

Preoperative Education and Training for Patients Undergoing Knee Replacement Surgery: A Systematic Review

Said Nasser Al-Harthy ■ Manal Amur Al-Hanshi ■ Cyruz P. Tuppal

Abstract

Osteoarthritis (OA) is the most common disabling musculoskeletal disorder worldwide, and its prevalence is rising in the United States, England and Wales, and Oman. Knee replacement is a common surgical procedure but integrating the multidisciplinary rehabilitation team, preoperative pre-education program contribute to pain relief much more on the quality of life among patients.

Evidence suggests that pre-operative treatment by a physiotherapist did not improve patient reported outcomes. The combination of pre-operative education and treatment by a physiotherapist may reduce the medical costs associated with surgery. On the contrary, a plethora of evidence may need to further yield confirmatory results.

Keywords: Preoperative Education. Training. Patients.
Knee Replacement Surgery. Systematic Review

Said Nasser Al-Harthy

*Oman Specialized Nursing Institute, Ministry of Health, Muscat,
Sultanate of Oman Honorary Tutor, Cardiff University*

Manal Amur Al-Hanshi

*Nurse-in-Charge, Khoula Hospital, Ministry of Health, Muscat,
Sultanate of Oman*

Cyruz P. Tuppal, Ph.D.

*Professor II, St. Dominic College of Asia
Adjunct Professor, Doctoral Studies, St. Paul University Philippines System,
Adjunct Professor, Graduate Studies Executive Program, Universitas
Pelita Harapan, Jakarta, Indonesia
ctuppal@spup.edu.ph*

Introduction

Knee replacement has revolutionized the care of patients with severe knee Osteoarthritis (OA) by relieving pain and improving quality of life (Heck, Robinson, Partridge, Lubitz, & Freund, 1998; Kane, Saleh, Wilt, & Bershadsky, 2005). It is a common surgical procedure. In the USA for example, 540,000 knee replacements were carried out in 2006 (DeFrances, Lucas, Buie, & Golosinskiy, 2008) and England and Wales over 93,000 knee procedures were conducted in 2012 National Joint Registry (2014). In Oman over 11, 000 knee replacements were performed in 2015 by the Ministry of Health (Ministry of Health Oman, 2017). In practice, patient who after the operation received exercise by the physiotherapist, and it is evident showing the shortening of hospital stay and increased the range of movement (Hughes, Kuffner, & Dean, 1993; Shoji, Solomonow, Yoshino, D'Ambrosia, & Dabezies, 1990). The multidisciplinary rehabilitation team preoperative has shown to improve outcomes (Khan, Ng, Gonzalez, Hale, & Turner-Stokes, 2008; Larsen, Hansen, Thomsen, Christiansen, & Soballe, 2009). Adding education program for pre-operative patients with adequate information and address realistic expectation of outcome, as patient expectations are known to have an impact both on functional outcome and quality of life after joint replacement (Mahomed et al., 2002). Pre-operative education and exercise by the multidisciplinary team could improve post knee replacement surgery.

Cochrane Library, Joanna Briggs Institute Library of Systematic Reviews (JBI) (The Joanna Briggs Institute, 2014), MEDLINE and DARE databases were consulted to establish whether a recent report on pre-education and training for knee replacement patients exists. From these databases, prevented the duplication of available resources for review. This search identified only two reviews (Jordan et al., 2014; McDonald, Page, Beringer, Wasiak, & Sprowson, 2014). Each report provides understanding of the impact of pre-education and training for knee replacement patients on post-operative health outcome. However, mixed results concluded that pre-education and training were not effective in improving the outcome. It is important to note that a lack of sufficient evidence of the effectiveness of pre-education and training for knee replacement patients does not necessarily equate to proof of ineffectiveness. Rather, this presents an opportunity for searching, synthesizing, and summarizing the available evidence on the effectiveness of pre-education and training for knee replacement patients in hospitals and recommendations for future research directions. The systematic review profiled in this paper searched, extracted, appraised, and synthesized international research, adhering to the guidelines published by the JBI for Evidence-Based Practice. We used these guidelines to minimize biases and establish the validity of the findings.

Methodology

The purpose of this review was to identify, appraise and synthesize the best available evidence on the effectiveness of prehabilitation (Education and Exercise) program on patients' health outcomes compared to standard care following the Total Knee Replacement (TKR).

The review considered participants undergoing a TKR, divided randomly into two groups (intervention group and the control group); the intervention group received pre-operative training program by a physiotherapist or education or both delivered by a healthcare professional within 13 weeks of operation. The control group received a defined usual care pre-surgery, aged 18, regardless of gender, social status, and educational level.

The review considered RCT studies that included any prehabilitation training program for the intervention group comparing with usual care for the control group.

This study found any objectively measured or self-reported functional results related to prehabilitation training program. Various reliable and validated instruments assessed these programs including:

1. Patient Functionality Standard form 36 (SF-36) physical function subdomain
2. WOMAC score, or other function related tools
3. Postoperative pain score Visual Analogue Scale (VAS)
4. Pain subcomponents of Western Ontario and McMaster Universities osteoarthritis index (WOMAC) or pain-related subcomponents of other instruments
5. Time to resume activities of daily living (ADL) quality of life.

This review considered all randomized control trials studies (RCTs) published in English language and restricted from 2011-2016. The RCTs should be comparing and examining the effect of the preoperative rehabilitation program, that is to say, "prescribed or supervised exercises with or without education, nutritional advising, among others against the usual care on the patient undergoing TKR surgery, identifying at least one clinically health outcome of interest post-surgery.

Initially, the researchers conducted a limited search using the Cochrane Database of Systematic Reviews to identify the similar studies and capture the keywords to avoid redundancy and repetition. Therefore, the search keyword terms included MeSH for pre-education, prehabilitation, physiotherapy, knee replacement surgery, and training.

A search was undertaken in nine electronic databases of all published randomized controlled trials using several combinations of terms of the keywords and Mesh namely CINAHL, Scopus, PsycINFO, PubMed, AMED, EMBASE, MEDLINE, ASSIA, ERIC. Moreover, to avoid duplicates, Scopus was used to search other databases (Table 1).

Table 1 Search Strategy Used

SEARCH ID#	Search term	Limiters	Results
#1	Total Knee replacement	2011-2016 Boolean/Phrase, English	82346
#2	Knee replacement surgery	2011-2016 Boolean/Phrase, English	71466
#3	#1 or #2	2011-2016 Boolean/Phrase, English	82,346
#4	Pre-operative education	2011-2016 Boolean/Phrase, English	4613
#5	Preoperative education	2011-2016 Boolean/Phrase, English	9792
#6	#4 or #5	2011-2016 Boolean/Phrase, English	9792
#7	Usual care	2011-2016 Boolean/Phrase, English	70956
#8	Usual therapies	2011-2016 Boolean/Phrase, English	64138
#9	#7 or #8	2011-2016 Boolean/Phrase, English	95023
#10	Improves patient outcomes	2011-2016 Boolean/Phrase, English	310251
#11	Improves outcomes	2011-2016 Boolean/Phrase, English	357745
#12	#10 or #11	2011-2016 Boolean/Phrase, English	357745
#13	#3 and #6 and #9 and #12	2011-2016 Boolean/Phrase, English	50
Total			15

Further, we conducted a hand search in various institutions including Khoula Hospital, Sultan Qaboos University Hospital, and Institute of Health Science Library to find any additional literature and unpublished studies through Cardiff University and Oman Ministry of Health e-Library. Two reviewers (SA and MA) conducted the search and identified potentially eligible studies.

Assessment of Methodological Quality

Two independent reviewers (SA, MA) screened the articles by title and then abstract using specific criteria. The same reviewers then critically appraised and assessed the methodological validity and risk of bias of each included trial before inclusion in the review, using the ten questions in the JBI (2014) critical appraisal instrument. Due to the nature of the studies under consideration some of the criteria such as blinding participants and concealing treatment group and generalizing the findings were not practical to most studies. Therefore, it was useful to include those with at least seven of the ten criteria of methodological quality. With the involvement of a third reviewer, it resolved the disagreement.

Results and Discussion

The findings are presented in narrative synthesis form as it was not possible for data synthesis statistically due to the different interventions and outcomes of the retrieved studies.

The search strategy identified 27 paper, of which 14 articles were relevant to this review based on the title. After removal of duplicate and detailed examination, full texts were retrieved for the remaining 11 studies. After critically appraised and assessed the methodological validity and risk of bias, eight papers were identified for data extraction and analysis. The details of the selection process are presented in Table 2.

Description of Studies

All eight studies gave specific details about their randomization and all of them assessed patient knee function level pre and post TKR surgery (Brown, Brosky, Topp, & Lajoie, 2012; Cavill et al., 2016; Cooke et al., 2016; Gstoettner, Raschner, Dirnberger, Leimser, & Krismer, 2011; Huang, Chen, & Chou, 2012; Matassi, Duerinckx, Vandenuecker, & Bellemans, 2014; McKay, Prapavessis, & Doherty, 2012; Skoffer et al., 2016). However, four were pilot RCT (Brown et al., 2012; Cavill et al., 2016; Cooke et al., 2016; McKay et al., 2012). Only one study reported that the participants were randomly assigned by a blind selection to an intervention or a control group (Brown et al., 2012). Five blinded of the eight studies reported about the outcome assessors (Cavill et al., 2016; Cooke et al., 2016; Matassi et al., 2014; Skoffer et al., 2016). Three most recent, two were from Australia, (Cavill et al., 2016; Cooke et al., 2016) and one from Denmark (Skoffer et al., 2016), and one study each from Italy (Matassi et al., 2014), United states of America (Brown et al., 2012), Taiwan (Huang et al., 2012), Canada.

Table 2 Appraisal of the Reviewed Studies

S.N.	Criteria	Author and Date							
		Cavill et al 2016	Cooke et al 2016	Skoffer et al 2016	Matassi et al 2014	Huang et al 2012	McKay et al 2012	Brown et al. 2012	Gstoettner et al. 2011
#1	Was the assignment to experiment group truly random?	Y	Y	Y	Y	Y	Y	Y	Y
#2	Were participants blinded to treatment allocation?	N	N	N	N	N	N	Y	N
#3	Was allocation to treatment groups concealed from the allocators?	Y	Y	Y	NC	N	N	Y	N
#4	Were the outcomes of people who withdrew described and included analysis?	Y	Y	Y	Y	Y	Y	Y	Y
#5	Were those assessing outcomes blind to the treatment allocation?	Y	Y	Y	Y	N	N	N	N
#6	Were the control and treatment groups comparable at entry?	Y	Y	Y	Y	Y	Y	Y	Y
#7	Were groups treated identically other than for the named interventions?	Y	Y	Y	Y	Y	Y	Y	Y
#8	Were outcomes measured in the same way for all groups?	Y	Y	Y	Y	Y	Y	Y	Y

Table 2 Appraisal of the Reviewed Studies

S.N.	Criteria	Author and Date							
		Cavill et al 2016	Cooke et al 2016	Skofffer et al 2016	Matassi et al 2014	Huang et al 2012	McKay et al 2012	Brown et al. 2012	Gstoettner et al. 2011
#9	Were outcomes measured in a reliable way?	Y	Y	Y	Y	Y	Y	Y	Y
#10	Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	Y	Y
#11	Total Score	9	9	9	8	7	7	9	7
#12	Risk of Bias	VL	VL	VL	VL	VL	VL	VL	VL

Note: Y=Yes, N=No, VL=Ve

(McKay et al., 2012) and Austria (Gstoettner et al., 2011). There were no studies conducted in Africa and Middle East.

Sample Size

All of the studies used convenience sampling with sample size from 18 (Brown et al., 2012) to 243 (Huang et al., 2012).

Baseline Comparability of Groups

Seven studies gave description of baseline comparability of varying details related to participants' demographics, including age, sex, BMI (Brown et al., 2012; Cooke et al., 2016; Gstoettner et al., 2011; Huang et al., 2012; Matassi et al., 2014; McKay et al., 2012). Two of the eight studies did not give any description of mobility level (Cooke et al., 2016; Skofffer et al., 2016).

Intervention

In all eight studies the intervention groups had usual care and different exercises programs; of which in seven studies the control group had only the usual care according to their organization (Brown et al., 2012; Cavill et al., 2016; Cooke et al., 2016; Gstoettner et al., 2011; Huang et al., 2012; Matassi et al., 2014; Skofffer et al., 2016). In only one study the control group had a usual care and exercise (McKay et al., 2012). For all studies differences in outcomes were compared between the control and experimental or intervention groups.

Outcome Assessment

The main outcome was any objectively measured or self-reported functional outcome such as pain, functional ability, and quality of life toward the TKR operation programmes. All of the studies used pre-validated interprofessional instruments. The tools that have been used for measuring the pain were as follow; Visual Analogue Scale (VAS) (Cavill et al., 2016; Huang et al., 2012); Western Ontario and McMaster Universities Arthritis Index (WOMAC) (Gstoettner et al., 2011; Matassi et al., 2014; McKay et al., 2012); Numeric Rating Scale (NRS) (Cooke et al., 2016) and Knee Injury and Osteoarthritis Outcome Score (KOOS) (Skofffer et al., 2016).

Functional Ability was measured by Standard Form-36 Health Survey (Sf-36) (Brown et al., 2012; McKay et al., 2012); Range of Motion (ROM) (Huang et al., 2012; Matassi et al., 2014); Timed Up and Go (TUG) (Cavill et al., 2016; Skofffer et al., 2016); WOMAC (Gstoettner et al., 2011; McKay et al., 2012) Knee Society Clinical Rating Score (KSS) (Gstoettner et al., 2011).

Quality of life was measured by European Quality of Life Instrument (EQ-5D-3L) (Cavill et al., 2016); Sf-36 (Brown et al., 2012; McKay et al., 2012), Knee Injury and Osteoarthritis Outcome Score (KOOS) (Skofffer et al., 2016).

Description of the Studies

The detailed summary of the characteristics of included studies including all results are given in Table 3. The major differences between the included studies are described below.

Cavill et al. (2016) conducted a Randomized Control Trial with assessor blinding evaluating the effect of prehabilitation education and treatment on the quality of life and function in patients having total knee replacement (TKR) by physiotherapist. Patients undergoing (TKA) (N= 64) were allocated to either Control group (n= 32) Standard care (education) or Intervention group (n= 32) Prehabilitation (exercise and education).

The intervention of prehabilitation consisted of one-hour twice-weekly sessions for at least three and a maximum of four weeks prior to surgery. The control group did not receive a pre-surgical exercise programme but only received usual care included education on 'what to expect once in for surgery'.

The researcher used a multi-method evaluation. Primary outcome measures were the EQ-5D-3L measuring the health-related quality of life (known as European Quality of Life Instrument) and patient specific functional scale (PSFS) to quantify activity limitation and measure functional outcome over time. Whilst secondary outcome measure included the active range of motion, TUG and length of stay. The study showed no significant between-group differences in EQ-5D utility (p=0.33) or PSFS (p=0.73) or TUG time (p= 0.08) and the EQ-5D VAS (p=0.11). There was no significant reduction in the acute hospital stay between the groups (p=0.96).

Huang et al (2012) randomized patients to either both a 40-minute education session and 4-week home exercise programme both given by an experienced physiotherapist or the control group who received no advice on exercise or education. Pain was the only PROM measured, using a VAS, whilst secondary outcome measures included length of stay and hospitalization-associated medical expenditure. The authors demonstrated no difference in pain scores but report a significant reduction in the length of stay (p=0.027) and medical costs (p=0.001) in the intervention group. The study lacked a defined primary outcome and thus has no power calculation. Follow up of patients was only until discharged and any potential longer term benefits from the intervention were not studied. The medical expenditure calculations were only inclusive of inpatient costs, assessing pre- and post-operative expenditure would give a better overall reflection of any cost savings.

The RCT conducted by McKay et al. (2012) aimed to examine the pre-operative treatment which consist of a 6-week prehabilitation exercise training program on presurgical quadriceps strength for patients undergoing total knee arthroplasty (TKA). All participants exercised 10-minute aerobic warm-up, 3 times per week for 6 weeks; the intervention group (n=10) followed by lower body exercise, while the control group (n=12) followed by upper body exercise before TKA by a trained kinesiologist.

The researcher evaluated the isometric quadriceps strength as primary outcome, whilst the secondary outcome measures included mobility using 50-foot flat surface walking test

Table 2 Summary of the Reviewed RCTs Studies

S.N	Author/ Date/ Country	Study Method/ Partici- pants	Interven- tions / Compar- ison	Outcome and As- essment Measures	Results (Mean, SD and p value)	Note
1	Cavill et al., 2016 Australia	Prospective Pilot RCT with assessor blinding. N=64 patients undergoing (TKA).	Intervention n=32 Prehabilitation (exercise and education) Control n=32 Standard Care (Education)	Range of motion and function. Primary outcome EQ-5D-3L and PSFS Secondary outcome TUG time and length of stay Stata/IC 11.2 for windows	No significant differences between-group in EQ-5D utility = -0.04 (-0.16, 0.08), p=0.50 PSFS: -0.59 (-1.8, 0.6), p=0.32 The difference was larger by group-joint interaction effects TUG time: 7.6 (-0.9, 16.1), p=0.08 EQ-5D VAS: -18.3 (-41.1, 4.5), p=0.11 Knee Flexion Improved; 12.6 (5.2, 20.0), p=0.001	

Table 2 Summary of the Reviewed RCTs Studies

S.N	Author/ Date/ Country	Study Method/ Participants	Interven- tions / Compar- ison	Outcome and As- essment Measures	Results (Mean, SD and p value)	Note
2	Cooke et al., 2016 Australia	Single-blinded, parallel, pilot RCT design. N=91 Patients undergoing hip or knee replacement.	Intervention n= 40 Preoperative (education via DVD and usual care) Control n= 32 usual care	Pain, anxiety, self-efficacy Numeric Rating Scale (NRS) State-Trait Anxiety Inventory (STAI) Self-Efficacy SPSS	No significant differences between groups at any time point Pain: T0 p= 0.121, T1 p=0.611, T2 p=0.208, T4 p=0.096, T5 p=0.621. STAI: T0 p= 0.950, T1 p=0.165, T2 p=0.695, T4 p=0.574, T5 p=0.662. Self-Efficacy: T0 p=0.897, T1 p=0.969, T2 p=0.875 T4 p=0.517	

Table 2 Summary of the Reviewed RCTs Studies

S.N	Author/ Date/ Country	Study Method/ Participants	Interven- tions / Compar- ison	Outcome and As- essment Measures	Results (Mean, SD and p value)	Note
3	Matassi et al., 2014 Italy	Prospective RCT single blinded study. N=122 Patients undergoing (TKA).	Treatment group n= 61 (Home based exercise programme 6 weeks before surgery) Control group n= 61 usual care	Range of motion and function Knee ROM and Knee Society Clinical Rating System SPSS: ANOVA	After 6 weeks in a treatment group, a significant improvement of passive and active flexion, extension, and knee score (p=0.0001) Significant difference in knee flexion post-operative (p=0.0016) Treatment group; reached 90° of knee flexion at a mean of 5.8 days. Control group only reached this at 6.9 days. Hospital stay Significant difference (p=0.011) Exercise group 9.1 days. Control group 9.9 days.	Both group assessed pre-operation All patients received the same implant type

Table 2 Summary of the Reviewed RCTs Studies

S.N	Author/ Date/ Country	Study Method/ Participants	Interven- tions / Compar- ison	Outcome and As- sessment Measures	Results (Mean, SD and p value)	Note
4	Brown et al., 2012 United State of America	Pilot RCT Blind draw N=18 Patients undergoing (TKA).	Treat- ment group n=11 (training booklet exercise pro- gramme) Control group n=7 usu- al care	Better quality of life Standard Form-36 Health Survey (SF-36) Quality Metric Health Out- comes SPSS: T-test	Physical func- tioning Significant differ- ence (p=0.04) Bodily pain Not significant (p=0.61) Social functioning Not Significant (p=0.65)	Both group assessed pre-op- eration

Table 2 Summary of the Reviewed RCTs Studies

S.N	Author/ Date/ Country	Study Method/ Participants	Interven- tions / Compar- ison	Outcome and As- sessment Measures	Results (Mean, SD and p value)	Note
5	Huang et al., 2012	RCT N= 243 Patients undergoing (TKA).	Rehabil- itation group n=126 (4 weeks home rehabil- itation educa- tion pro- gramme) Control group n=117 usual care	Primary outcome Range of Motion; (PROM) and Pain (VAS) at Pre TKA, Post TKA and on discharge day. Sec- ondary outcome Reduce length of hospital stay SPSS: T test, Pearson's Chi test, and p=0.05	Hospital length of stay Study group (5-10 day) Control group (5-12 days) Significant improvement (p=0.027) No significant improvement in function in all three times Knee ROM Pre TKA T1 (p=0.549) Post TKA T2 (p=0.673) on discharge T3 (p=0.582) VAS: Pre TKA T1 (p=0.362) Post TKA (p=0.431) On discharge (p=0.686)	