Original Article

Does Rehabilitation before Total Knee Arthroplasty Benefit Postoperative Recovery? A Systematic Review

Abstract

Background: Arthritis is the most common form of joint disease. Total knee arthroplasty (TKA) is the most effective surgical intervention for end-stage knee osteoarthritis. The purpose of this study is to access whether patients who participated in preoperative rehabilitation before primary TKA received any postoperative benefit compared to patients who did not participate in preoperative rehabilitation. **Materials and Methods:** A comprehensive search of Medline, PubMed, Embase, CENTRAL, CINAHL, Ageline, and hand searching references and abstracts was performed. Inclusion criteria included patients undergoing primary and unilateral TKA. Exclusion criteria included patients who have bilateral, unicompartmental, or revision TKA. All studies compared preoperative exercise program versus no preoperative exercise. Outcomes included patients' function, acute care length of stay (LOS), pain, and stiffness. The Western Ontario and McMaster Universities Osteoarthritis Index and 36-Item Short-Form Health Survey functional scales were used to assess these outcomes. Assessment was performed within 3 months of TKA. **Results:** Of 1347 articles, 1308 studies were excluded during title and abstract screening. Thirty nine articles underwent full-text screening and were narrowed to five studies matching all criteria. Two studies were combined showing a significant decrease in LOS favoring preoperative exercise (−0.93, 95% confidence interval: −1.29, −0.57). There was a lack of evidence to show any difference regarding self-reported function, stiffness, pain, and physical role. **Conclusion:** Preoperative exercise program may be beneficial and is associated with a significant decrease in length of hospital stay. No conclusive evidence can be delineated from the literature with respect to clinical outcome measures. Well-designed randomized trials would strengthen this position.

Keywords: *Knee arthroplasty, outcomes, prerehabilitation, systemactic review*

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Introduction

Arthritis is the most common form of joint disease with radiographic evidence in up to 80% of the population by age 65. Total knee arthroplasty (TKA) is an effective method of pain relief and improving function.[1-6]

Patients awaiting TKA typically have advanced degenerative changes causing impaired muscle strength, decreased range of motion, altered balance, and global deconditioning.[5] These contribute to physical disability and alteration in gait mechanics.[7] Delayed diagnosis and treatment can lead to greater disability and deconditioning resulting in longer postoperative recovery, increased pain, and dysfunction.[5,8]

One method to minimize the effect of the overall deconditioning is to enroll patients into a physiotherapy program to decrease pain and increase function. These programs, often termed prehabilitation, are thought to benefit those treated nonoperatively for their arthritis. A Cochrane review of 2562 patients in 17 studies demonstrated benefits that included reduced pain and improved physical function in patients with osteoarthritis of the knee.[9] Prehabilitation is thought to be one method to delay or decrease the burden of patients requiring TKA.

Previous observational and randomized clinical trials ignited interest in focusing on preoperative rehabilitation and its potential effect on postoperative recovery. Observational studies have showed poor outcomes in those deconditioned compared to those with a higher baseline functional status.[5,8] The few randomized controlled trials (RCTs) focusing on prehabilitation showed an improvement while others showed little or no benefit.

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There have been attempts to assimilate the knowledge from randomized trials; however, each has their own unique challenges that limited the utilization of the information. Using the AMSTAR tool, we assessed the quality of the previous systematic reviews on the benefits of preoperative rehabilitation on postoperative recovery after TKA [Figure 1].[10-15] Using the AMSTAR scoring, we found multiple flaws.

The objective of our study is to use randomized control trials to determine whether preoperative rehabilitation in patients who undergo TKA offered any benefit in pain, function, range of motion, and length of stay (LOS) compared to patients who did not participate in a preoperative rehabilitation or exercise regimen. Using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), 36-Item Short-Form Health Survey (SF-36) scores, and hospital LOS, our primary objective is to assess patients' self-reported function and LOS in the hospital. Our secondary objectives are to assess function with respect to pain and stiffness.

Materials and Methods

A study protocol was created with *a priori* hypotheses and objectives. Patients included within the study protocol included those undergoing primary, unilateral, uncomplicated TKA. Studies that included bilateral, unicompartmental, and revision TKA were excluded from the study. Studies included trials with patients who underwent preoperative rehabilitation or an exercise program before their surgery, which was then continued postoperatively. These groups of patients were compared against a group of patients who did not participate in preoperative exercise- or rehabilitation-specific program. Primary outcomes assessed patients' function and length of hospital stay. Secondary outcomes include pain and stiffness. WOMAC and SF-36 functional scales were used to assess the outcomes of pain, function, and stiffness. Any effect was assessed within 3 months of the TKA. Only. RCTs were included in the study.

Medline (1946-2015), PubMed (1950-2015), Embase (1980-2015), CENTRAL, CINAHL (1982-2015), and Ageline (1966-2015) databases were selected to identify relevant studies. All relevant papers were hand searched and references reviewed looking for any further studies. Major orthopedic conferences' abstracts were also scanned for any relevant unpublished studies. For any unclear studies, the authors were contacted for clarification. All searches were performed on December 5, 2015 [Figure 2].

All identified articles were imported into Endnote x7 software (Clarivate Analytics. Philadelphia, PA. USA). Premade title and abstract screening and full-text screening forms were made to guide selection of appropriate RCTs. Using the premade forms, screening began with a comprehensive, inclusive title and abstract screening search. The two reviewers (RS and IA) then independently performed a full-text assessment using the full-text screening forms to identify the relevant articles to include in the review. A kappa statistic was used to measure the correlation between the two reviewers for the full-text screening. Any discrepancies were discussed between two reviewers.

To gather appropriate data to answer our primary and secondary outcomes, the WOMAC and SF-36 scale values were identified. Both these scales are well-validated tools with high reliability and validity on all categories. We extracted the data from the three categories of the WOMAC (pain, stiffness, and function) and extracted three of the eight domains of the SF-36 (bodily pain, physical role, and function). Finally, we looked at length of time in an acute care facility postoperatively.

Risk of bias testing was addressed at both the study and outcome level. At the study level, the risk of bias

AMSTAR Categories	Silkman et al.	Coudeyre et al.	Ackerman et al.
A Priori Design	NO	NO	YES
Duplicate selection/extraction	NO	YES	NO
comprehensive lit search	NO	YES	YES
Grey Literature included	NO	NO	NO
List of included/excluded	YES	NO	NO
Charcteristics of included	YES	YES	YES
Quality of included	YES	YES	YES
Quality used form conclusions	NO	NO	NO
Combining methods appropriate	N/A	N/A	YES
Publication Bias Assessed	NO	NO	YES
conflict interest stated	NO	NO	YES
	7 NO; 3 Yes	6 NO; 4 YES	4 NO; 7 YES

Figure 1: Amstar categories

#	Searches	Results	Search Type
1	Preoperative Care/	50195	Advanced
2	Physical Therapy Modalities/ or Physical Therapy Specialty/	29104	Advanced
3	pre-operative physiotherapy.ab,ti.	7	Advanced
4	preoperative physiotherapy.ab,ti.	21	Advanced
5	prehabilitation.ab,ti.	57	Advanced
6	pre-operative rehabilitation.ab,ti.	8	Advanced
7	preoperative rehabilitation.ab,ti.	34	Advanced
8	pre-operative exercise.ab,ti.	5	Advanced
9	preoperative exercise.ab,ti.	112	Advanced
10	exercise before surgery.ab,ti.	4	Advanced
11	rehabilitation before surgery.ab,ti.	1	Advanced
12	rehabiliation prior surgery.ab,ti.	0	Advanced
13	presurgical.ab,ti.	5006	Advanced
14	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	83429	Advanced
15	Arthroplasty, Replacement, Knee/ or Arthroplasty/ or Arthroplasty, Replacement, Hip/	31718	Advanced
16	total hip arthroplasty.ab,ti.	8996	Advanced
17	total knee arthroplasty.ab,ti.	7712	Advanced
18	tha.ab,ti.	4428	Advanced
19	tka.ab,ti.	3269	Advanced
20	hip replacement.ab,ti.	7551	Advanced
21	knee replacement.ab,ti.	4715	Advanced
22	hip arthroplasty.ab,ti.	11141	Advanced
23	knee arthroplasty.ab,ti.	9752	Advanced
24	15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23	44252	Advanced
25	Randomized Controlled Trials as Topic/ or Randomized Controlled Trial/	446072	Advanced
26	randomized controlled trial.pt.	362054	Advanced
27	controlled clinical trial.pt.	87462	Advanced
28	randomized. ab.	262574	Advanced
29	placebo. ab.	142174	Advanced
30	randomised. ab.	51546	Advanced
31	randomly. ab.	187448	Advanced
32	clinical trials as topic.sh.	167631	Advanced
33	trial.ti.	112531	Advanced
34	25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33	889663	Advanced
35	14 and 24 and 34	261	Advanced

Figure 2: Summary of searches

was assessed using the Cochrane Collaboration tool for assessing the risk of bias. With respect to reviewing the level of outcomes in the studies we reviewed, the risk of bias was assessed and summarized [Figures 3 and 4]. Using these figures, the extent of bias was reviewed to determine if these results could be trusted for clinical application. Finally, within each outcome, funnel plots were examined to look for any exaggerated studies that could represent publication bias.

No discrepancies were found between the two reviewers. Once the data were collected, the principal summary measure was determined to be the mean difference, as all outcomes were deemed to be continuous variables. The data were extracted from relevant studies and imported into the Review Manager 5 software (*Review Manager (RevMan) [Computer program]. Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014.*

Results

Detailed search produced 1594 results. Hand searching references, abstracts, and contacting authors did not produce any additional articles. After removal of 247 duplicate articles, 1347 articles were used for the title and abstract screening. Nearly 1308 studies were excluded during this process. The remaining 39 articles were used for full-text eligibility screening. Of the 39 studies, 34 were excluded from the study. Reasons for exclusion included three duplicates not previously identified, five studies reviewed included outcomes not of interest, three were systematic reviews of RCTs, ten were not randomized controlled clinical trials, ten studies only included total hip arthroplasty, and three studies involved highly specific patient population that was not amenable to be included into the systematic review [Figure 5].[16-23] Kappa correlation for the full-text review was 0.87 (standard error = 0.16). This resulted from a discrepancy in one study due to the

Prehabilitation prior to total knee arthroplasty compared to no prehabilitation for better patient satisfaction

Patient or population: Unilateral, uncomplicated, primary total knee arthroplasty
Settings: Primary Care Hospitals
Intervention: Prehabilitation prior to total knee arthroplasty
Comparison: no prehabilitation

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk **No prehabilitation**	Corresponding risk **Prehabilitation prior to total knee arthroplasty**				
Length of Stay Scale from: 6.7 to 8.	The mean length of stay in the control groups was **7.65 days**	The mean length of stay in the intervention groups was **0.93 lower** (1.29 to 0.57 lower)		358 (2 studies)	⊕⊕⊕⊖ **moderate**[1,2,3]	
WOMAC Function Scale from: 1.2 to 26.4. Follow-up: mean 8.7 weeks	The mean womac function in the control groups was **11.5**	The mean womac function in the intervention groups was **0.30 lower** (0.76 lower to 0.16 higher)		289 (4 studies)	⊕⊖⊖⊖ **very low**[1,2,4]	
WOMAC Stiffness Scale from: 1.1 to 3.9. Follow-up: mean 9.5 weeks	The mean womac stiffness in the control groups was **2.87**	The mean womac stiffness in the intervention groups was **0.00 higher** (0.42 lower to 0.41 higher)		261 (3 studies)	⊕⊖⊖⊖ **very low**[1,2,4]	
WOMAC Pain Scale from: 0.98 to 5. Follow-up: mean 9.5 weeks	The mean womac pain in the control groups was **3.90**	The mean womac pain in the intervention groups was **0.06 higher** (0.36 lower to 0.48 higher)		290 (4 studies)	⊕⊖⊖⊖ **very low**[1,2]	
SF-36 Function Scale from: 41.6 to 53.1. Follow-up: mean 10.6 weeks	The mean sf-36 function in the control groups was **48.5**	The mean sf-36 function in the intervention groups was **4.05 lower** (9.63 lower to 1.53 higher)		252 (3 studies)	⊕⊖⊖⊖ **very low**[1,2]	
SF-36 Physical Role Scale from: 23.2 to 49.9. Follow-up: mean 10.6 weeks	The mean sf-36 physical role in the control groups was **33.5**	The mean sf-36 physical role in the intervention groups was **1.02 higher** (8.02 lower to 10.07 higher)		252 (3 studies)	⊕⊖⊖⊖ **very low**[1,2,4]	
SF-36 Bodily Pain Scale from: 46.6 to 68.1. Follow-up: mean 10.6 weeks	The mean sf-36 bodily pain in the control groups was **57.5**	The mean sf-36 bodily pain in the intervention groups was **2.63 lower** (7.75 lower to 2.49 higher)		252 (3 studies)	⊕⊖⊖⊖ **very low**[1,2]	

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval;

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

[1] Large Bias noted in primary studies including attrition bias, lack of blinding and poor concealment of allocation
[2] Wide CI that includes null effect and both treatment and control groups
[3] large overall effect with p<0.00001 and CI from -1.29 to -0.57 with very little heterogeneity with I2=0%
[4] One favors control while other favors treatment group

Figure 3: Summary of findings

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Prehabilitation prior to total knee arthroplasty	No prehabilitation	Relative (95% CI)	Absolute		
Length of Stay (range of scores: 6.7-8; Better indicated by lower values)												
2	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	strong association[3]	181	177	-	MD 0.93 lower (1.29 to 0.57 lower)	⊕⊕⊕O MODERATE	CRITICAL
WOMAC Function (follow-up mean 8.7 weeks; range of scores: 1.2-26.4; Better indicated by lower values)												
4	randomised trials	very serious[1]	serious[4]	no serious imprecision	serious[2]	none	139	150	-	MD 0.30 lower (0.76 lower to 0.16 higher)	⊕OOO VERY LOW	CRITICAL
WOMAC Stiffness (follow-up mean 9.5 weeks; range of scores: 1.1-3.9; Better indicated by lower values)												
3	randomised trials	very serious[1]	serious[4]	no serious indirectness	serious[2]	none	126	135	-	MD 0.00 higher (0.42 lower to 0.41 higher)	⊕OOO VERY LOW	IMPORTANT
WOMAC Pain (follow-up mean 9.5 weeks; range of scores: 0.98-5; Better indicated by lower values)												
4	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	140	150	-	MD 0.06 higher (0.36 lower to 0.48 higher)	⊕OOO VERY LOW	IMPORTANT
SF-36 Function (follow-up mean 10.6 weeks; range of scores: 41.6-53.1; Better indicated by lower values)												
3	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	122	130	-	MD 4.05 lower (9.63 lower to 1.53 higher)	⊕OOO VERY LOW	IMPORTANT
SF-36 Physical Role (follow-up mean 10.6 weeks; range of scores: 23.2-49.9; Better indicated by lower values)												
3	randomised trials	very serious[1]	serious[4]	no serious indirectness	serious[2]	none	122	130	-	MD 1.02 higher (8.02 lower to 10.07 higher)	⊕OOO VERY LOW	IMPORTANT
SF-36 Bodily Pain (follow-up mean 10.6 weeks; range of scores: 46.6-68.1; Better indicated by lower values)												
3	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	122	130	-	MD 2.63 lower (7.75 lower to 2.49 higher)	⊕OOO VERY LOW	IMPORTANT

[1] High risk of Bias noted in primary studies due to large number of participants lost to follow-up, lack of blinding of patients, care-givers and outcome assessors, and poor concealment of allocation
[2] Wide CI that includes clinically relevant benefit and clinically relevant harm
[3] large overall effect with p<0.00001 and CI from -1.29 to -0.57 with very little heterogeneity with I2=0%
[4] One favors control while other favors treatment group

Figure 4: Grade reporting

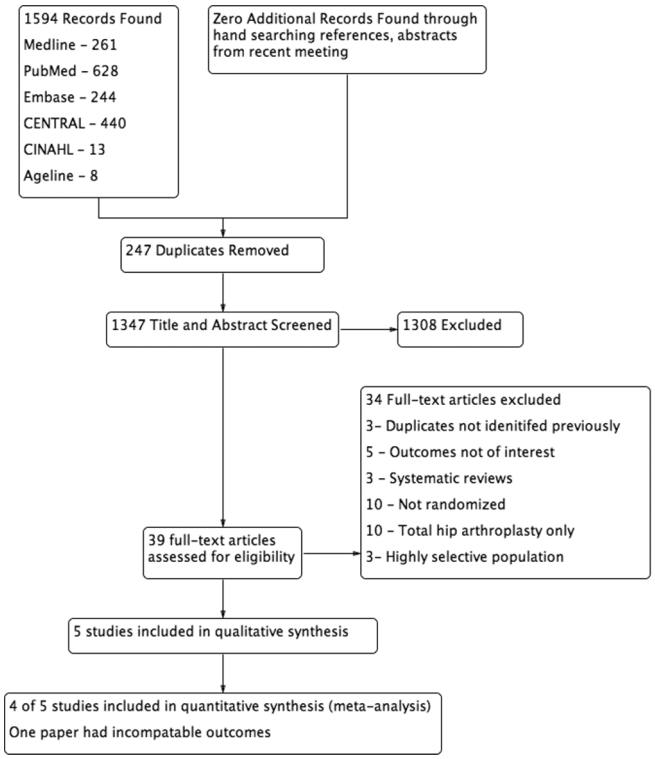

Figure 5: Prisma flow diagram

unconventional outcomes.[24] However, since it contained appropriate length of hospital stay data, we agreed for it to be included within the systematic review.

Five papers were selected for inclusion in this systematic review. To address our objectives regarding the WOMAC categories (pain, stiffness, and function), four studies qualified to be enrolled.[24-27] Of the four studies, one by Beaupre *et al*. transformed the WOMAC data to correlate with the SF-36 scale. In order to transform this back to match the conventional 10-point visual analog format, the results of the paper required a calculated transformation. A sensitivity analysis with and without this paper was performed to verify that the calculation did not produce spurious results. The results from both inclusion and exclusion of the study lead to similar results. In addition, within the funnel plot, no study was found to be overtly different [Figure 6]. With the inclusion of these results, the confidence intervals (CIs) tightened in all three cases for the WOMAC function, pain, and stiffness and therefore leading to a stronger analysis of the results.

To address the three SF-36 domains of interest, three RCTs were eligible.[24,26,27] To address LOS in the acute care hospital, two studies were eligible to enroll[28,24] [Figure 7].

Observing the demographics of the patient population across studies, there is little difference observed [Figure 8].

Overall, there was a high loss to followup or completion of study throughout all studies except for one (Huang *et al*.[26]). Two studies (Gstoettner *et al*.[29] and Rooks *et al*.[30]) had very small patient populations.

Two studies examined the LOS in an acute care facility after TKA [Figure 9a]. Combined, the studies included 181 patients in the treatment group and 177 patients in the control group. The mean difference was found to be −0.93 (95% CI: −1.29, −0.57). The CI was not found to cross the line of no effect. The test for overall effect was found to be statistically significant in favor of preoperative rehabilitation (Z = 5.10; $P < 0.00001$). No heterogeneity was identified ($\chi^2 = 0.69$ and $I^2 = 0\%$).

WOMAC	With Paper		Without paper	
	MD	95% CI	MD	95% CI
Function	-0.3	-0.76, 0.16	-0.7	-1.39, 0.00
Stiffness	0	-0.42, 0.41	0.06	-0.48. 0.60
Pain	0.06	-0.36, 0.48	0.21	-0.38, 0.79

Figure 6: Western Ontario and McMaster Universities Osteoarthritis index results

Functional outcomes were assessed using both the WOMAC and SF-36 regarding self-reported function. Four papers were applicable for the meta-analysis evaluating WOMAC function [Figure 9b]. The total sample size included 139 patients in the prehabilitation group versus 150 patients in the control group. Using the random-effects model, mean difference was found to be −0.30 (95% CI: −0.76, 0.16). The CI was found to cross the no effect line. The test for overall effect was not found to be statistically significant ($P = 0.20$ and Z = 1.29). No heterogeneity was found ($\chi^2 = 0.47$, $I^2 = 0\%$). Three studies were available to review with respect to SF-36 function [Figure 9c]. The total treatment population included 122 patients and 130 controls. Using

Source	Funding	Methodological Quality	Intervention/ Comparison	Participants	Location of Study	Outcomes
Beaupre et al. 2004	Not Reported	No Random Sequence generation, poor allocation concealment (envelopes), 20% loss to follow-up (see participants column), high attrition bias with 80% data collected and imputation required. Unclear blinding and reporting bias	Strengthening and Resistance training, Range of Motion and Education program. 3/week, 4 weeks. 3,6,12 month follow-up Compared to usual care without formal exercise	40-75yo, non-inflammatory arthritis, primary TKA in single center 130 enrolled (66C,65T), 22 withdrew, total completed = 58C, 51T	Canada	- WOMAC - SF-36 - ROM- goniometer - Strength - dynamometer
Gstoettner et al. 2011	Not Reported	No Random Sequence Generation, poor Allocation concealment (envelopes). Blinding, attrition bias and reporting bias all unclear	Proprioception training, walking and stretching 1/week, 6 weeks compared to no training. 6 weeks follow-up	Unilateral severe OA for primary TKA without more than one joint pain in single center 50 eligible, 38 enrolled, 4 drop out in treatment group, total = 14T, 20C	Austria	- WOMAC - Knee Society Score - Gait Speed – 60m timed walk - Balance Test – Biod Stability System
Huang et al. 2012	Not Reported	No Random Sequence generation, poor allocation concealment (envelopes), unclear blinding, reporting and attrition bias. No loss to follow-up	Home Exercise program, thigh muscle strengthening and education program 1/day home, 4 weeks compared to no exercise, usual care	Unilateral primary TKA, commit to rehab program, non-inflammatory, no condition where moderate exercise contraindicated in single center 243 enrolled, no drop out = 126T, 117C	Taiwan	- Length of Stay - VAS Pain - ROM - goniometer - Medical Cost
Mitchell et al. 2005	NHS Research Developm ent Grant	Random Sequence generated, fair allocation concealment, no reporting bias detected. High attrition bias (see participants column), no reporting of blinding	Home Exercise Daily. Flexion/Extension, gait re-education, home/functional adaptations 1/day home, 8 weeks compared to only post-op physiotherapy. 12 week follow-up	Primary unilateral TKA, no revision, bilateral or terminal illness or contralateral knee <12 months in single center 160 enrolled (80 per arm); 45 withdrew; Total completed = 57 T, 22C	United Kingdom	- WOMAC - SF-36 - Economic Analysis
Rooks et al. 2006	NIH grant	High attrition bias, 12% enrollment, 50% drop out, no information on concealment, random sequence generation, blinding of physicians or data analyst. Outcome assessment blinded. Unclear reporting bias	Water and land based exercise, total body fitness, flexibility training and education booklet 3/week, 6 weeks compared to education only. 8, 26 week follow-up	Unilateral, primary TKA, non-inflammatory or other conditions precluding moderate exercise, no bilateral TKA, single center 45 Enrolled (22 T, 23C), 16 Drop out (8 per group)= total completed 14 (T), 15C	United States of America	- WOMAC - SF-36 - Performance test – repetition max leg press - Balance test – functional reach test - Mobility test –time up and go test

TKA – total knee arthroplasty
WOMAC – Western Ontario and McMaster University Osteoarthritis Index
SF-36 – Short form 36
ROM – Range of Motion
OA – Osteoarthritis
VAS – Visual Analogue Scale for pain
T – Treatment Group = Pre-operative exercise program
C- Control Group = no pre-operative exercise program

Figure 7: Enrolled studies

	Age, years (mean(SD))		Female (number (%))		BMI (SD)	
	Control	Intervention	Control	Intervention	Control	Intervention
Beaupre et al	67 (7)	67 (6)	29 (50)	31 (60)	31 (5)	32(6)
Gstoettner et al	72.8	66.9	14 (70)	16 (89)	28.2	27.4
Huang et al	69.8(7.2)	70.5 (7.4)	86 (73.5)	88 (69.8)	27.2 (4.5)	27.1 (4)
Mitchell et al	70.6 (8.2)	70.0 (7.2)	30 (52.6)	36 (63.2)	Not reported	Not reported
Rooks et al	69 (8)	65 (8)	9 (57)	7 (50)	33.9 (6.5)	35.7 (9.2)

BMI – Body Mass Index
SD – Standard Deviation

Figure 8: Patient demographics

the random-effects model, the mean difference was found to be −4.05 (95% CI: −9.63, 1.53). This CI crosses the line of no effect. The test of overall effect was not found to be significant (P = 0.15; Z = 1.42). No significant heterogeneity was found (χ^2 = 0.50, I^2 = 0%).

Secondary outcomes were assessed using the WOMAC pain and SF-36 bodily pain values. Four studies were appropriate to review with respect to WOMAC pain [Figure 9d]. Using the random-effects model, the mean difference was found to be 0.06 (95% CI: −0.36, 0.48). The CIs cross the line of no effect. The test for overall effect was not significant (P = 0.78, Z = 0.28). No significant heterogeneity was found (χ^2 = 0.80, I^2 = 0%). Three studies were included in the analysis of SF-36 bodily pain [Figure 9e]. One hundred and twenty two patients in total were in the treatment group whereas 130 patients were found in the no prehabilitation group. Using the random-effects model, the mean difference was found to be −2.63 (95% CI: −7.75, 2.49). The CI crossed the line of no significance. The test for overall effect was not significant (P = 0.31). No significant heterogeneity was found (χ^2 = 0.59, I^2 = 0%).

Three studies were included in the review of WOMAC stiffness [Figure 9f]. This involved 126 patients who underwent prehabilitation versus 135 control patients. Using the random-effects model, the mean difference lay on the line of no effect, 0.00 (95% CI: −0.42, 0.41). The test for overall effect was not found to be significant (P = 0.98; Z = 0.02). No significant heterogeneity was found (χ^2 = 0.65, I^2 = 0%).

Three studies were included in the review of SF-36 physical role [Figure 9g]. One hundred and twenty two patients were in the treatment group versus 130 patients in the no prehabilitation group. Using the random-effects model, the mean difference was found to be 1.02 (95% CI: −8.02, 10.07). The CI crosses the line of no effect. No significant heterogeneity was found (χ^2 = 0.45, I^2 = 0%).

The risk of bias across each outcome was performed using the GRADE criteria. The GRADE criteria aim to classify the quality of a recommendation based on the strength of evidence. The GRADE criteria use the design of the study, risk of bias, inconsistency, indirectness, imprecision, and other considerations to create a judgment on the quality of evidence [Figure 10].

Due to the low quality of randomized clinical trials, all outcomes have a great risk of bias and all have imprecise results with large CIs. As a result, all outcomes except for LOS resulted in "very low" grade of evidence. LOS resulted in a "moderate" quality of GRADE evidence. This outcome was upgraded since there was a strong association and large overall effect with P < 0.00001 with very low heterogeneity (I^2 = 0%).

All outcomes were homogeneous [Figure 9a-g]. All outcomes had an I^2 of 0% while no overt imbalance was noted within the funnel plots. Since all studies were homogenous, no further analyses or subgroup analyses were necessary.

Discussion

This study examines whether preoperative physiotherapy improves the outcome after TKA. Our primary outcomes included LOS in the hospital and knee function as per the WOMAC and SF-36 scales. Our secondary outcomes included postoperative pain, stiffness, and physical role.

There are multiple strengths of this review. We performed a complete search of all the available literature. We did not limit our search to the English language and performed hand searches of references and abstracts from recent conferences. We also attempted to contact authors when necessary. Our study was performed in duplicate with strong agreement between reviewers. We examined risks of bias across both studies and outcomes to present the results accurately.

Limitations did exist within this paper. There was no uniformity in our preoperative exercise program. We included any program which encouraged range of motion and strengthening exercises. Second, we felt that the self-reported outcomes were most important in the 3 months following TKA and thus only included studies that offered outcomes at the 3-month postoperative mark. However, the lack of heterogeneity in the results may have alleviated the impact of these potential limitations.

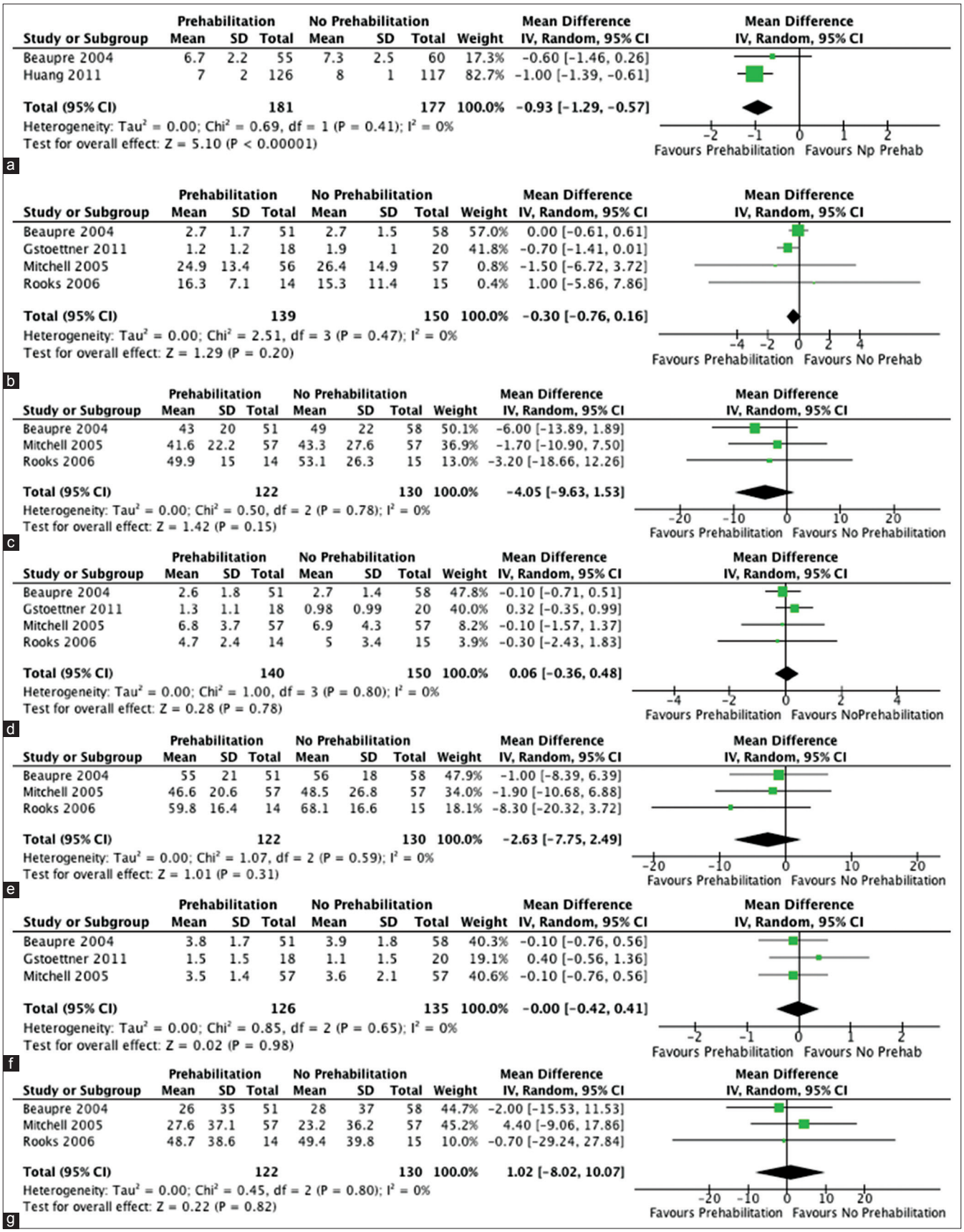

Figure 9: (a) Length of stay. (b) Western Ontario and McMaster Universities Osteoarthritis index function. (c) 36-Item Short-Form Health Survey function. (d) Western Ontario and McMaster Universities Osteoarthritis index Pain. (e) 36-Item Short-Form Health Survey pain. (f) Western Ontario and McMaster Universities Osteoarthritis index stiffness. (g) 36-Item Short-Form Health Survey physical role

In assessing the risk of bias and quality of included studies, the quality of available literature is poor. In fact, looking at the Grade profiles [Figure 10], all outcomes except for LOS in the hospital arise from very poor quality of evidence. The failure of included randomized clinical trials to reduce bias lowers the internal validity of included studies. Imprecision of estimates, wide CIs, and small patient populations that did not reach the estimated power in nearly all studies, seriously limits the applicability of RCT study results. However, the very low heterogeneity and therefore higher reliability (I^2 = 0% and insignificant Chi-square test for homogeneity) across all included studies do help strengthen the overall findings of this study.

LOS in the hospital was the only outcome that rated "moderate" as per the GRADE criteria. The upgrade was accepted compared to other outcomes, as there was a large estimate of effect (P < 0.00001) and smaller CIs (−1.29, −0.57). There was very little heterogeneity across the two included studies (I^2 = 0%, χ^2 = 0.69).

Although limited by the quality of the studies available in the literature, this review did show that preoperative physiotherapy reduced acute care hospital stay after TKA when compared to patients who did not have preoperative therapy (−0.93, 95% CI: −1.29, −0.57, Z-test for overall effect P < 0.00001). As health care organizations are forced to work with smaller budgets and are asked to provide efficient care, this finding is significant since decreasing the postoperative hospital stay following total knee replacement can decrease the medical cost per patient.

Our second primary outcome involved examining overall patient function less than or equal to 3 months after surgery. Both the WOMAC and SF-36 had similar results. In both cases, there was no benefit noted with the CIs crossing the line of no effect. In the case of the WOMAC function, the mean difference was found to be −0.30 (95% CI: −0.76, 0.16 and Z-test for overall effect, P = 0.20). In the case of the SF-36, the mean difference was −4.05 (95% CI: −9.63, 1.53 and Z-test for overall effect P = 0.15). In both cases, there was a tendency toward favoring prehabilitation; however, there was insufficient evidence to show any effect with the current data.

Examining the secondary outcomes, SF-36 physical role (1.02 95% CI: −8.02, 10.07), WOMAC stiffness (−0.00 95% CI: −0.42, 0.41), and WOMAC pain (0.06 95% CI: −0.36, 0.48) all had the mean difference centered on the line of no significance. Limited data is available to conclude preoperative physiotherapy and any effect of it on these postoperative outcomes. There was a

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Prehabilitation prior to total knee arthroplasty	No prehabilitation	Relative (95% CI)	Absolute		
Length of Stay (range of scores: 6.7-8; Better indicated by lower values)												
2	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[2]	strong association[3]	181	177	-	MD 0.93 lower (1.29 to 0.57 lower)	⊕⊕⊕O MODERATE	CRITICAL
WOMAC Function (follow-up mean 8.7 weeks; range of scores: 1.2-26.4; Better indicated by lower values)												
4	randomised trials	very serious[1]	serious[4]	no serious imprecision	serious[2]	none	139	150	-	MD 0.30 lower (0.76 lower to 0.16 higher)	⊕OOO VERY LOW	CRITICAL
WOMAC Stiffness (follow-up mean 9.5 weeks; range of scores: 1.1-3.9; Better indicated by lower values)												
3	randomised trials	very serious[1]	serious[4]	no serious indirectness	serious[2]	none	126	135	-	MD 0.00 higher (0.42 lower to 0.41 higher)	⊕OOO VERY LOW	IMPORTANT
WOMAC Pain (follow-up mean 9.5 weeks; range of scores: 0.98-5; Better indicated by lower values)												
4	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	140	150	-	MD 0.06 higher (0.36 lower to 0.48 higher)	⊕OOO VERY LOW	IMPORTANT
SF-36 Function (follow-up mean 10.6 weeks; range of scores: 41.6-53.1; Better indicated by lower values)												
3	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	122	130	-	MD 4.05 lower (9.63 lower to 1.53 higher)	⊕OOO VERY LOW	IMPORTANT
SF-36 Physical Role (follow-up mean 10.6 weeks; range of scores: 23.2-49.9; Better indicated by lower values)												
3	randomised trials	very serious[1]	serious[4]	no serious indirectness	serious[2]	none	122	130	-	MD 1.02 higher (8.02 lower to 10.07 higher)	⊕OOO VERY LOW	IMPORTANT
SF-36 Bodily Pain (follow-up mean 10.6 weeks; range of scores: 46.6-68.1; Better indicated by lower values)												
3	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	122	130	-	MD 2.63 lower (7.75 lower to 2.49 higher)	⊕OOO VERY LOW	IMPORTANT

[1] High risk of Bias noted in primary studies due to large number of participants lost to follow-up, lack of blinding of patients, care-givers and outcome assessors, and poor concealment of allocation
[2] Wide CI that includes clinically relevant benefit and clinically relevant harm
[3] large overall effect with p<0.00001 and CI from -1.29 to -0.57 with very little heterogeneity with I2=0%
[4] One favors control while other favors treatment group

Figure 10: Quality of evidence

slight tendency for SF-36 bodily pain to favor preoperative physiotherapy (−2.63, 95% CI: −7.75, 2.49); however, the CI did cross the line of no effect, while the WOMAC pain centered more closely to the line of no effect.

Function and pain were examined both within the SF-36 and the WOMAC scales. In three out of four studies, all patients were scored using both the SF-36 and the WOMAC scales. Therefore, combining these outcomes using standardized mean difference was of little value since they represent data from the same set of patients. One study by Gstoettner *et al*. examined only the WOMAC. This study only included 18 patients within the treatment group and 20 within the control group. The value of combining the data using standardized mean difference was minimal.

It is unfortunate that all aspects of self-reported postoperative outcomes produced inconclusive results. In determining the success or failure of an operation, patient-perceived care outweighs all other methods of judging surgical outcomes. However, since these conclusions are derived from poor research studies, there is ample opportunity for further research to examine the effects of preoperative exercise program. Furthermore, although the evidence favored a decreased LOS in patients who had preoperative therapy, having higher quality studies would allow us to further examine this effect and narrow the CIs.

Conclusion

Preoperative physical therapy lowered acute hospital LOS following TKA. Clinical outcome measures, which included the use of SF-36 and WOMAC scores, were inconclusive; this study demonstrates the need for further research in the form of randomized control trials to improve the overall quality of evidence available.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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