/J4W7P].

Search strategy

MEDLINE, CINAHL, ProQuest, PubMed, Cochrane Library and Google Scholar were searched from inception to October2022. The key literature search terms were obtained from systematic reviews with meta-analysis [23, 26] and adapted with additional search words related to the study aims (Supplement 1). Searches used the following combined and/or truncated key terms: rehabilitation OR prehabilitation OR preoperative OR presurgical care OR exercise OR training OR physical therapy OR physiotherapy, AND total knee arthroplasty OR total knee replacement AND total hip arthroplasty OR total hip replacement AND joint arthroplasty OR joint replacement, AND home-based OR self-management OR tele-rehab OR tele-prehab OR online OR virtual OR community OR remote. Reference lists were manually searched for additional studies.

Eligibility and Study selection

Randomised controlled trials (RCTs) and pilot RCTs that examined the effect of prehabilitation interventions involving a partial or fully unsupervised home-based exercise programme on pre-and postoperative outcomes in participants awaiting TKA or THA were included. Full-text, English-language journal articles, with a patient population older than 18-years old were selected. We excluded articles that reported fully supervised programs delivered in a hospital or clinical setting that required expert equipment or techniques such as proprioception training, acupuncture, neuromuscular electrical stimulation (without exercise) and education-only programmes. We classed prehabilitation interventions to be any prescribed aerobic, strength, resistance or flexibility exercises that required physical effort. Trials without a control group were excluded.

Outcomes of interest included pain, function, QoL, hospital length of stay and programme compliance. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) subdomains for pain and function and Short Form-36 (SF-36) for QoL were extracted from each study where applicable. Otherwise, alternate measures such as visual analog scale (VAS), numeric pain rating scale (NPRS), Harris hip score (HHS) and hip disability and osteoarthritis outcome score (HOOS) were converted to WOMAC pain, WOMAC function and SF-36 for estimation of the overall effect and to allow for comparison across studies [34]. To convert effect estimates back to WOMAC pain and function scale (0–100) or SF-36 scale (0-100), the standardised mean differences(SMDs) were multiplied by the median standard deviation (SD)[35]. Where pain was reported during specific activities such as walking, sit-to-stand, stair ascend and stair descent; pain during walking was used.

One investigator (TDK) performed the searches. Two reviewers (TDK and KK) independently assessed eligibility in two phases, screening of titles and abstracts and then full text review. Disagreements were discussed between the reviewers, and in the event of disagreement consensus was achieved by consulting a third independent reviewer (DMD).

Data extraction

Means and standard deviations, mean differences or effect sizes for the outcomes of interest were independently extracted by two reviewers (TDK and KK). We extracted from each article: sample size; participant demographics; intervention details; follow-up period; time to surgery; intervention compliance and adverse events. Preoperative outcomes were extracted following prehabilitation intervention and prior to surgery. Postoperative outcomes were extracted at the longest follow-up time point for each study up to six months post-op. Where information was insufficient, authors were contacted. If authors could not be reached, information was imputed from original figures or obtained from previous review articles where possible.

Statistical analysis and risk of bias assessment

SMDs (effect sizes) and 95% confidence intervals were calculated from pre-and postintervention means and standard deviations using the RevMan 5 software[36]. Authors were contacted for full data sets where applicable. Negative SMD values indicated outcomes that favoured the prehabilitation intervention group. We considered values of <0.2 a small effect size, 0.2 to 0.5 a moderate effect size and >0.8 a large effect size [37].

Meta-analysis was performed using a random effects model. Data were combined in a meta-analysis when at least two trials were clinically homogeneous. If clinical heterogeneity prevented reasonable combining of data, the results were reported in descriptive format. Heterogeneity is reported using the chi-squared test and I^2 statistic. An I^2 statistic of 50%-74% indicates substantial heterogeneity and >75% considerable heterogeneity. Statistical significance was accepted at $p<0.05$.

Two reviewers (TDK, KK) independently evaluated the methodological quality of included studies using the PEDro scale[38, 39],and risk of bias using the Cochrane Risk of Bias tool (ROB2)[40] .PEDro scores are reported on a 0-10 scale (criterion one is not scored), with >9 indicating excellent methodological quality, 6 to 8 good quality, 4 to 5 fair, and <4 poor. The ROB2 tool reports a low, unclear, or high risk of bias.

RESULTS

Study selection

The search yielded a total of 889 results. One hundred and seventy-seven trials were retrieved for full-text review and 22 trials fulfilled the inclusion criteria for the systematic review. One trial[41] did not report separate outcomes for hip and knee arthroplasty and in another study[42] the reviewers were unable to obtain the raw data sets. Therefore, 20 trials were included in the meta-analysis (Figure 1).

Study characteristics

From 22 RCTs involving 1601 participants, 1049 were awaiting TKA, 240 awaiting THA and 312 awaiting either hip or knee replacement which was not differentiated within the studies. The mean age of participants was 66.8 years and 68.5% were women.

Intervention designs are described in Table 1. Nineteen trials compared prehabilitation interventions with usual care[41-59] while three trials compared two intervention modalities to usual care [60-62].

For participants awaiting TKA, 14 trials studied prehabilitation interventions compared to usual care [42-44, 48, 49, 51, 53, 55-61]. The exercise interventions included a combination of physiotherapy led supervised sessions followed by remote unsupervised home-based exercises [43, 44, 49, 51, 53, 55, 56, 59], fully home-based programmes [57, 60] and other interventions in addition to home-based exercise included telerehabilitation [60], home-based resistance training and neuro muscular electrical stimulation (NMES) [58, 61], an integrated education programme [42, 48, 53], self-management plans [41] and telephone monitoring [41, 53].

For participants awaiting THA, five trials studied prehabilitation interventions compared to usual care [45-47, 50, 52]. The exercise interventions included a combination of physiotherapy led supervised sessions followed by remote unsupervised home-based exercises [45, 47, 52, 63] and home-based exercise and education [46].

Three trials evaluated prehabilitation interventions versus usual care in both hip and knee arthroplasties [41, 54, 62]. The exercise interventions included preoperative online exercises using a microsite [54], home-based exercises directed by a self-management plan and monthly telephone monitoring [41] and supervised telecommunication (online) exercises followed by unsupervised home-based exercises [62].

Intervention compliance and adverse events

Compliance was reported in only 11 studies, but a mean value of 90.5 % was highlighted in those that recorded this data [43, 45, 47, 50, 52, 54, 55, 58, 60-62]. During the preoperative period, reasons for not continuing with the intervention were surgery cancellation or postponement, having surgery brought forward, time commitments and other medical reasons. In the postoperative period complications following surgery resulted in participants being lost to follow-up.

No serious adverse events occurred as a result of the exercise intervention in the five studies that reported this data [45, 47, 51, 52, 62]. Post-exercise soreness was treated with massage, relaxation techniques, stretching exercises, medication, or a combination of these interventions.

Methodological quality and risk of bias

There were two excellent quality trials (>9/10) and 14 good quality trials (>6/10) with an average score of 6/10 for all trials on the PEDro scale. Almost all trials adhered to random allocation, between-group comparisons and measures of variability for at least one key outcome. Most trials did not blind participants or therapists which was expected, given the nature of rehabilitation interventions in clinical populations. Allocation concealment was used by eight trials and outcome assessors were blinded in 15 of the trials. Intention to treat analysis was performed by 11 trials and measures of at least one key outcome from >85% of participants were obtained in 17 trials (Table 2). The risk of bias summary is shown in Figure 2 and the risk of bias for each study is shown next to the forest plots (Figure 3-9) and in the supplementary file (Supplement 2). All trials were judged as low risk for sequence generation, selective reporting and other biases. Eighteen of the trials were judged as low risk for incomplete data. Low risk was judged for blinding of outcome assessors in 15 trials. The combined risk of bias summary table is available as supplementary information.

Effect of prehabilitation on pain

Thirteen trials with 832 participants showed that prehabilitation compared with usual care improved pain prior to TKA (SMD -1.02, 95% CI -1.63 to -0.40, p<0.05), however no difference was observed in those awaiting THA, based on five trials with 193 participants (SMD -0.02, 95% CI -0.31 to 0.26, p=0.87) (Figure 3). Effect sizes were larger for the TKA than THA, however, considerable levels of heterogeneity (I^2=93%) were reported between the TKA trials compared to low heterogeneity (I^2 = 0%) between the THA trials.

There was no effect of prehabilitation on postoperative pain following either TKA or THA. Six trials with 446 participants showed a small improvement in pain after TKA that was not statistically significant, but was in favour of prehabilitation (SMD -0.28, 95% CI -0.78 to 0.21, p=0.28). Three trials with 145 participants showed a small improvement in pain after THA although again not statistically significant after THA (SMD 0.19, 95% CI -0.28 to 0.66, p = 0.44) (Figure 4). Considerable heterogeneity (I^2 = 79%) was observed between the TKA trials and moderate heterogeneity (I^2 =49%) between the THA trials.

Effect of prehabilitation on function

Six trials with 229 participants awaiting TKA, suggested an effect of prehabilitation compared to usual care on preoperative function (SMD -0.48, 95% CI -0.97 to 0.02, p = 0.06). In THA, six trials with 250 participants suggested a non-significant effect of prehabilitation (SMD -0.18, CI -0.43 to 0.07, p = 0.16) (Figure 5). Effect sizes were larger for the TKA than THA and substantial levels of heterogeneity were reported for the TKA trials (I^2 = 65%) and low heterogeneity was overserved between the THA trials (I^2 =0%).

No significant effect was observed in improving function post-operatively. Three trials with 110 participants suggested that prehabilitation may improve function after TKA but the effect was not significant (SMD -0.69, 95% CI -01.89 to 0.49, p = 0.25). Three trials with 147 participants showed that prehabilitation had no effect on improving function after THA (SMD 0.14, 95% CI -0.50 to 0.77, p = 0.68) (Figure 6). Larger effect sizes were found in TKA trials and considerable heterogeneity existed in both TKA and (I^2= 86%) and THA (I^2 = 74%).

Effect of prehabilitation on quality of life

No effect was seen on measures of QoL pre-operatively. Two trials with 120 participants showed that prehabilitation compared to usual care had no effect on improving QoL prior to TKA (SMD 0.61, 95% CI -0.64 to 1.87, p = 0.34) (Figure 7). Considerable heterogeneity was observed (I^2 = 88%). Four trials with 134 participants showed that prehabilitation had no

effect on improving QoL prior to THA (SMD 0.03, 95% CI -0.36 to 0.42, p = 0.87) and heterogeneity was low (I^2 = 19%) (Figure 8).

Quality of life post TKA was reported by one study [58], and was thus not included in the meta-analysis. Significant improvement in QoL at 12 weeks after surgery was reported, however, the study had a very small sample size (n=28) that may have inflated effect sizes. Two trials with 88 participants showed no difference in QoL after THA (SMD -0.05, 95% CI -0.46 to 0.37, p = 0.83) (Figure 8) and with low heterogeneity (I^2 = 0%).

Effect of prehabilitation on length of hospital stay

Four trials with 505 participants showed significant improvement (p < 0.00) for hospital LOS (days) in favour of prehabilitation following TKA (SMD -0.43, 95% CI -0.64 to -0.23) (Figure 9). Low heterogeneity (I^2 = 19%) was observed.

Three trials with 176 participants showed improvement, although not significant, (p = 0.12) for hospital LOS (days) in favour of prehabilitation following THA (SMD, -0.24, 95% CI -0.53 to 0.06) (Figure 9). Low heterogeneity was observed (I^2 = 0%).

DISCUSSION

This is the first comprehensive systematic review and meta-analysis focused on prehabilitation interventions with a home-based exercise component; one of the predominant methods of delivering exercise prehabilitation in the UK. Prehabilitation improves pain and possibly function in patients prior to TKA, although the evidence is less clear regarding any benefits in THA. Hospital LOS was reduced with prehabilitation, but postoperative patient reported pain and function appear to be largely unaffected. No effect was found on measures of patient QoL prior or post TKA and THA.

It is important to consider that the studies included in this review were conducted before the global pandemic with the longest waiting times recorded at up to six months from diagnosis to surgery. Wait times longer than 180 days have been linked to significantly increased length of hospital stay following TKA [64] and possibly contribute to the further clinical deterioration of arthritis and associated musculoskeletal deconditioning [60,61]. Currently, healthcare systems globally face significantly longer waiting times for surgery and length of hospital stay compared to before the pandemic [65]. Increased waiting times have enhanced the interest in prehabilitation to maintain and improve patients' functional status prior to arthroplasty [66, 67]. To promote presurgical optimisation the concept of "waiting well" has been encouraged in the UK. Some basic online support services are available in certain areas, such as My Planned Care App in England, however, there are no comprehensive home-based prehabilitation services, to the authors' knowledge, that are available to support patients currently while they wait for their arthroplasty.

Knee strength and functional performance is anticipated to decline in the preoperative period due to disuse atrophy [56, 68]. The surgical insult and subsequent recovery will affect physical performance in the early post-operative phase and the extent of this will vary across the population. Prehabilitation may have a prophylactic role in expediting subsequent post-operative recovery of function in certain groups, such as the elderly, however this level of data was not captured in the wider meta-analysis. Regaining muscular strength after disuse is lower in elderly patients compared to younger counterparts[69]. Therefore, older patients may benefit more from the effects of prehabilitation on improved pain, function and presurgical presentation, which may also translate into better postoperative outcomes [12]. The effect of the prehabilition on pain and function is likely to be greater in the preoperative period as there is room for improvement, whereas postoperatively the effect of the arhroplasty on these outcomes may be difficult to measure using current Patient Reported Outcome Measures (PROMs). This may be in part related to the ceiling effect of commonly used PROMs[70, 71]. Furthermore, QoL of patients with osteoarthritis has been shown to reduce with every additional month spent on the waiting list [3]. Poorer QoL is expected for frail patients who have severe symptoms such as joint pain, stiffness, and limited functional and self-care ability [72]. Therefore, longer wait times put patients at risk of further symptom deterioration and it is plausible for the protective effect of prehabilitation to therefore be more pronounced.

Compliance with prehabilitation interventions was reported by only 11 of the 22 included trials, however, in those that did report these data high levels of compliance were seen (90.5%). To obtain the optimal benefits of exercise, an appropriate exercise prescription according to the latest clinical guidelines is recommended[15]. Hurley et al. (2007) showed that combining exercise and self-management programmes in a home-based environment might enhance the benefits of prehabilitation given that exercise instructions are easy to follow [73]. Therefore, increased surgical waiting times can potentially be utilised for more comprehensive physical optimisation before surgery comprising of patient specific exercise prescriptions, goal setting and behaviour change approaches.

Previous reviews have studied the effect of prehabilitation on postoperative pain, function and hospital LOS[22, 24, 25, 28-30]. However, we evaluated the effectiveness of prehabilitation prior to TKA and THA in addition to outcomes following surgery to account for factors associated with surgical success, complications and recovery. The included studies in this review had reasonably good methodological quality (6/10 PEDro scores). Most concerns arose from the lack of patient and therapist blinding which is usually not possible in exercise interventions. Programme design based on access to equipment, facilities, and level of supervision varied greatly in previous reviews[22-26, 29, 30] and this may affect the ability to combine research evidence effectively in a meta-analysis. A better understanding of programme design provides important insights into programme effectiveness to elicit long-term exercise-related improvements[74]. The specific effect of home-based prehabilitation interventions in patients with osteoarthritis have not been reported previously in meta-analyses. In addition, follow-up periods were not defined[22-24, 26, 27, 29, 30] and compliance[22, 23, 27, 30] with exercise interventions were underreported in previous reviews. Finally, the sample sizes[22-26, 29] of the included studies were generally small which may inflate effect sizes and the methodological quality of previous reviews varied considerably.

There were specific limitations in the trials included in this study that contributed to heterogeneity. Due to the lack of large randomised controlled trials, most studies were inadequately powered to detect small-to-medium effect sizes and increased the chance that baseline differences between groups affected pre and post intervention results. Age groups varied considerably across studies. This is important to note since elderly patients with more pronounced disuse atrophy may gain more from prehabilitation[68]. Most studies provided insufficient information on exercise interventions such as whether exercises were individual or group based, who supervised the sessions and the durations of supervised sessions. A diverse range of exercise interventions was carried out with no uniformity in intervention time, frequency, or type of exercise. It is assumed that most studies followed best practice guidelines at the time, however, outcomes were based on addressing patient dysfunction and improving symptoms. Compliance was not reported by 11 of the 22 studies. The direct comparison of the effect of prehabilitation on TKA versus THA were not examined by any of the studies. It is recommended that future trials should use the guidelines (TIDieR Checklist) for describing interventions[75], and newer evidence based approaches are needed to demonstrate the benefits of prehabilitation.

Prehabilitation in a home-based environment seems to be feasible and safe, improves pain and function before TKA and THA, reduced the LOS, and compliance with such programmes is excellent. The evidence is less clear about the effects of prehabilitation on QoL and outcomes after arthroplasty. However, high evidence heterogeneity, limited power, as well as lack of adequate intervention description in studies does not allow firm conclusions about the optimal delivery of prehabilitation programmes. Further research on multimodal prehabilitation exercise programmes is warranted.

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Tables:

Table 1: Summary of included trials: Prehabilitation interventions compared with usual care for TKA and THA.

Study	Study type	Sample size (n) I1/(I2)/C	Age (y), Mean ± SD, I1/(I2)/C	Sex % Female, I1/(I2)/C	Joint	All outcome measures	Applicable Outcome measures	Time to surgery	Preoperative intervention	Follow-up period	Compliance
An et al. (2021)	RCT	18/17/18	71.1 ± 3.30/ 70.05 ± 2.41/ 70.38 ± 2.59	100/100 /100	Knee	WOMAC pain, function and total scores, QS strength with a dynamometer, TUG, knee flexion ROM, PPT	WOMAC pain and function, strength	6 months	Intervention 1: Remote telerehabilitation group: Warm-up, mobility, flexibility, strength and balance training. 2 x /day, 5 days/week for 3 wk. Intervention 2: Preoperative Patient Education Group: Non-supervised exercise 2 x /day, 5 days/week for 3 wk.	Preoperative, postoperative at 6 wk	90 % compliance exercise prehab. 85% compliance education
Aoki et al. (2009)	RCT	17/19	72.3 ± 5.2/ 74.4 ± 6.4	100/100	Knee	Pain: VAS (during gait), gait speed (m/min), knee flexion ROM	VAS pain	3 months	Home-based, knee flexibility exercises daily for 11-12 wk	Preoperative only (admission day)	93.1% of the days, and 91% of the sessions completed

Study	Study type	Sample size (n) I1/(I2)/C	Age (y), Mean ± SD, I1/(I2)/C	Sex % Female, I1/(I2)/C	Joint	All outcome measures	Applicable Outcome measures	Time to surgery	Preoperative intervention	Follow-up period	Compliance
Borjesson et al. (1996)	RCT	34/34	64 ± 4/ 64± 5	50/50	Knee	Pain during walking out of 10, passive ROM, step up and down, QS, free walking speed (m/sec), step frequency (steps/sec), stride length, single stance phase (% gait cycle) of each leg	Pain	Not reported	Strengthening, stretching and aerobic exercise. Unsupervised home exercise 2 x per week. Supervised classes 3 x/ wk for 5 wk.	Preoperative only (12wk intervention)	Not reported
Bruce-Brand et al. (2012)	Prospective RCT	10/10/6	63.9 ± 5.8/63.4 ± 5.9/65.2 ± 3.1	66/66 /50	Knee	25m walk test, repeated CRT, SCT, WOMAC function, pain and stiffness, SF-36, QS strength and QS cross-sectional area	WOMAC function and pain.	6 months	Intervention 1: Home-based resistance training 3 x/wk for 6 wk. Intervention 2: Unsupervised NMES session of the affected QFM, 5 days/wk for 6 wk.	Preoperative (8 wk intervention), post-intervention at 6 wk and 14wk	70% compliance over 18 months. NMES: 91% RT:83%
Cheng-Jung et al. (2022)	Prospective RCT	35/35	73.5 ± 5.3 / 74.4 ± 5.4	71/88	Knee	VAS pain, STAI, WOMAC function, AKS	VAS Pain, WOMAC function	Not reported	Integrated education programme: Verbal preop education, prehabilitation, multidisciplinary personal rehab during hospital stay, supervised home-based exercise after discharge.	Preoperative (admission day), discharge day, postop at 2 wk, 6 wk and 13 wk.	Not reported

Study	Study type	Sample size (n) I1/(I2)/C	Age (y), Mean ± SD, I1/(I2)/C	Sex % Female, I1/(I2)/C	Joint	All outcome measures	Applicable Outcome measures	Time to surgery	Preoperative intervention	Follow-up period	Compliance
Crotty et al. (2009)	RCT	75/77	68.1 ±10.6 / 67.0 ±11.0	60/60	Hip and knee	AQoL, CES-D, WOMAC pain, function and stiffness, BMQ, HeiQ	WOMAC pain and function, QoL	Not reported	Self-management action designed for personal home-based and community-based exercise goals. A monthly telephone call by a support volunteer. Encouraged to attend 'Moving towards wellness course'. Encouraged to attend 2 x joint replacement education sessions.	Preop (6-month intervention) Surgery may have occurred	Not reported
Doiron-Cadrin et al. (2020)	Pilot RCT	11/12/11	69.9 ± 9.1/ 61.3 ± 8.1/ 66.7 ± 9.2	64/83 /73	Hip and knee	LEFS, WOMAC pain, stiffness, and function; SF-36, PCS, MCS, TUG, SPW, SCT	WOMAC pain and function, QoL	Not reported	Two supervised physiotherapy sessions/ wk through telecommunication. Repeat the same exercises 5 days/wk at home without supervision and keep a logbook.	Preop only (12wk intervention)	Tele-rehabilitation group: 77%, In-person group: 80%

Study	Study type	Sample size (n) I1/(I2)/C	Age (y), Mean ± SD, I1/(I2)/C	Sex % Female, I1/(I2)/C	Joint	All outcome measures	Applicable Outcome measures	Time to surgery	Preoperative intervention	Follow-up period	Compliance
Gilbey et al. (2003)	Prospective RCT	37/31	66.73±10.19/ 63.29 ± 12.01	57/68	Hip	WOMAC total, pain, function, stiffness, patient satisfaction questionnaire	WOMAC pain and function	8 weeks	Aerobic, strength and hydrotherapy sessions. 2x clinic and 2x home sessions, 1 hr/wk for 8 wk	1 wk preop, postop at 3 wk, 12wk and 24 wk.	Scheduled exercise sessions 97%, home-based sessions: 95%
Gocen et al. (2004)	Prospective RCT	29/30	46.93 ±11.48/ 55.50 ± 14.44	45/27	Hip	VAS pain, HHS, ROM hip abduction	VAS pain, HHS function and QoL	Not reported	Home exercise and education 3x/day for 8 wk	Preop (1 day before surgery), at discharge, postop at 3 months and 24 months.	Not reported
Hoogeboom et al. (2010)	Pilot RCT	10/11	77.3 ± 3/75.0 ± 5	70/64	Hip	HOOS pain, symptoms, function, QOL. LAPAQ, PSC, VAS pain, 6MWT, TUG, CRT; PWC-170, HGS	VAS pain, HOOS pain and function	3 weeks	Supervised exercise program and home exercise, 2x/wk for 3-6wk	Preop and postop (LOS and complications)	91% compliance
Huang et al. (2012)	Prospective RCT	126/117	69.8 ± 7.2/ 70.5 ± 7.4	68.8/ 73.5	Knee	Knee ROM, VAS pain, LOS	VAS pain, LOS	4 weeks	Education and home exercise strengthening for 4 wk	Preop and postop 5 days until discharge (LOS and complications)	Not reported
Matassi et al. (2012)	Prospective RCT	61/61	66 6 ±7.2/ 67 ± 7.7	54/43	Knee	Days before reaching 90° of knee flexion, knee ROM, KSS, LOS	KSS function, LOS	Not reported	Exercise instruction plus unsupervised exercise, 5 days/wk for 6 wk	Preop and postop at 6 wk, 6 months and 12 months	Not reported

Study	Study type	Sample size (n) I1/(I2)/C	Age (y), Mean ± SD, I1/(I2)/C	Sex % Female, I1/(I2)/C	Joint	All outcome measures	Applicable Outcome measures	Time to surgery	Preoperative intervention	Follow-up period	Compliance
Mikkelsen et al. (2014)	RCT	32/30	64.8 ± 8 / 65.1 ±10	44/40	Hip	Leg extension power: The Nottingham Power Rig, max walking speed (20m walk test), CRT, SCT, HHD, HOOS pain, activities of daily living and function	HOOS pain and function	10 weeks	IG: Home-based exercise 5 days/week and progressive resistance training 2 days/week. CG: home-based exercise 7 days/week	Preop (10 wk intervention), 6 and 12 months postop.	85% compliance
Nunez et al. (2006)	RCT	51/49	72.6 ± 6.2 / 69.5 ±6.8	76/65	Knee	HRQL, WOMAC pain, stiffness and function, SF-36, number and cost of visits to general physician	WOMAC pain and function	< 6 months	2 individual sessions and 2 group sessions and education followed by daily home exercise.	Preop (3-month intervention), follow up at 9 months.	Not reported
Oosting et al. (2012)	Pilot RCT	15/15	76.9 ± 6.3/ 75.0 ± 6.3	93/67	Hip	PSC, CRT, 6MWT, TUG, VAS Pain, HOOS Pain, function and ADL, function in sport and recreation, hip-related QoL, LAPAQ	HOOS pain and function	>3 weeks	Supervised home exercise, 30 min, 2x/wk and 4 unsupervised exercise sessions for 3-6 wk	Preop (6 wk intervention), postop follow for complication rate, LOS, or functional recovery	99% compliance

Study	Study type	Sample size (n) I1/(I2)/C	Age (y), Mean ± SD, I1/(I2)/C	Sex % Female, I1/(I2)/C	Joint	All outcome measures	Applicable Outcome measures	Time to surgery	Preoperative intervention	Follow-up period	Compliance
Rittharomya et al. (2020)	RCT	48/44	Young-old (60-69) 26, Middle-aged old (70-79) 22 / Young-old (60-69) 23, Middle-aged old (70-79) 21	89/88	Knee	SEEQ, NPRS, HHD, ROM (goniometer), TUG, Mini-OAKHQOL	NPRS	>3 months	Health information, quadriceps exercise, and monitoring through telephone or LINE application. Quadriceps training exercise demonstrated and practised. Encouraged home-based quadriceps exercise 60-100 times/day 5 x/ wk.	Preop only (12 wk intervention)	Not reported
Soeters et al. (2018)	RCT	63/63	61 ± 9 / 62 ± 8	56/71	Hip and knee	WOMAC pain, stiffness, function and total, LOS	WOMAC pain and function, LOS	Not reported	One supervised demonstration: precautions, exercises, bed mobility, ambulation, stairs negotiation. Provided access to microsite with videos, pictures and information about exercises, transfers, ambulation and ADL.	Preop online intervention (4-6wk), postop follow-up at 4-6 weeks for LOS and functional recovery (WOMAC scores)	Preop: 96% postoperatively: 76%

Study	Study type	Sample size (n) I1/(I2)/C	Age (y), Mean ± SD, I1/(I2)/C	Sex % Female, I1/(I2)/C	Joint	All outcome measures	Applicable Outcome measures	Time to surgery	Preoperative intervention	Follow-up period	Compliance
Swank et al. (2011)	RCT	36/35	63. ± 7.3/ 62.6 ±7.6	67/63	Knee	VAS pain, 6MWT, STS, Ascend time for the 1st and 2nd second flight of stairs (s), Peak torque extension and flexion with surgical and non-surgical leg	VAS pain	Not reported	Home-based exercise 2x/ week and supervised exercise 1x/wk for 4-8wk	Preop intervention only	90% compliance
Topp et al. (2009)	RCT	26/28	64.1 ± 7.05/ 63.6 ± 6.68	73/64	Knee	VAS pain, STS, up/down stairs, 6MWT, QS	VAS pain	5 months	Resistance, flexibility and step training, 1 supervised and 2 home sessions, 3x/wk	Preop 4 wk, assessment (5-month intervention), postop follow-up at 4 wk and 12 wk	Not reported
Tungtrongjit et al. (2012)	RCT	30/30	63 ±7.6/ 65.9 ± 7.2	86.7/80.0	Knee	VAS pain, ROM, QS, Modified WOMAC score: pain, stiffness and function	VAS pain, WOMAC pain and function	Not reported	Quadriceps strengthening home program, 3x/day for 3 wk	Preop intervention until surgery. Postop follow-up at 1 month, 3 months and 6 months.	Not reported
Walls et al. (2010)	Pilot RCT	9/5	64.4 ± 8.0/ 63.2 ± 11.4	67/80	Knee	WOMAC pain, function, stiffness, SCT, CRT. Timed walk (25 m), QS, SF-36, PCS, MCS, LOS, discharge destination.	WOMAC Pain and function, LOS	Not reported	Home-based NMES and resistance exercise, 20 min/day for 5 days/wk for 8 wk	Preop 6 wk intervention, postop follow-up at 6wk and 12 wk	99% compliance

Study	Study type	Sample size (n) I1/(I2)/C	Age (y), Mean ± SD, I1/(I2)/C	Sex % Female, I1/(I2)/C	Joint	All outcome measures	Applicable Outcome measures	Time to surgery	Preoperative intervention	Follow-up period	Compliance
Weidenhielm et al. (1993)	RCT	20/20	64 ± 4/ 63± 5	55/45	Knee	Pain: 4-point scale and 10-point scale during walk, walking speed (self-selected), max walk speed, knee ROM, QS	Pain	3 months	Strengthening, stretching and aerobic exercise. Supervised group sessions 3 x/wk unsupervised home exercise daily	Preop intervention for 3 wk. Postop follow-up at 3 months	Not reported

N: number of participants.SD ±: standard deviation (unless otherwise stated). I: Intervention Group. C: Control Group. I1: Intervention Group One. I2: Intervention Group 2. PT: Physiotherapist or Physical Therapist. Reps: Repetitions. RM: Repetition Maximum. ST: Strength Training. Wk: Weeks. VAS: Visual Analog Scale for Pain. LOS: Hospital Length of Stay. STAI: State-Trait Anxiety Inventory. ADL: Activities of Daily Living. WOMAC: Western Ontario and Mcmaster Universities Osteoarthritis Index. QS: Quadriceps Strength. HS: Hamstring Strength. HHS: Harris Hip Score. NRS: Numeric Rating Scale for Pain, AIMS: Arthritis Impact Measurement Scale. HAD: Hospital Anxiety and Depression Score. NMES: Neuromuscular Electrical Stimulation. HOOS: Hip Injury and Osteoarthritis Outcome Score. SF-36: Shortform Health Survey-36. KOOS: Knee Injury and Osteoarthritis Outcome Score. NEADL: Nottingham Extended Activities of Daily Living. HADSA: Hospital Anxiety and Depression Scale (Anxiety Subdomain). ROM: Range of Motion. 6MWT: Six-Minute Walk Test. SEEQ: Self-Efficacy Expectation Questionnaire. HHD: Hand-Held Dynamometry. TUG: Timed-Up-And-Go Test. Mini-OAKHQOL: Mini-Osteoarthritis of Knee and Hip Quality of Life. PSC: Patient-Specific Complaints. CRT: Chair Rise Time. LAPAQ: Longitudinal Aging Study Amsterdam Physical Activity Questionnaire. HRQL: Health Related Quality of Life. HGS: Hand Grip Strength. STS: Sit To Stand Test. AQoL: Assessment Of Quality Of Life. CES-D: Centre For Epidemiologic Studies Depression Scale. BMQ: Beliefs About Medicines Questionnaire. HeiQ: Health Education Impact Questionnaire. LEFS: Lower Extremity Functional Scale. PCS: Physical Composite Score. MCS: Mental Composite Score. SPW: Self-Paced Walk. SCT: Stair Climb Test. AKS: American Knee Society Scores. PPT: Pain Pressure Threshold. PCS: Physical composite score. PWC-170: Physical Work Capacity on an Aerobic Bicycle Ergometer. KSS: Knee Society Clinical Rating Score. RT: Resistance Training. PRT: Progressive Resistance Training. Preop: Preoperative. Postop: Postoperative

Table 2: Methodological quality according to the PEDro criteria.

	PEDro Criteria											
Study	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total (/10)**
An et al. (2021)	1	1	1	1	1	0	1	1	1	1	1	9
Aoki et al. (2009)	1	1	0	1	0	0	1	1	1	1	1	7
Borjesson et al. (1996)	1	1	0	1	0	0	1	1	1	1	1	7
Bruce-Brand et al. (2012)	1	1	1	1	0	0	1	0	0	1	1	6
Cheng-Jung et al. (2022)	1	0	0	1	0	0	1	1	0	1	1	5
Crotty et al. (2009)	1	1	1	1	0	0	0	1	1	1	1	7
Doiron-Cadrin et al. (2020)	1	1	1	1	0	0	1	1	1	1	1	8
Gilbey et al. (2003)	1	1	0	1	0	0	0	0	0	1	1	4
Gocen et al. (2004)	1	1	0	0	0	0	1	1	1	1	1	6
Hoogeboom et al. (2010)	1	1	1	1	0	0	1	1	0	1	1	7
Huang et al. (2012)	1	0	0	1	0	0	0	1	0	1	1	4
Matassi et al. (2012)	1	1	0	1	0	0	1	1	0	1	1	6
Mikkelsen et al. (2014)	1	1	1	1	1	0	1	1	1	1	1	9
Nunez et al. (2006)	1	1	0	1	0	0	1	0	0	1	1	5
Oosting et al. (2012)	1	1	1	1	0	0	1	1	1	1	1	8
Rittharomya et al. (2020)	1	1	0	1	0	0	1	1	1	1	1	7
Soeters et al. (2018)	1	1	0	1	0	0	0	1	1	1	1	6
Swank et al. (2011)	1	1	0	1	0	0	0	1	1	1	1	6
Topp et al. (2009)	1	1	0	1	0	0	0	1	0	0	1	4
Tungtrongjit et al. (2012)	1	1	1	1	0	0	1	0	0	1	1	6
Walls et al. (2010)	1	1	0	1	0	0	1	0	0	1	1	5
Weidenhielm et al. (1993)	1	1	0	1	0	0	0	1	0	1	1	5

NOTES. PEDro criteria: 1. Eligibility criteria were specified. 2. Random allocation. 3. Concealed allocation. 4. Baseline similarity between groups. 5. Subject blinding. 6. Therapist blinding. 7. Assessor blinding. 8. Follow-up >85%. 9. Intention-to-treat analysis. 10. Between-group statistical comparisons. 11. Point measures and measures of variability reported. Item scoring: 1 = present, 0 = absent. Criterion 1 is not included in the total score.

Figures:

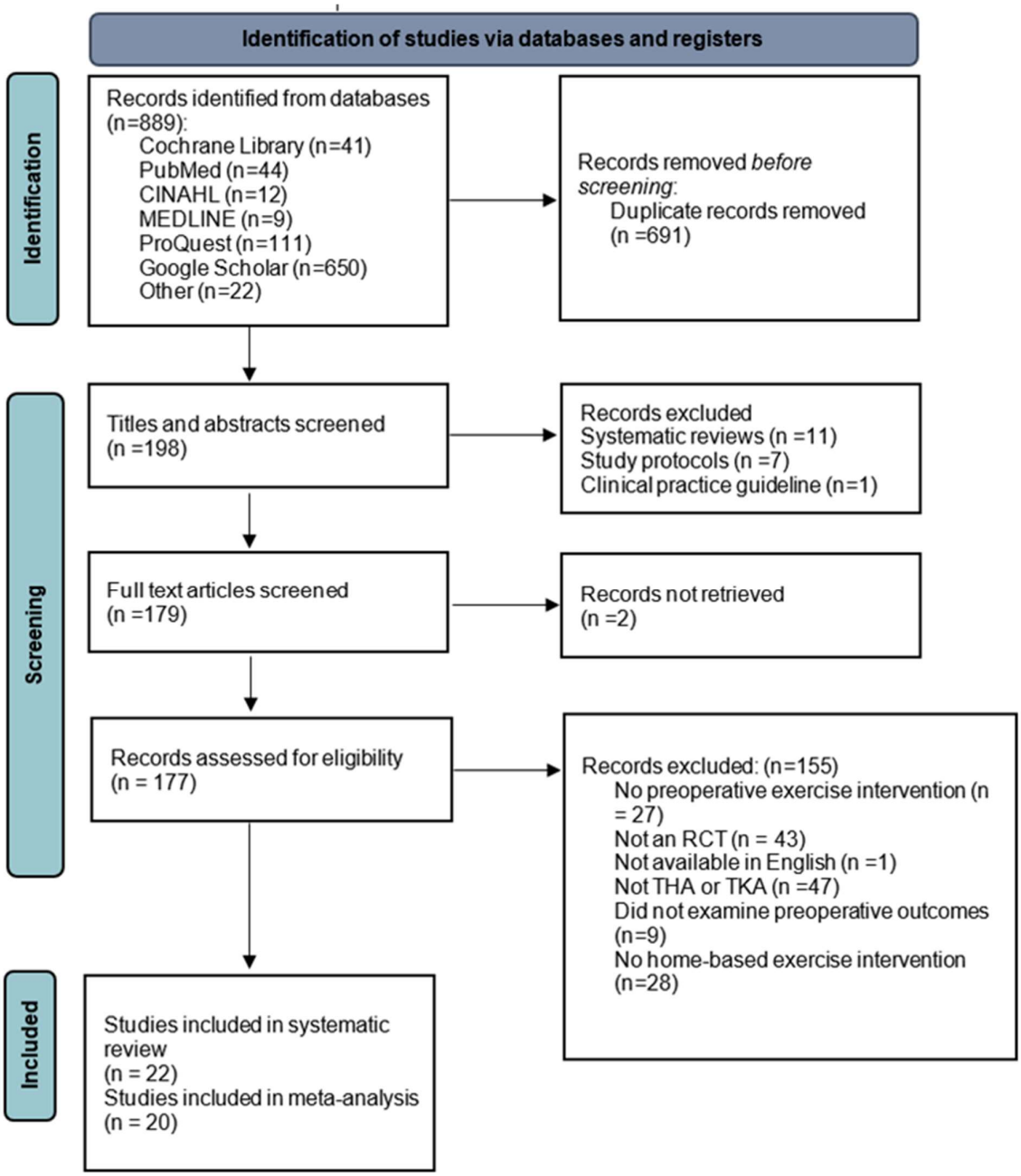


Figure 1: PRISMA flow diagram of study selection process.

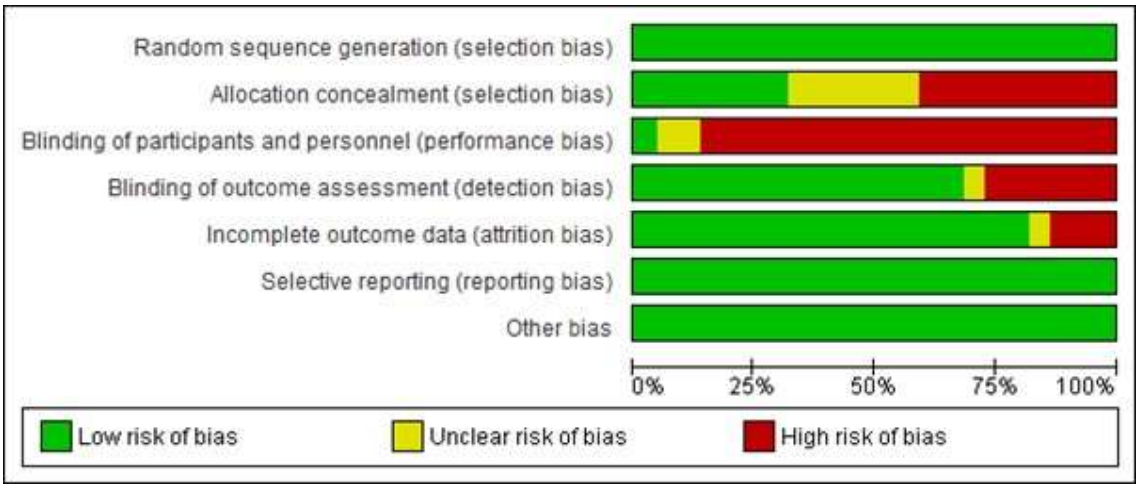


Figure 2: Risk of bias summary.

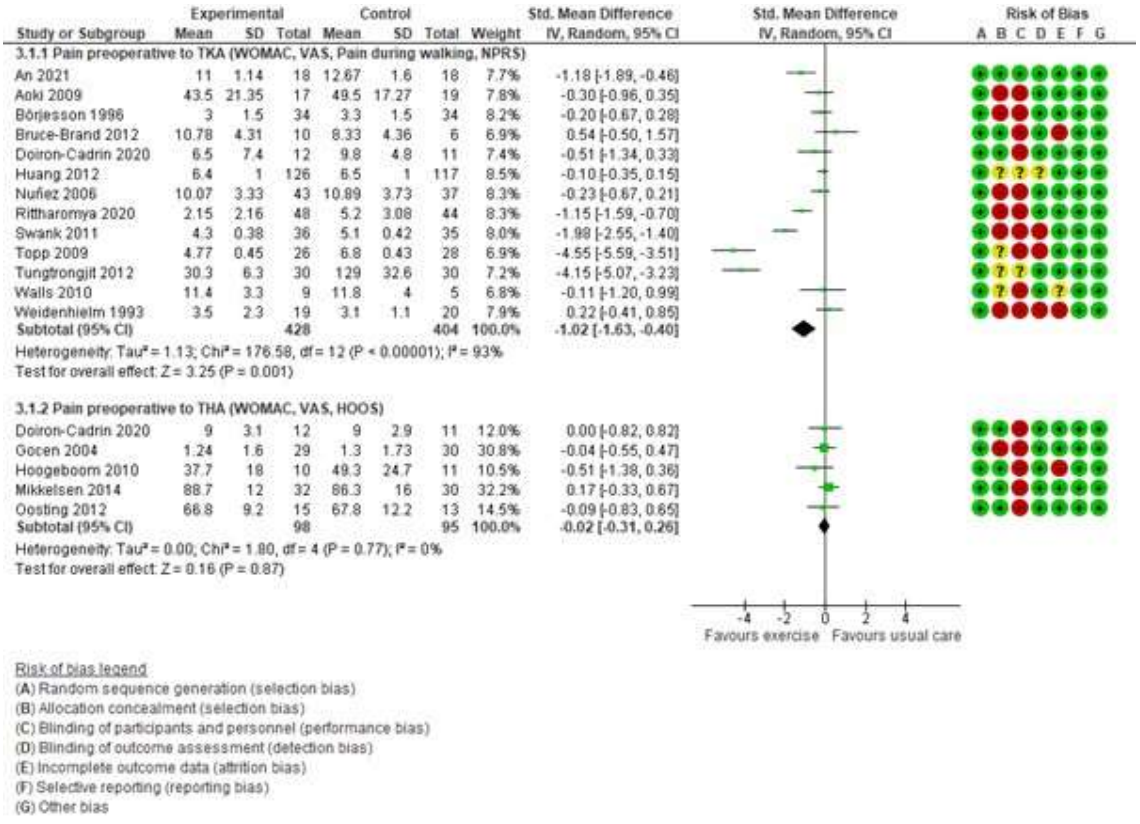


Figure 3: Effect of prehabilitation vs standard care on pain prior to TKA and THA.

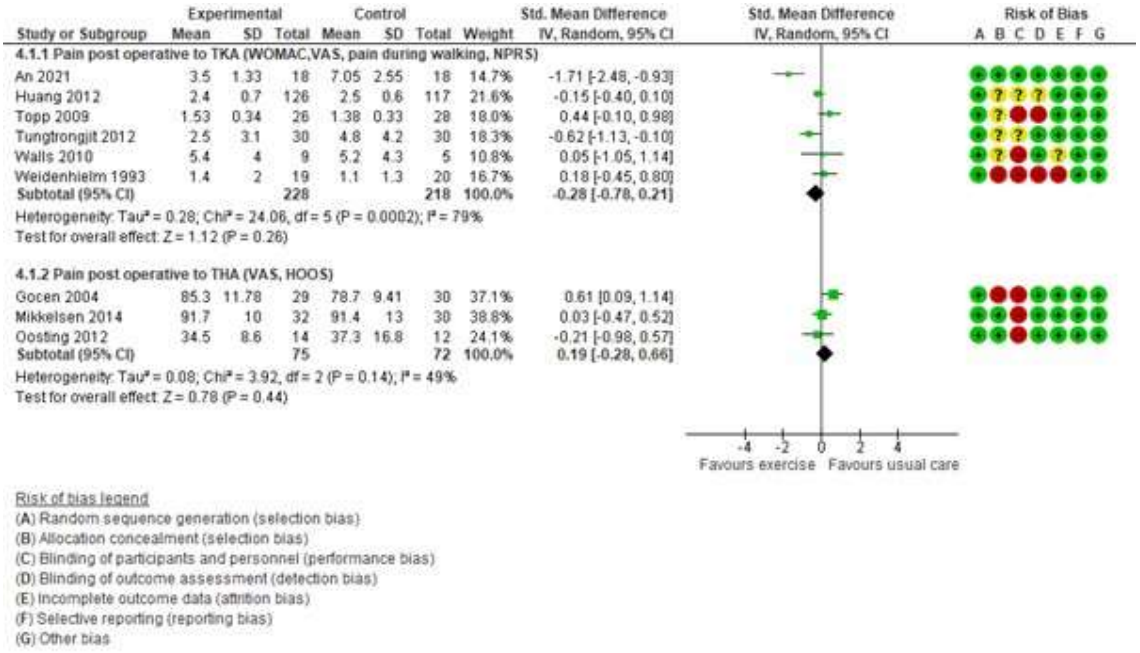


Figure 4: Effect of prehabilitation vs standard care on pain post TKA and THA.

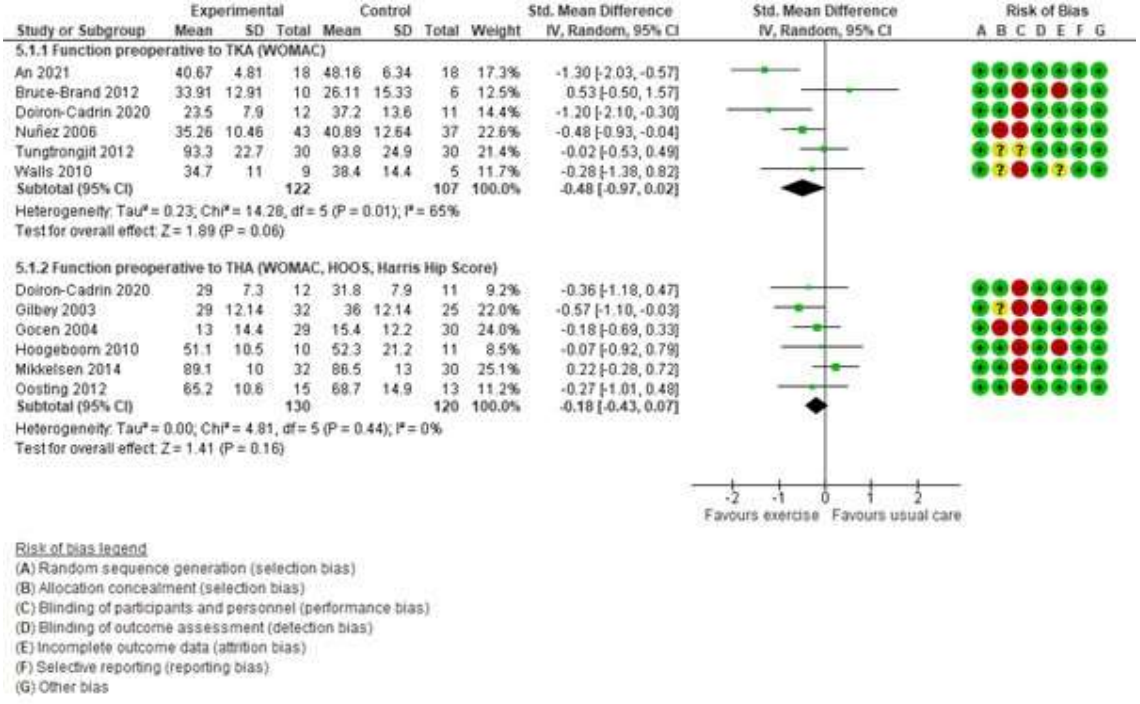


Figure 5: Effect of prehabilitation vs standard care on function prior to TKA and THA.

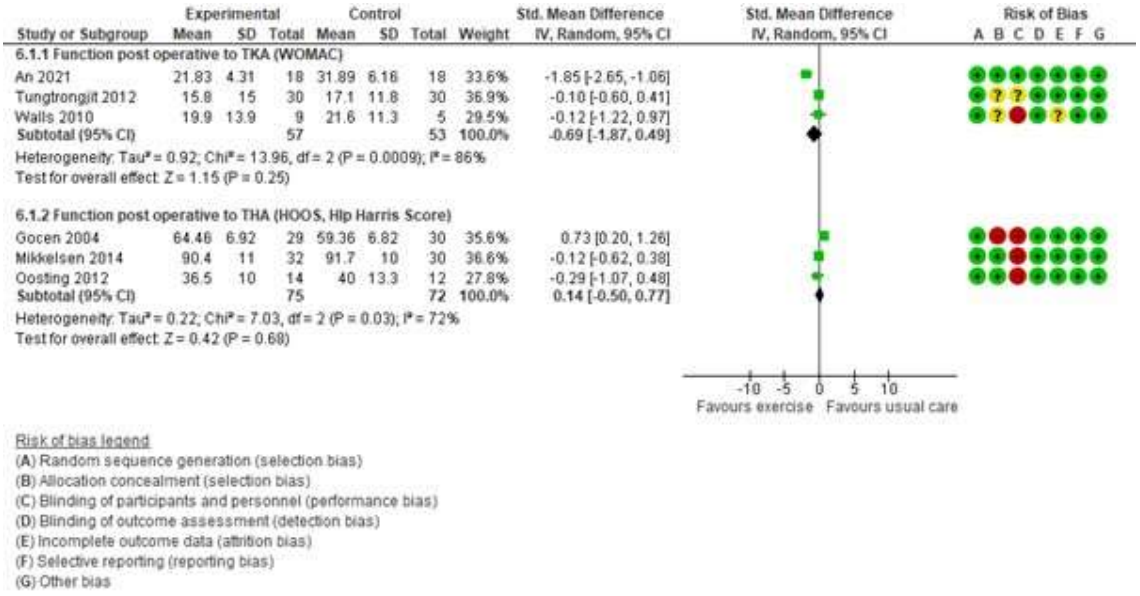


Figure 6: Effect of prehabilitation vs standard care on function post TKA and THA.

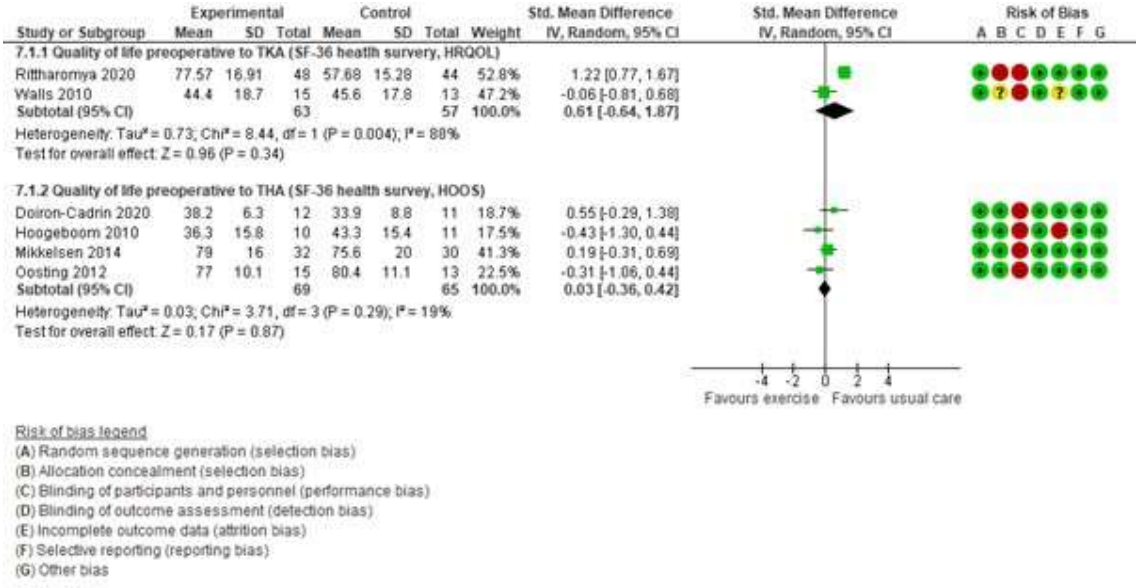


Figure 7: Effect of prehabilitation vs standard care on QoL prior to TKA and THA.

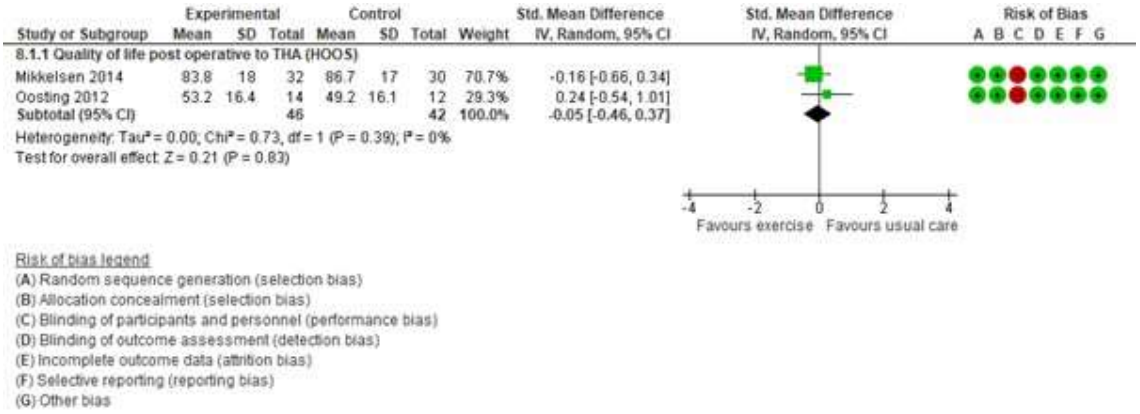


Figure 8: Effect of prehabilitation vs standard care on QoL post THA.

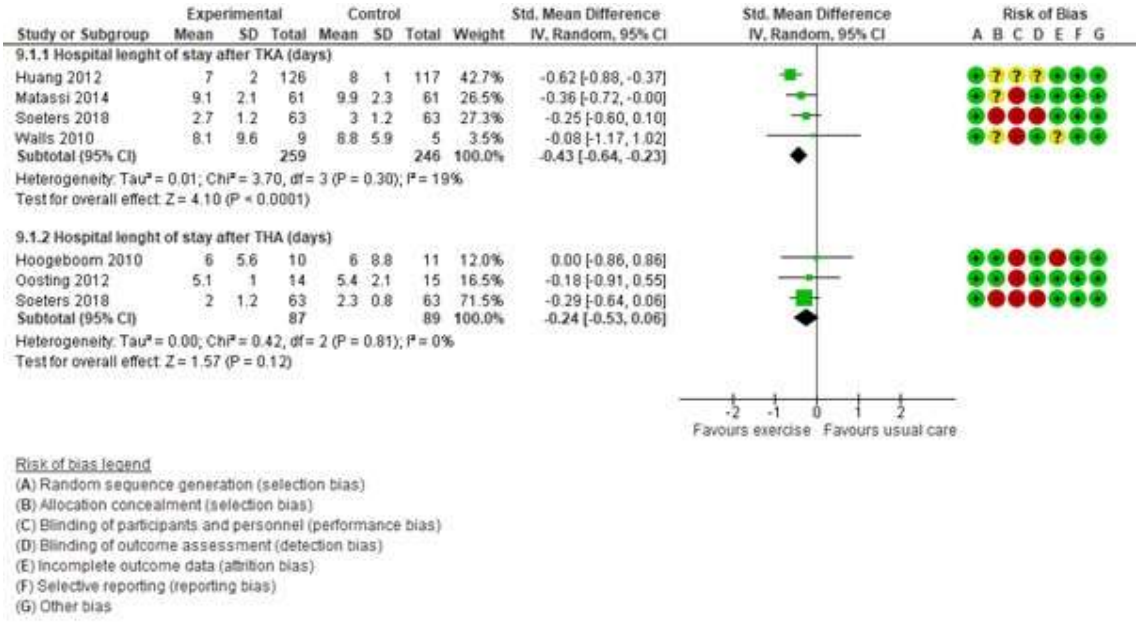


Figure 9: Effect of prehabilitation vs standard care on hospital length of stay (days) post TKA and THA.

<u>Supplementary Material:</u>

Supplement 1: Search Strategies.

CINAHL

1. *exp *Physical Therapy/*
2. *exp *EXERCISE/*
3. *exp *THERAPEUTIC EXERCISE/*
4. *exp *REHABILITATION/*

5. *exp *PREHABILITATION/*
6. *exp *PREOPERATIVE/*
7. *exp *HOME REHABILITATION, REMOTE, ONLINE, VIRTUAL/*
8. *exp *REHABILITATION, COMMUNITY-BASED, SELF-MANAGMENT/*
9. *exp *RESEARCH, REHABILITATION/*
10. *exp *REHABILITATION, GERIATRIC/*
11. *exp *physical activity/*
12. *exp *physical fitness/*
13. *exp *physical exertion/*
14. *exp *athletic training/*
15. *exp *physical training/*
16. *1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14*
17. *exp HIP/*
18. *exp HIP JOINT/*
19. *exp KNEE/*
20. *exp KNEE JOINT/*
21. *hip.mp. [mp=title, CINAHL subject headings, abstract, instrumentation]*
22. *knee.mp. [mp=title, CINAHL subject headings, abstract,instrumentation]*
23. *exp Hip Surgery/*
24. *exp Knee Surgery/*
25. *exp ARTHROPLASTY/*
26. *exp ARTHROPLASTY, REPLACEMENT/*
27. *exp ARTHROPLASTY, REPLACEMENT, HIP/*
28. *exp ARTHROPLASTY, REPLACEMENT, KNEE/*
29. *exp Joint Prosthesis/*
30. *joint replacement.mp. [mp=title, CINAHL subject headings, abstract, instrumentation]*
31. *arthroplasty.mp. [mp=title, CINAHL subject headings, abstract, instrumentation]*
32. *23 or 24 or 27 or 28*
33. *17 or 18 or 19 or 20 or 21 or 22*
34. *25 or 26 or 29 or 30 or 31*
35. *33 and 34*
36. *32 or 35*

37. *16 and 36*

MEDLINE

1. *exp *EXERCISE/*
2. *exp *REHABILITATION/*
3. *exp *PREHABILITATION/*
4. *exp *PREOPERATIVE/*
5. *exp *EXERCISE THERAPY/*
6. *exp *HOME REHABILITATION, REMOTE, ONLINE, VIRTUAL/*
7. *exp *REHABILITATION, COMMUNITY-BASED, SELF-MANAGMENT/*
8. *exp *Exercise Movement Techniques/*
9. *exp *Physical Therapy Modalities/*
10. *exp *"Physical Therapy (Specialty)"/*
11. *exercise.mp. [mp=title, abstract, CAS registry/ec number word, MeSH subject heading]*
12. *physiotherapy.mp. [mp=title, abstract, CAS registry/ec number word, MeSH subject heading]*
13. *physical therapy.mp. [mp=title, abstract, CAS registry/ec number word, MeSH subject heading]*
14. *exp *EXERTION/*
15. *exp *physical activity/*
16. *exp *physical fitness/*
17. *exp *physical training/*
18. *1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17*
19. *exp HIP/*
20. *exp HIP JOINT/*
21. *exp KNEE/*
22. *exp KNEE JOINT/*
23. *hip.mp. [mp=title, abstract, CAS registry/ec number word, MeSH subject heading]*
24. *knee.mp. [mp=title, abstract, CAS registry/ec number word, MeSH subject heading]*
25. *exp Joint Prosthesis/*

26. *exp Hip Prosthesis/*
27. *exp Knee Prosthesis/*
28. *exp "Prostheses and Implants"/*
29. *exp ARTHROPLASTY/*
30. *exp ARTHROPLASTY, REPLACEMENT/*
31. *exp ARTHROPLASTY, REPLACEMENT, HIP/*
32. *exp ARTHROPLASTY, REPLACEMENT, KNEE/*
33. *arthroplasty.mp.*
34. *joint replacement.mp.*
35. *23 or 24 or 25 or 26 or 27 or 28*
36. *19 or 20 or 21 or 22 or 23 or 24*
37. *29 and 30*
38. *31 or 32 or 33 or 34*

Pubmed

1. *exp *Physiotherapy/*
2. *exp *Physical Activity/*
3. *exp *EXERCISE, EXERCISE THERAPY/*
4. *exp *Kinesiotherapy/*
5. *exp *REHABILITATION/*
6. *exp *PREHABILITIATON/*
7. *exp *PREOPERATIVE/*
8. *exp *HOME REHABILITATION, REMOTE, ONLINE, VIRTUAL/*
9. *exp *REHABILITATION, COMMUNITY-BASED, SELF-MANAGMENT/*
10. *exp ARTHROPLASTY/*
11. *exp HIP ARTHROPLASTY/*
12. *exp KNEE ARTHROPLASTY/*
13. *exp JOINT PROSTHESIS/*
14. *exp Knee Prosthesis/*
15. *exp Hip Prosthesis/*
16. *exp HIP/*
17. *exp KNEE/*
18. *16 or 17*
19. *8 or 9*
20. *exp Total Knee Replacement/*

21. *exp Total Hip Prosthesis/*
22. *exp Knee Surgery/*
23. *exp Hip Surgery/*
24. *joint replacement.mp.*
25. *arthroplasty.mp.*
26. *8 or 9 or 10 or11 or 12 or 13 or 18 or 20 or 21 or 22 or 23 or 24 or 25*
27. *1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9*
28. *26 and 27*

ProQuest

1. *exp *Physical Therapy/*
2. *exp *EXERCISE/*
3. *exp *THERAPEUTIC EXERCISE/*
4. *exp *REHABILITATION/*
5. *exp *PREHABILITAITON/*
6. *exp *PREOPERATIVE/*
7. *exp *HOME REHABILITATION, REMOTE, ONLINE, VIRTUAL/*
8. *exp *REHABILITATION, COMMUNITY-BASED, SELF-MANAGEMENT/*
9. *exp *RESEARCH, REHABILITATION/*
10. *exp *REHABILITATION, GERIATRIC/*
11. *exp *physical activity/*
12. *exp *physical fitness/*
13. *exp *physical exertion/*
14. *exp *athletic training/*
15. *exp *physical training/*
16. *1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15*
17. *exp HIP/*
18. *exp HIP JOINT/*
19. *exp KNEE/*
20. *exp KNEE JOINT/*
21. *hip.mp. [mp=title, ProQuest subject headings, abstract, instrumentation]*
22. *knee.mp. [mp=title, ProQuest subject headings, abstract, instrumentation]*
23. *exp Hip Surgery/*
24. *exp Knee Surgery/*
25. *exp ARTHROPLASTY/*

26. *exp ARTHROPLASTY, REPLACEMENT/*
27. *exp ARTHROPLASTY, REPLACEMENT, HIP/*
28. *exp ARTHROPLASTY, REPLACEMENT, KNEE/*
29. *exp Joint Prosthesis/*
30. *joint replacement.mp. [mp=title, ProQuest, subject headings, abstract, instrumentation]*
31. *arthroplasty.mp. [mp=title, ProQuest, subject headings, abstract, instrumentation]*
32. *23 or 24 or 27 or 28*
33. *17 or 18 or 19 or 20 or 21 or 22*
34. *25 or 26 or 29 or 30 or 31*
35. *33 and 34*
36. *32 or 35*
37. *16 and 36*

Cochrane library

1. *exp *Physiotherapy/*
2. *exp *Physical Activity/*
3. *exp *EXERCISE, THERAPEUTIC EXERCISE*
4. *exp *Kinesiotherapy/*
5. *exp *REHABILITATION, COMMUNITY-BASED, SELF-MANAGEMENT/*
6. *exp *PREHABILITIATON/*
7. *exp *PREOPERATIVE/*
8. *exp *HOME REHABILITATION, REMOTE, ONLINE, VIRTUAL/*
9. *exp ARTHROPLASTY/*
10. *exp HIP ARTHROPLASTY/*
11. *exp KNEE ARTHROPLASTY/*
12. *exp JOINT PROSTHESIS/*
13. *exp Knee Prosthesis/*
14. *exp Hip Prosthesis/*
15. *exp HIP/*
16. *exp KNEE/*
17. *15 or 16*
18. *9 or 12*
19. *17 and 18*

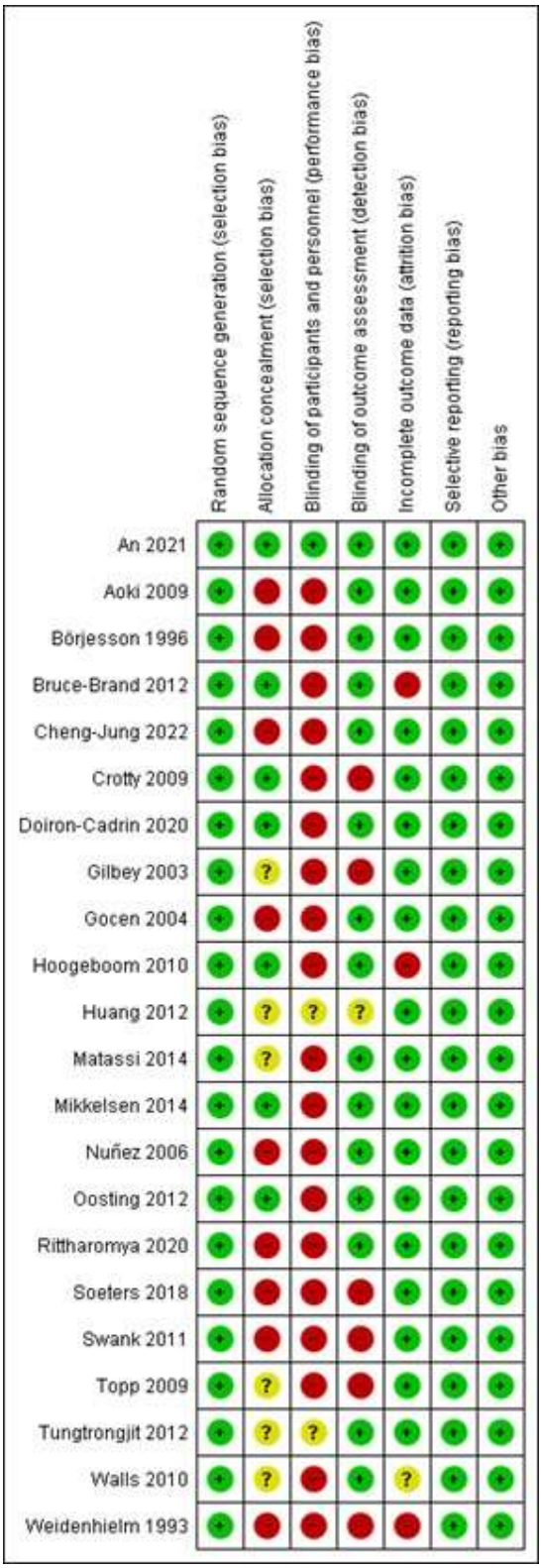
20. *exp Total Knee Replacement/*
21. *exp Total Hip Prosthesis/*
22. *exp Knee Surgery/*
23. *exp Hip Surgery/*
24. *joint replacement.mp.*
25. *arthroplasty.mp.*
26. *10 or 11 or 12 or 13 or 14 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25*
27. *1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9*
28. *26 and 27*

Google Scholar

1. exp *Physiotherapy/
2. exp *Physical Activity/
3. exp *EXERCISE, THERAPEUTIC EXERCISE
4. exp *Kinesiotherapy/
5. exp *REHABILITATION, COMMUNITY-BASED, SELF-MANAGEMENT/
6. exp *PREHABILITIATON/
7. exp *PREOPERATIVE/
8. exp *HOME REHABILITATION, REMOTE, ONLINE, VIRTUAL/
9. exp ARTHROPLASTY/
10. exp HIP ARTHROPLASTY/
11. exp KNEE ARTHROPLASTY/
12. exp JOINT PROSTHESIS/
13. exp Knee Prosthesis/
14. exp Hip Prosthesis/
15. exp HIP/
16. exp KNEE/
17. 15 or 16
18. 9 or 12
19. 17 and 18
20. exp Total Knee Replacement/

21. exp Total Hip Prosthesis/
22. exp Knee Surgery/
23. exp Hip Surgery/
24. joint replacement.mp.
25. arthroplasty.mp.
26. 10 or 11 or 12 or 13 or 14 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
27. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
28. 26 and 27

Supplement 2: Risk of Bias summary of Individual studies.


Random sequence generation (selection bias)
Allocation concealment (selection bias)
Blinding of participants and personnel (performance bias)
Blinding of outcome assessment (detection bias)
Incomplete outcome data (attrition bias)
Selective reporting (reporting bias)
Other bias
An 2021
Aoki 2009
Börjesson 1996
Bruce-Brand 2012
Cheng-Jung 2022
Crotty 2009
Doiron-Cadrin 2020
Gilbey 2003
Gocen 2004
Hoogeboom 2010
Huang 2012
Matassi 2014
Mikkelsen 2014
Nuñez 2006
Oosting 2012
Rittharomya 2020
Soeters 2018
Swank 2011
Topp 2009
Tungtrongjit 2012
Walls 2010
Weidenhielm 1993

1
2