International Journal of Orthopaedic and Trauma Nursing 42 (2021) 100830

Contents lists available at ScienceDirect

International Journal of Orthopaedic and Trauma Nursing

journal homepage: www.elsevier.com/locate/ijotn

Health related quality of life in patients having total knee replacement and associations with symptoms, recovery, and patient education: A six month follow up study

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ARTICLE INFO

Keywords:
Total knee replacement
HRQOL
Recovery

ABSTRACT

Aim: To describe the symptoms, recovery, patient education, and health related quality of life (HRQOL) of patients having total knee replacements at three time points and to detect experiences and situations that predict HRQOL six weeks and six months post-surgery.

Method: A prospective exploratory two-site study assessing 123 patients, while in hospital (T1), at six weeks (T2), and at six months (T3) post-discharge. HRQOL was measured using the SF-36v2 and symptoms were measured with the Hospital and Anxiety Scale. Two questions considered pain and two considered movement and tiredness while two questions addressed recovery and patient education. Linear regression models were used to calculate predictors of mental and physical HRQOL at T2 and T3.

Results: HRQOL improved from T1 to T3. The main predictors of higher physical scores at T2 were; being older, fewer symptoms of depression and little distress related to movement. At T3 the main predictors were; having resumed work, finding patient education very useful, experiencing no pain in the last 24 h and fewer symptoms of depression. The main predictors of higher mental scores at T2 were fewer symptoms of anxiety and depression and little distress related to movement while at T3 these were fewer symptoms of anxiety and depression and experiencing no pain last 24 h.

Conclusion: Apart from pain, function and resumption of activities, the symptoms of anxiety and depression influence HRQOL. These symptoms should be assessed during the hospital stay.

Introduction

Nursing care of patients having total knee replacement (TKR) for the management of osteoarthritis (OA), a chronic degenerative joint disease, aims to relieve pain, improve function and improve post-surgical quality of life (QOL) (Whale et al., 2019). Patients experience a wide range of physical health problems following TKR including; pain, limited functional mobility, fatique, leg edema, sleeping disorders and problems with appetite and bowel function (Szöts et al., 2015), with pain and limited function being the most common symptoms. Postoperative improvement in pain and function is greatest in the first 3 months post-surgery and continues to improve the first year thereafter (Wylde et al., 2019). Patient-reported function and pain following TKR is associated with older age, no psychological morbidity, obesity and higher medical comorbidity (Singh and Lewallen, 2014). Worse pain post-surgery has been reported to correlate with preoperative pain, preoperative anxiety, cruciate retaining implants and the number of postoperative complications (Desmeules et al., 2013; Wylde et al., 2017).

QOL usually improves following TKR (Desmeules et al., 2013; Neuprez et al., 2020) but up to 30% of patients have deemed their QOL to be insufficient postoperatively (Kahlenberg et al., 2018). This is of great importance since, in orthopaedics, improved QOL is considered one of the main postoperative outcomes (Canovas and Dagneaux, 2017; Shan et al., 2015). QOL of TKR patients is mostly affected by pain and function (Goodman et al., 2020; Shan et al., 2015) but the presence of comorbidities such as diabetes (Tew et al., 2019), preoperative anxiety and depression (Alattas et al., 2017) as well as preoperative pain

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https://doi.org/10.1016/j.ijotn.2020.100830
Received 11 August 2020; Received in revised form 19 October 2020; Accepted 23 October 2020
Available online 2 November 2020

catastrophizing (Yakobov et al., 2018) have also been associated with QOL among TKR patients.

Various patient characteristics have been identified as risk factors for worse outcomes post-TKR. These include; preoperative pain and worse function, co-morbidities, lower socioeconomic status, having work, being female and older age (Alattas et al., 2017; de Achaval et al., 2016; Goodman et al., 2020; Singh and Lewallen, 2014) as well as psychiatric disorders (Hirchman et al., 2013; Pan et al., 2019; Utrillas-Compaired et al., 2014). A study of 7,153,750 TKR patients in the United States involving data from 2002 to 2014 found patients with psychiatric disorders to have higher odds ratios for most postoerative complications and all pain-related symptoms observed in the study (Pan et al., 2019). Preoperative anxiety and depression have been found to be risk factors for worse pain and worse outcomes in the short term but not in the long term (Wylde et al., 2017; Xu et al., 2019). A German study of the influence of psychiatric disorders found that one-year post-TKR surgery patients with preoperative depressive or anxiety symptoms experienced worse pain, worse knee function and more dissatisfaction than those without these symptoms (Bierke et al., 2016; Bierke and Petersen, 2017). After five years, having preoperative depression was still significantly associated with these outcomes, but not having preoperative anxiety (Bierke et al., 2020).

Pain relief, restoration of function and improved QOL are outcomes that patients rank highly after TKR and they expect improvement (de Achaval et al., 2016; Goodman et al., 2020). However, these expectations are often not met, highlighting the need for better patient education to help them set realistic goals (de Achaval et al., 2016; Ghomrawi et al., 2020; Tilbury et al., 2016). Studies have reported that, when asked postoperatively, patients have several unanswered questions about their recovery process, symptoms and unfulfilled expectations (Berg et al., 2019). A systematic review on returning to work post hip and knee surgery found that most patients who were employed before TKR returned to work postoperatively and work status improved generally (Tilbury et al., 2014). However, recovery takes time and, in a cross-sectional study of TKR patients who were employed before surgery, while 59% had returned to work six months post-surgery, 28% never returned to work (Kievit et al., 2014). Styron et al. (2011) found that having a sense of urgency about returning to work, being female, self-employed and having better mental and physical health were predictive factors for patients returning to work.

The present study took place at two sites in Iceland where fast-track protocols had been implemented; these protocols have been shown to decrease length of hospital stay and short term complications (van Egmond et al., 2015) and morbidity (Kehlet and Thienpont, 2013). Long term effects on functional outcome and QOL have, however, not been shown to be affected by fast-track TKR (Jansen et al., 2020).

The main focus of care for TKR patients is resolution of pain, functional progress and improvement of post-surgical QOL where nurses play an essential role by providing direct physical care and managing expectations through evidence based patient education. The intentions of the present study were to enhance nurses‘ knowledge and improve their means to provide optimal perioperative care with respect to long term QOL. The aim of the study was to; (a) describe general symptoms, recovery, patient education and health related QOL (HRQOL) in patients having TKR at three time points: while in hospital (T1), at six weeks (T2) and at six months’ (T3) post-surgery; and (b) detect experiences and situations that predict HRQOL six weeks and six months post-surgery.

The study

Methods

Research design and setting

This was a prospective, exploratory two-site study. The settings were (a) a 687 bed hospital in the capital city of Iceland (hospital A) where the mean length of stay at the surgical division was 5.0 days, and all major surgeries were performed there (Landspitali, 2017) and (b) a 110 bed hospital in the north of Iceland (hospital B) with a mean length of stay at the surgical division was 2.9 days and where mostly total hip and knee replacement surgeries were performed (Sjúkrahúsið á Akureyri, 2018).

Participants and procedure

Eligible for participation were patients who had elective TKR surgery at hospital A and at hospital B from January 15th, 2016 to July 15th, 2016 and were: assessed by nurses as qualified for participation, understood written and oral Icelandic, stayed overnight at the hospital, were discharged home and were at home six weeks’ and six months’ post-surgery. Data collection was completed six months after the last participant had his/her surgery. Participation included answering questionnaires post-surgery at the hospital (T1), six weeks (T2) and six months’ (T3) post-surgery from hospital.

At admission to the hospital a nurse approached the patients, introduced the study and gained permission for a study-nurse to contact him/her at the ward. If the patient agreed, the study was explained on day one post-surgery and the patients received the hospital-questionnaire to complete. The hospital questionnaire was in a paper and pencil format but participants could choose to answer an alternative questionnaire online. Online data were collected using RedCap software (REDCap, n.d.). The participants were mailed the paper version of the home-questionnaire or e-mailed the online version, with a reminder sent via text message and e-mail twice after the questionnaire was sent. The procedure was repeated once for those who had not responded two weeks after the due date.

During the study period 233 patients at hospital A and 80 at hospital B underwent TKR. The response rate was 65% (n = 204; 136 at hospital A and 68 at hospital B) with 123 participating at all three times points (n = 83 at hospital A n = 40 at hospital B) and included in the analysis.

Measures

The main outcome variable for the study was HRQOL. It was measured at all times with the generic Short Form 36 Health Survey (SF-36v2) (Ware and Gandek, 1998). SF-36v2 consists of 35 items (with responses varying from yes/no to a six-point ordinal rating scale) forming eight domains relating to self-reported HRQOL: physical functioning (PF), role-physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role-emotional (RE), and mental health (MH). Together, the outcome of four of those (PF, RP, BP, GH -21 items) constituted a physical component score (PCS) and that of the other four (VT, SF, RE, MH -14 item) constituted a mental component score (MCS). Scores range from 0 to 100, with higher scores indicating better HRQOL. The raw data scores were analysed using the SF-36v2 software to generate norm based scores of the PCS and MCS components (Ware, 1997). In the present study, scores were calculated by norm-based scoring (NBS) with 50 as the standard score for each domain and component.

Other variables (predictive variables) assessed to describe situations that the patient population faced were; (a) Symptoms of anxiety and depression measured with the Hospital Anxiety and Depression Scale (HADS) at all times (Zigmoid and Snaith, 1983) (This scale consists of two subscales, HADS-A and HADS-D, each with seven items that measure respectively symptoms of anxiety and depression. Each item is rated on a scale from 0 to 3 with range of scores from each subscale from 0 to 21. Higher score indicate more symptoms of anxiety or depression, those who score above 10 are categorised as having moderate to severe symptoms of depression and/or anxiety.); (b) Difficulty with movement and tiredness during previous seven days, measured on a scale from 1 (no distress at all) to 5 (very much distress) at all times; (c) The presence of pain related to surgery during the previous 24 h (yes/no); (d) At T2 and T3 patients were asked how well they had recovered since the operation (very well/well/fairly well/badly/very badly) and how useful they found patient education (very useful/rather/neither or/little/not useful); (e) Contact with a physician due to the surgery was assessed at

T3; and (f) Resuming work at T2 and T3. At T1 background information was gained on age (years), gender (male/female), living with spouse at home (yes/no), body max index, needs of other members at home for assistance with daily living (yes/no) and co-morbidities that were assessed with a single question on presence of other diseases (yes/no). If yes participants were asked if they had hypertension, arthritis, heart- and vascular, cancer, diabetes, pulmonary or mental disease (participants could mark more than one disease).

Ethical considerations

The study design and procedure was approved by the National Bioethics Committee (approval number: 15-040-V1) and the directors of medicine at both hospitals approved the study as required by law.

Data analysis

Statistical analyses were carried out using Statistical Package for Social Sciences, 24.00 (SPSS).

All categorical variables were decoded as dichotomous and are presented as such. Descriptive data are presented as mean values, with standard deviations, percentages, and relationships between outcome variables and predictor variables presented using Pearson correlations and *t*-test. One-way repeated-measures ANOVA, followed by Bonferroni multiple pairwise comparison, was used to measure differences in means scores in the PCS and MCS and the domains of the SF-36v2 (Field, 2013). The significance level was set at <0.05. Four linear regression models were employed to calculate significant predictors of the mean score of MCS and PCS six weeks and six months post-surgery. For each model, background variables and variables assessed at the time of data collection as having significant association with the outcome variable were entered. Apart from background information, the only data collected at the hospital that will be presented is data on HRQOL.

A prior power analysis was conducted to estimate sample size for multiple regression using GPower (Erdfelder et al., 1996). The criterion for statistical significance was set at $\alpha = 05$, two-tailed, power (1 - β) was set at 0.80, effect size was set at 0.08 and 10 predictors were assumed. This showed that in order to reach statistical significance at 0.05 level our required sample size was estimated to be 108 respectively.

Validity and reliability

The SF-36v2 validity and reliability have been established in large populations of both healthy individuals and those with co-morbidities (Ware and Gandek, 1998). HADS has been standardized for use in Iceland (Smari et al., 2008) and used in various studies with acceptable reliability.

Results

Forty patients had their TKR surgery at hospital B and 83 at hospital A. There were no significant differences between them regarding the outcome variables, so findings from both sites are grouped together in all analyses.

Descriptive findings

Background information

Most participants were women (50.3%), 67.1 years of age, living with a spouse at home (75.6%), with an average BMI of 31.5 (SD = 6.2) and had another disease than the one leading to the operation (77.2%). In 11.4% of homes someone apart from the participant needed assistance with daily activities (Table 1).

Health related quality of life

Table 2 shows mean NBS scores and SD for PCS, MCS and all 8 components of SF-36v2. The mean scores are displayed in Fig. 1. There was a significant increase in scores of PCS between all time-points, but no significant difference was detected in scores of MCS between time-

Table 1
Descriptive characteristics of participant (N = 123) and significant relationships with Physical Component Scale (PCS) and Mental Component Scale (MCS) scores six weeks (T2) and six months (T3) post discharge.

Continous variables#	n	Mean (sd)	PCS	MCS	PCS	MCS
			Six weeks post discharge		Six months post discharge	
			p.	p.	p.	p.
Age (mean ± sd)	117	67.1 (8.0)	<0.01	ns	ns	ns
Body Max Index	113	31.5 (6.2)	ns	ns	ns	ns
HASD-Anxiety at T2 ++	115	3.6 (2.9)	<0.01	<0.01	na	na
HADS-Anxiety at T3	115	3.9 (3.4)	na	na	<0.01	<0.01
HADS-Depression at T2	117	2.5 (2.7)	<0.01	<0.01	na	na
HADS-Depression at T3	117	3.1 (3.2)	na	na	<0.01	<0.01
Categorical variables##	n (%)					
Gender (male) (N* = 117)	55 (44.7)		ns	ns	ns	ns
Living with spouse at home (yes) (N = 117)	93 (75.6)		ns	ns	ns	ns
Other members of the home need assistance with daily living (yes) (N = 103)	14 (11.4)		<0.01	<0.01	<0.01	<0.01
Other diseases (yes) (N = 115)	95 (77.2)		ns	ns	ns	ns
Experiencing pain last 24 h at T2 (yes) (N = 115)	94 (76.4)		<0.01	<0.05	na	na
Experiencing pain last 24 h at T3 (yes) (N = 100)	58 (47.2)		na	na	<0.01	<0.01
Trouble with movement caused no/little distress last week at T2 (N = 111)	62 (51.2)		<0.01	<0.01	na	na
Trouble with movement caused no/little distress last week at T3 (N = 114)	71 (57.7)		na	na	<0.01	<0.01
Tiredness caused little/ no distress last week at T2 (N = 116)	65 (52.8)		<0.01	<0.01	na	na
Tiredness caused little/ no distress last week at T3 (N = 113)	80 (65.0)		na	na	<0.01	<0.01
Recovery good/very good at T2 (N = 123)	67 (54.5)		<0.01	<0.01	na	na
Recovery good/very good at T3 (N = 120)	69 (56.1)		na	na	<0.01	<0.01
Has contacted physicians post discharge at T3 (yes) (N = 119)	36 (29.3)		-	-	<0.01	<0.05
Patient education very useful at T2 (N = 119)	68 (55.3)		<0.01	ns	na	na
Patient education very useful at T3 (N = 118)	49 (39.8)		na	na	<0.01	ns
Has begun working at T2 (N = 121)	14 (11.4)		ns	ns	na	na
Has begun working at T3 (N = 121)	47 (38.2)		na	na	<0.01	<0.01

+PCS and MCS range from 0 to 100 with higher scores indicating better physical or mental health related quality of life.

++scores on HADS subscales range from 0 to 21 with higher scores indicating more symptoms of anxiety or depression.

significance based on Pearson correlations. r for significant correlations ranged from 0.290 (for for age and PCS-T2) to 0.786 (for HADS-Depression T3 and MCS-T3).

significance based on *t*-test. Descriptive findings are presented for groups shown in table. Difference in statistical findings is such that participants experiencing less pain last 24 h, with less trouble caused by movement or tiredness,

reporting better recovery, finding patient education very useful, had contacted a physician post discharge, had a family member needing assistance with activities of daily live and had begun working scored higher on PSC and MSC then their counterparts when the associations are significant.
*N indicates number of participants answering the questions. Valid percentage is presented.

points. Mean scores on MCS were higher than on PCS at all time-points. In the subscales the highest scores were found in MH, and there was no difference in scores between time-points. The lowest scores were found in PF with significant increases between time-points. The mean VT scores increased significantly between T1 and T3; and the SF scores between T2 and T3. The trend was for scores to increase significantly. However, there was a significant drop in RP and RE scores from T1 to T2.

HADS, trouble with movement and tiredness, pain, patient education and recovery (predictive variables)

The mean score on HADS-A was 3.6 six weeks post-surgery, increasing to 3.9 at six months' post-surgery. Six weeks post-surgery twelve patients (9.7%) experienced moderate to severe symptoms of anxiety and 17 patients (13.8%) at six months. For depression the numbers were seven patients (5.7%) and 12 patients (9.8%) respectively (these numbers are not shown in tables). Most participants (76.4%) experienced pain during the previous 24 h when asked six weeks post-surgery and 47.2% at six months' post-surgery. Difficulty with movement caused little or no problems during the previous week among 62 participants (51.2%) six weeks post-surgery and 71 participants (57.7%) six months' post-surgery. The numbers for little/or no problems caused by tiredness were 65 (52.8%) and 80 participants (65.0%) respectively. Six weeks post-surgery patient education was found useful by 55.3% (n = 68) of participants, recovery was reported good or very good by 54.5% (n = 67) and 11.4% (n = 14) had started working and at six months' post-surgery 39.8% (n = 49), 56.1% (n = 69) and 38.2% (n = 47) respectively. At six months' post-surgery 36 patients (29.3%) had contacted a physician due to their recovery.

Relationships between variables measuring HRQOL and predictive variables

Table 1 shows the associations between scores on the PCS and MCS at six weeks and six months' post-surgery with HADS, difficulty with movement and tiredness, pain, patient education and recovery. It can be seen that there were significant associations between higher mean scores on PCS six weeks post-surgery and age, higher mean scores on HADS-A and HADS-D at T2, someone living at home who needs assistance with daily living, having experienced pain the previous 24 h at T2, having no trouble with movement and tiredness at T2, reporting good/very good recovery and very useful patient education at T2. The same significant associations were found for MCS six weeks post-surgery except that there was no associaton found between age and finding patient education very useful.

Table 2
Mean (M) scores and standard deviation (SD) for norm based scores for Physical Component Score (PCS), Mental Component Scores (MCS) and the eight domains of SF-36v2 at all times, as well as significant difference in scores between times by one-way repeated-measures ANOVA#.

	At hospital			At home six weeks post surgery			At home six months post surgery			p.
	N	M	SD	N	M	SD	N	M	SD	
PCS	90	29.5	9.4	100	33.5	7.7	107	39.9	8.8	≥0.001
MCS	90	54.6	9.3	100	52.5	9.3	107	53.0	8.7	≥0.05
Physical Functioning (PF)	115	30	10.3	117	33	10	118	39.8	10	≥0.001
Role Physical (RP)	111	38.3	7.8	113	35.2	7	114	41.4	8.9	≥0.001
Bodily Pain (BP)	115	30.9	7.9	116	36.3	8.9	119	43.7	10.3	≥0.001
General Health (GH)	110	46.2	8.6	116	48.2	9.1	118	46.9	9.1	≥0.05
Vitality (VT)	116	45.3	8.6	117	46.2	9.5	119	48.1	9.2	≥0.001
Social Functioning (SF)	115	42.7	10.7	117	42.5	11	119	47	10.2	≥0.001
Role Emotional (RE)	104	47.2	7.8	101	43.4	10.2	112	47.3	8.4	≥0.001
Mental Health (MH)	112	52.5	8.5	116	53	9.1	119	53.1	8.6	ns

$ Bonferroni adjusment for MCS did not show significant differense between scores at times 1, 2, and 3; for GH there was significant difference in scores between T1 and T2, and between T2 and T3, not between T1 and T3; for VT significant difference was found only in scores between T1 and T3; for SF there was not a difference in scores between T1 and T2.

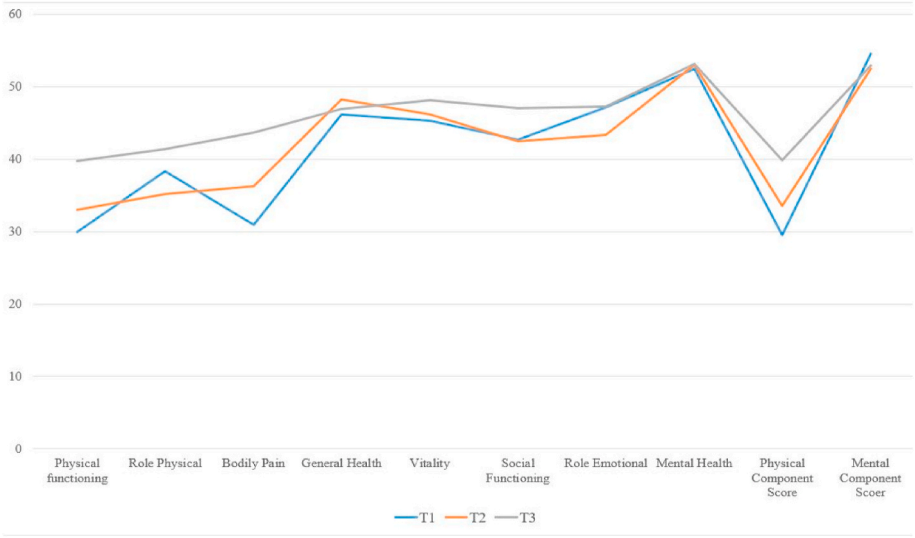

Fig. 1. Norm based scores on SF-36v2. Scores range from 0 to 100, higher scores indicate better quality of life, 50 is the standard score for each item.

Significant associations between higher mean scores on PCS six months post-surgery were found with higher mean scores on HADS-A and HADS-D at T3, having a family member living at home who needs assistance with daily living, having experienced pain the previous 24 h at T3, having no difficulty with movement and tiredness at T3, reporting good/very good recovery at T3, having contacted a physician post discharge, finding patient education very useful at T3 and having begun working at T3. The same significant associations were found for MCS six months post-surgery except that no association was found with finding patient education very useful.

Predictors of PCS and MCS six weeks (T2) and six months' (T3) post-surgery

The final regression models for potential predictors of PCS and MCS at both times are shown in Table 3. It should be noted that, although the contribution of each variable in each model was not always statistically significant, the results suggest that the variables in each model contribute to scores on each model *i.e.* of PCS and MCS six weeks and six months post-surgery. The PCS model six weeks post-surgery shows that being older, scoring lower on HADS-D at T2 and reporting no or little distress related to difficulty with movement at T2 predicts higher scores on the PCS. The model explains 58.7% of the variance of PCS six weeks post-surgery (Adjusted $R^2 = 0.587$). Holding other variables constant, the strongest predictor for higher score on PCS six weeks post-surgery is finding difficulty with movement causing little or very little distress (B = 12.6).

The PCS model six months post-surgery shows that having begun working at T3, finding patient education very useful at T3, experiencing no pain in the previous 24 h at T3 and scoring lower on HADS-D at T3 predicts higher scores on the PCS. The model explains 67% of the variance of PCS six months post-surgery (Adjusted $R^2 = 0.67$). Holding other variables constant, the strongest predictor for higher scores on PCS six months post surgery is to have no pain in the previous 24 h at T3 (B = 11.0).

The MCS model six weeks post-surgery shows that scoring lower on HADS-D and HADS-A at T2 and reporting no or little distress related to difficulty with movement at T2 predicts higher scores on MCS. The model explains 57.6% of the variance of MCS six weeks post-surgery (Adjusted $R^2 = 0.576$). Holding other variables constant, the strongest predictor for higher score on MCS six weeks post-surgery is to score lower on HADS-A at T2 (B = 4.0).

The MCS model six months post-surgery shows that having no pain in the previous 24 h at T3 and scoring lower on HADS-D and HADS-A at T3 predicts higher scores on MCS. The model explains 71.1% of the variance of MCS six months post-surgery (Adjusted $R^2 = 0.711$). Holding other variables constant, the strongest predictor for higher score on MCS six months post-surgery is to score lower on HADS-D (B = 5.4).

Discussion

In the present study, HRQOL was measured among patients having fast-track elective TKR surgery. The importance of measuring HRQOL among this patient group has been well documented. However, studies in different societies, different hospitals and where different recovery methods are in use are needed. The benefit of the present study lies in its description of the postoperative experiences of all patients in a small country who had fast-track elective TKR during a six months period.

Our findings show that physical HRQOL as measured by PCS, increases significantly from time of surgery until six months later, but not mental HRQOL as measured by MCS. The same is reflected in the four physical domains that all have lower scores at all times than the four mental domains. These findings are similar to what has been reported in other studies (Klemetti et al., 2015, 2016; Levinger et al., 2017; Naylor et al., 2009).

Predictors for worse physical (PCS) and mental (MCS) HRQOL six months post-surgery were worse pain at the time and more symptoms of depression. In addition, at that time, not to have resumed work and not

Table 3
Regression models for potential predictors of Physical Component Scale (PCS) and Mental Component Scale (MCS) scores six weeks (T2) and six months (T3) post discharge from hospital#.

Variables	PCS six weeks post discharge				MCS six weeks post discharge			
	Confidence interval				Confidence interval			
	B	t	Lower bound	Upper bound	B	t	Lower bound	Upper bound
(Constant)	34.4	2.7**	9.4	59.5	98.7	9.5**	78.0	119.4
Age (mean ± sd)	0.5	3.5**	0.2	0.8	na	na	na	na
Other members of the home need assistance with daily living	3.5	1.0	−3.7	10.8	0.9	−0.2	−9.8	7.9
Recovery good/very good at T2	−3.7	−1.5	−8.7	1.2	−1.1	−0.4	−7.0	4.8
Patient education very useful at T2	2.9	1.3	−1.7	7.5	na	na	na	na
Experiencing pain last 24 h at T2	−5.5	−1.8	−11.6	0.6	1.3	0.3	−6.1	8.7
HADS-D at T2	−1.9	−3.3**	−3.0	−0.7	−2.2	−3.3**	−3.6	−0.9
HADS-A at T2	−0.1	−0.3	−1.2	0.9	−2.4	−4.0**	−3.6	−1.2
Tiredness caused little/no distress last week at T2	0.0	0.0	−5.5	5.5	4.7	1.4	−11.4	2.0
Trouble with movement caused no/little distress last week at T2	12.6	4.3**	−18.4	−6.8	8.0	2.3*	14.9	1.1
	PCS six months post discharge				MCS six months post discharge			
(Constant)	69.8	5.0**	41.9	97.6	93.2	7.8**	69.1	117.3
Has begun working at T3	10.2	2.7**	2.5	17.8	3.8	1.2	−2.6	10.1
Other members of the home need assistance with daily living	0.0	0.0	−11.0	10.9	−2.5	−0.5	−11.5	6.6
Recovery good/very good at T3	−3.5	−0.9	−11.5	4.5	−1.8	−0.5	−8.7	5.0
Patient education very useful at T3	8.5	2.5*	1.6	15.3	na	na	na	na
Has contacted physicians post discharge at T3	1.1	0.3	−6.3	8.5	−1.1	−0.4	−7.4	5.1
Experiencing pain last 24 h at T3	−11.0	−3.1**	−18.2	−3.7	−7.7	−2.5*	−14.0	−1.4
HADS-D at T3	−1.7	−2.7*	−3.0	−0.4	−3.0	−5.4**	−4.1	−1.9
HASD-A at T3	−1.1	−2.0	−2.3	0.0	−1.8	−3.7**	−2.8	−0.9
Tiredness caused little/no distress last week at T3	1.5	0.4	−6.8	9.8	−1.7	0.5	−5.4	8.8
Trouble with movement caused no/little distress last week at T3	4.6	1.1	−12.6	3.5	−1.3	0.4	−5.6	8.2

Adjusted R square for PCS model at T2 = 0.587 and at T3 = 0.670; for the MCS models it is 0.576 at T2 and 0.711 at T3. The F-change is significant at allt times at $p \leq 0.01$. F for PCS model at T2 = 15.527 and at T3 = 12.150; for the MCS models F = 17.289 at T2 and at T3 F = 16.009.
#only variables with significant association with the outcome variable are entered into each model.
*significant at $p < 0.05$; **P < 0.01.

finding patient education very useful predicted worse physical HRQOL, more symptoms of anxiety and worse mental HRQOL. Lower age and more difficulty with movement were significant predictors at T2 were not significant at T3. These findings are analogous to the findings of Canova and Dagneaux (2017) where TKR patients' recovery in relation to QOL was dependent on many other than functional factors such as physical, psychological, social and behavioural factors. It has been established that the prevalence of anxiety is increasing in TKR patients and is closely correlated with the outcome (Pan et al., 2019). Furthermore, preoperative anxiety and depression are significant predictors of a poor post-operative HRQOL (Alattas et al., 2017) and this establishes the need to diagnose and treat anxiety and depression early in the process, preferably preoperatively. Another study found preoperative anxiety to influence pain one year after TKR but was not a risk factor for pain five years postoperatively (Wylde et al., 2011).

In the present study 76.4% of the participants reported having experienced pain in the previous 24 h at T2, dropping significantly to 47.2% at T3. No or mild pain and good functional ability have been shown to be associated with high HRQOL and patient satisfaction four months after operation (Larsen et al., 2012).

Styron et al. (2011) found that having a sense of urgency about returning to work, being female, self-employed and having higher mental and physical health scores were predictive factors of patients returning to work. In a systematic review, Tilbury et al. (2014) found that most patients who were employed before TKR returned to work postoperatively and that work status generally improved. However, recovery takes time and, in a cross-sectional study of TKR patients who were employed before surgery, 59% had returned to work six months after surgery (Kievit et al., 2014). We found significant associations between having resumed work with higher scores on PCS and MSC at six months post discharge and that having resumed work was one of the strongest predictors for higher scores on the PCS scale at that time. This supports findings indicating the importance of work status with HRQOL.

Over half (55.3%) of participants found patient education useful six weeks post-surgery with 39.8% of them stating so after six months (39.8%). These numbers are higher than in an earlier study where approximately 30% of patients undergoing surgery in the same setting as in the present study found patient education useful when asked six weeks post-surgery. The quality of patients' education decreases postoperative complications (Thomas and Sethares, 2008). From 2009 to 2012 Klemetti et al. (2015) studied received and expected knowledge among European patients having knee/hip arthroplasty to gain information for empowering patient education. They found that received knowledge was significantly lower than expected knowledge among the patients including Icelandic patients. Klemetti et al. (2016) also found that the received knowledge did not have any relationships with information preferences. Coupled with our findings, this underlines the importance of disseminating research findings into the clinical environment for nurses to implement them into their practice.

We found significant associations between worse HRQOL and having a family member living at home who needs assistance with daily living, to have contacted a physician post-surgery, tiredness and reporting poor recovery. These did not come up as significant predictors in the regression models and we did not find any studies addressing this. Nevertheless, these situations are important in the daily lives of people and, considering our small number of participants, they need to be studied in larger patient populations.

Clinical implications of the findings in this study suggest that to enhance HRQOL of patients undergoing TKR, diagnosing and treating anxiety and depression before surgery could be beneficial. Patients can experience pain for months post surgery which influences their HRQOL and managing their pain with follow up is important. Patient education should be evidence based and take into consideration expectations of patients and their information needs.

Strengths and limitaions

A strenght of the this study is the use of extremly well researched, reliable and validated instruments i.e. SF-36v2 and HADS. Also the two largest hospitals in Iceland, where almost all TKRs are performed participated in the study. However, the small sample size of patients answering at all three time-points is a limitation which measn that we cannot assess how well our sample represents the population. The patients were asked to answer the questionnaire on day one to three postsurgery but we did not ask about the date they answered the questionnaire, which we now consider a limitation since it may have affected the answers. Finally, the well-known limitations of self-report questionnaires with a possible bias from rating one's own behaviour should be acknowledged (Toomingas et al., 1997).

Conclusion

Our findings have important clinical implications for knowledge about HRQOL of TKR patients in the context of postoperative nursing. The main focus of perioperative care is patient safety through preoperative evaluation, education and interventions to ensure optimal patient health condition before surgery and support postoperative recovery. For patients having TKR, nurses should emphasise pain relief and patient education regarding physical function, when patients can expect to be able to resume their activities and how pain resolves over time. In addition, due to the influence of symptoms of anxiety and derpression on HRQOL patients having those symptoms should be detected at the hospital and they should be followed-up and receive appropriate interventions.

Ethical statement

On behalf of all authors I declare that the study design and procedure was approved by the National Bioethics Committee (approval number: 15-040-V1) and the directors of medicine at both hospitals approved the study as required by law.

Funding source

The study was funded by the University of Iceland Science Fund, the Landspitali University Hospital Science Fund and the Icelandic Nurses Association Science Fund. On behalf of all authors I declare that these funders did not have any role in the study design, collection, analysis and interpretation of data or in our decision to submit our manuscript for publication.

Declaration of competing interest

The authors have declared no conflicts of interest.

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