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Postoperative Psychosocial Factors in Health Functioning and Health-Related Quality of Life After Knee Arthroplasty: A 6-Month Follow up Prospective Observational Study

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Abstract

Objective. Knee arthroplasty (KA) is an effective and cost-effective treatment for end-stage knee osteoarthritis. Despite high surgical success rates, as many as 25% of patients report compromised postoperative functioning, persistent pain, and reduced quality of life. The purpose of this study was to assess the predictive value of psychological factors in health functioning and quality of life, during a 6-month period after KA. **Design.** A prospective observational study. **Setting.** Surgery at two hospitals and follow-up was carried out through the domiciliary rehabilitation service. **Subjects.** In total, 89 patients (age 70.27 ± 7.99 years) met the inclusion criteria. **Method.** A test battery composed of Health functioning associated with osteoarthritis (WOMAC), Health-related quality of life (EQ-5D-5L), Anxiety and Depression (HADS), Pain attitudes (SOPA-B), Pain catastrophizing (PCS), and Fear of Movement (TSK-11) was assessed at 1 week, and 1, 3, and 6 months after surgery. A mixed effects linear model was used to estimate the effect of time and covariates. An exploratory factor analysis was used to identify the number of dimensions underlying the group of psychological measurements. **Results.** In WOMAC model, anxiety level ($F = 120.8$), PCS ($F = 103.9$), depression level ($F = 93.6$) and pain score ($F = 72.8$) were the most influential variables. Regarding EQ-5D-5L model, anxiety level ($F = 98.5$), PCS ($F = 79.8$), depression level ($F = 78.3$) and pain score ($F = 45$) were the most influential variables. Pain score and the psychosocial variables of PCS, TSK, HADS-A, HADS-D, SOPA-B Emotion, SOPA-B Harm and SOPA-B Disability loaded in one single dimension. **Conclusions.** Postoperative acute pain and psychosocial factors of pain catastrophizing, anxiety, depression, and pain attitudes might influence health functioning and quality of life during KA rehabilitation. Such factors could be gathered into one single dimension defined as pain-related psychologic distress.

Key Words: Knee Osteoarthritis; Knee Arthroplasty; Health Quality of Life; Health Functioning; Psychosocial Factor

Introduction

Knee arthroplasty (KA) is an effective and cost-effective treatment for end-stage knee osteoarthritis [1]. Despite high surgical success rates, as many as 25% of patients report compromised postoperative functioning, persistent pain, and reduced quality of life [2, 3].The predictors of poor postoperative outcomes can be divided into modifiable and nonmodifiable factors [4]. On the one hand, risk factors such as young age, female sex and number of comorbidities have been widely studied and they are considered as non-modifiable risk factors [4, 5]. On the other hand, preoperative pain intensity, pain catastrophizing or mental health have been reported to be important predictors for poor postoperative outcomes, such as persistent pain [5]. From a clinical perspective, these risk factors are interesting since they can be modified with proper interventions, such as pain neuroscience education or physical therapy [6–8].

The identification of modifiable risk factors for poor outcomes after KA is a fundamental step in designing interventions to improve patient outcomes [9]. Therefore, numerous studies have focused on investigating the influence of different types of preoperative risk factors on postoperative outcomes. The results are promising since several modifiable risk factors such as pain catastrophizing have been identified [5]. Consequently, targeted interventions have been evaluated, but no benefits have been shown in terms of function and pain when compared with usual surgical and postoperative care [10, 11].

On that basis, risk factors may influence postoperative outcomes in a more complicated way. Therefore, in addition to evaluating preoperative risk factors, it is important to also consider acute postoperative factors that may influence rehabilitation and recovery [9]. In fact, prediction of chronic postsurgical pain has been found to be stronger when assessing both preoperative and postoperative risk factors [12]. Furthermore, there are some factors that may be more associated with outcomes when measured in the postoperative period (i.e., postoperative self-efficacy) [13].

Orthopedic surgeries such as KA are considered for end-stage knee osteoarthritis when conservative treatment has failed [14]. Therefore, preoperative risk factors are hardly manageable since subjects scheduled for KA usually remain untreated until surgery. After surgery, conservative treatment is resumed, but physiotherapy interventions after KA have mainly focused on improving physical outcomes (i.e., physical function or range of motion [ROM]), and they have only shown short-term benefits on postoperative outcomes [15]. This may be because acute functional limitations are not risk factors for poor outcomes after KA, or it may be that these interventions require evaluation in trials focused on high-risk patients [9]. In any case, there is insufficient evidence regarding acute postoperative risk factors for poor outcomes after KA, hence more research is needed [9]. The identification of both preoperative and postoperative risk factors could improve our knowledge about these subjects and lead to a more comprehensive approach during rehabilitation.

During the last decade, it has become evident that pain-related psychosocial factors such as pain catastrophizing, anxiety and depression increase the risk of poor outcomes after KA [5, 16]. Still, there is little evidence regarding their influence when assessed postoperatively [9]. Therefore, the aim of this study was to assess the predictive value of pain attitudes, pain catastrophizing, anxiety, depression and pain-related fear of movement in health functioning and quality of life, during a 6-month period after KA.

Methods

This research was conducted according to the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement [17], following the declaration of Helsinki. The study protocol received approval from The Research Ethics Committee of University of Vic—Central University of Catalonia (59/2018). The protocol was registered at clinicaltrials.gov (NCT03378440). All the participants agreed to participate and signed an informed consent form.

Study Design and Context

A 6-month follow-up prospective observational study design was used. The participants' recruitment took place between December 2018 and January 2020 and was carried out using a consecutive (nonrandom) strategy through a domiciliary rehabilitation service.

The data collection and follow-up period were carried out between December 2018 and May 2020. Health functioning and quality of life were assessed at multiple time points, including 1 week and 1, 3, and 6 months after surgery. Psychosocial factors were also measured at 1 week after surgery.

Participants

Eligible participants were women and men from the age of 18 onward with a total or unicompartmental KA due to primary OA. Exclusion criteria included participants who had underwent revision surgery, had been operated on due to secondary osteoarthritis, were unable to read or speak in Spanish, had a diagnosis of inflammatory arthritis or severe depression, and those admitted to the domiciliary physiotherapy service after the first assessment.

Outcome Measures

Demographic and Health Data

At baseline (1 week after surgery), the following demographic data were collected: age, sex, body mass index (BMI), Charlson comorbidity index (CCI) [18], smoking habit, alcohol habit, type of surgery (total or unicompartmental), and educational level.

Primary Variables

The following outcome variables were assessed at 1 week, and 1, 3, and 6 months after surgery:

Health Functioning Associated with Osteoarthritis. The Spanish version of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) was used as a measure of health functioning after KA [19]. The WOMAC is a multidimensional scale composed of 24 items grouped into three dimensions: pain (five items), stiffness (two items) and physical function (seventeen items). The WOMAC uses a 5-point Likert scale with responses ranging from 0 = none to 4 = extreme. The final score for the WOMAC was determined by summing the aggregate scores for pain, stiffness, and physical function [19]. The WOMAC is valid and reliable for assessing health functioning in OA participants and is sensitive to changes in health functioning in those who underwent KA [20–22]. The minimum clinically important difference for the WOMAC total score was 10 [23].

Health-Related Quality of Life. The Spanish version of the Euro Quality of Life 5 D-5L (EQ-5D-5L) was used to measure participants' health-related quality of life [24]. This assessment tool consists of a descriptive system to define health in term of five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The total score is converted through a descriptive system to a summary index score, ranging from "worse than dead" state (<0) to "full health state" (upper value 1) [25]. The EQ-5D-5L has shown more validity than its previous version (5 D-3L) in patients with hip and knee osteoarthritis [26].

Secondary Variables

The following secondary variables were assessed at baseline.

Pain. The pain was assessed during rest and using a 100-mm visual analog scale (VAS) [0 = no pain, 100 = worst imaginable pain] [27].

Pain Catastrophizing. The Spanish version of the Pain Catastrophizing Scale (PCS) was used to assess thoughts and feelings related to pain experiences [28]. The PCS is a 13-item self-administered questionnaire composed of three subscales: rumination, magnification and helplessness. The Spanish version of the PCS has shown an acceptable internal consistency (Cronbach's alpha total = 0.79); rumination = 0.82; magnification = 0.72, helplessness = 0.80) [28] and has been associated with post-surgical persistent pain after knee arthroplasty [5].

Pain-Related Fear of Movement. The Spanish version of the Tampa Scale of Kinesiophobia (TSK-11) was used to measure pain-related fear of movement. The TSK-11 is a 11-item self-administered questionnaire. The scores range between 11 and 44, considering higher scores as higher degree of kinesiophobia. This assessment tool has shown an acceptable internal consistency (Cronbach's alpha = 0.79) [29].

Depression and Anxiety. The Spanish version of the Hospital Anxiety and Depression Scale (HADS) was used to measure depression and anxiety. The total scores range between 0 and 42 points, considering higher scores as higher degree of depression and anxiety. This assessment tool has shown an excellent internal consistency (Cronbach's alpha = 0.90) [30].

Pain Attitudes. The Spanish brief version of the Survey of Pain Attitudes (SOPA-B) was used to assess participants' attitudes when they feel pain [31]. The SOPA-B includes 30 items that assess 6 pain-related beliefs: the extent to which patients believe they can control their pain (Pain Control), the extent to which patients believe they are unable to function because of pain (Disability), the extent to which patients believe that pain means they are doing exercise that is damaging themselves and therefore they should avoid such activity (Harm), the extent to which patients believe that their emotions impact their pain (Emotion), the extent to which patients believe that others should be solicitous in response to their experience of pain (Solicitude), and the extent to which patients believe that medical procedures are appropriate and can cure their pain problem (Medical Procedures).

Procedure

Data collection was carried out by three physiotherapists, and the same physiotherapist assessed the same participant at each follow-up (1 week, 1 month, 3 months, and 6 months after surgery). All the measurements were carried out at the participants' homes.

Most of the outcome variables consisted of self-administered questionnaires and required no or minimal interaction with the assessor. Due to the advanced age of some participants, if needed, the assessors gave support by reading the questionnaires during the assessments.

Biases

Before the study started, the three physiotherapists had a meeting to establish standard assessment criteria and prevent biases. Moreover, all the questionnaires were given in a random order to prevent possible biases, such as automation of the responses due to fatigue.

Sample Size Calculation

In relation to the variables assessed, sample size was estimated for a total of seven possible predictors. According to Cohen's guidelines (1988) [32], it was assumed that the multiple regression model would reach a large effect size (f^2=0.35). Thus, it was estimated that a sample of 70 subjects was needed to achieve a Cohen's f^2 of 0.35, with seven possible predictors and considering an alpha error of 0.05 and power of 0.95. The software used was G*Power Program 3.1.9.2 from the University of Düsseldorf [33], and the test conducted was an a priori F test for linear multiple regression, fixed model. Because of the longitudinal design of the study, the sample size was increased by 25% to avoid risk of dropout (n = 88).

Statistical Analysis

Continuous variables were described using means and standard deviations, and medians and interquartile ranges. Categorical variables were presented with raw frequencies and percentages. All primary and secondary continuous variables were tested for normality using Kolmogorov-Smirnov test. Due to a lack of normal distribution, correlation between explanatory variables were assessed using Spearman's correlation test.

First, a baseline model was estimated describing the evolution of means over time measurements for the primary endpoint. A mixed effects model with the proper distance between measurement time points (fixed) was estimated, including a random term representing individual profile variations. This overall trajectory was used as comparison pattern when including additional covariates, such as gender, age group or psychological impairment measures. Two separate models were estimated one for WOMAC scores and another for EQ-5D-5L scores.

Second, gender, age, type of surgery, and BMI were included as sociodemographic and procedure related covariates and were retained in all further models in order to control for such features.

Third, each one of the proposed explanatory covariates were include in the model separately in order to allow estimating the individual isolated effect.

Fourth, since all psychological impairment measures had shown to correlate, exploratory factor analysis (EFA) was used (with principal components extraction method) to identify the number of dimensions underlying the group of psychological measurements. The number of factors was assessed using the Kaiser-Guttman rule considering the number of eigenvalues larger than 1, along with the amount of variance accounted for by each dimension. Whether only one dimension could be identified, it would justify only including a reduced number of covariates in the mixed effect model due to multicollinearity.

For all the analyses, *P* values of less than .05 were considered statistically significant results. All statistical analysis was performed with the IBM SPSS, version 26 (IBM, Chicago, IL, USA).

Results

Sample Characteristics

One hundred and twenty-three subjects were assessed for eligibility. A total of 89 subjects met the inclusion criteria and agreed to participate in the study. One participant was lost at the 6-months follow-up (Figure 1).The mean age of the study sample was 70.3 ± 7.99 years, most of them being female (66.3%). The descriptive characteristics of the participants are shown in Table 1. All psychosocial variables showed significant correlations between them at 1-week follow-up ($P < .01$).

Evolution of Means over Time

The evolution of WOMAC total score over time showed a significant difference between every pair of follow-up measurements ($P \leq .001$) (Table 2). From now on, time factor will be presented as weeks instead of months. Using week-24 as reference moment, subjects presented a mean score of 22.91 points higher at week-1 ($P < .001$), 9.90 at week-4 ($P < .001$), and 3.51 at week-12 ($P = .001$). Mean decrease from week-1 to week-4 was 4.33 points per week; from week-4 to week-12 mean decrease was 0.80 points per week; and between week-12 and week-24 a mean reduction of 0.28 points per week was observed. It could be observed that a substantial improvement was achieved during the first 4 weeks, which greatly decelerates over the following weeks until the 24-weeks follow-up (Figure 2).

Variance estimates at each measurement moment also decreased over time (week-1 = 308.5 ± 46.2, week-4 = 250.3 ± 37.5, week-12 = 291.3 ± 43.7, week-24 = 238.1 ± 25.4, respectively), as the average level of the trajectory approached the floor value.

The evolution of EQ-5D-5L over time showed a significant improvement along the first 12 weeks ($P < .001$), but improvement did not reach statistical significance between the week-12 and week-24 ($P = .052$). Compared to the week-24 reference moment, subjects presented on average a 0.302 lower utility value (as measured by the EQ-5D-5L summary index score) at week-1 ($P < .001$), 0.135 lower at week-4 ($P < .001$), and 0.031 lower at week-12 ($P = .052$). A mean reduction of 0.056 points per week was found; from week-4 to week-12 a mean reduction of 0.013 points per week was found; and between week-12 and week-24 a mean reduction of 0.003 points per week was observed. A substantial improvement in quality of life during the first 4 weeks was observed, which greatly decelerated over the following months until the 24-weeks follow-up (Figure 3).

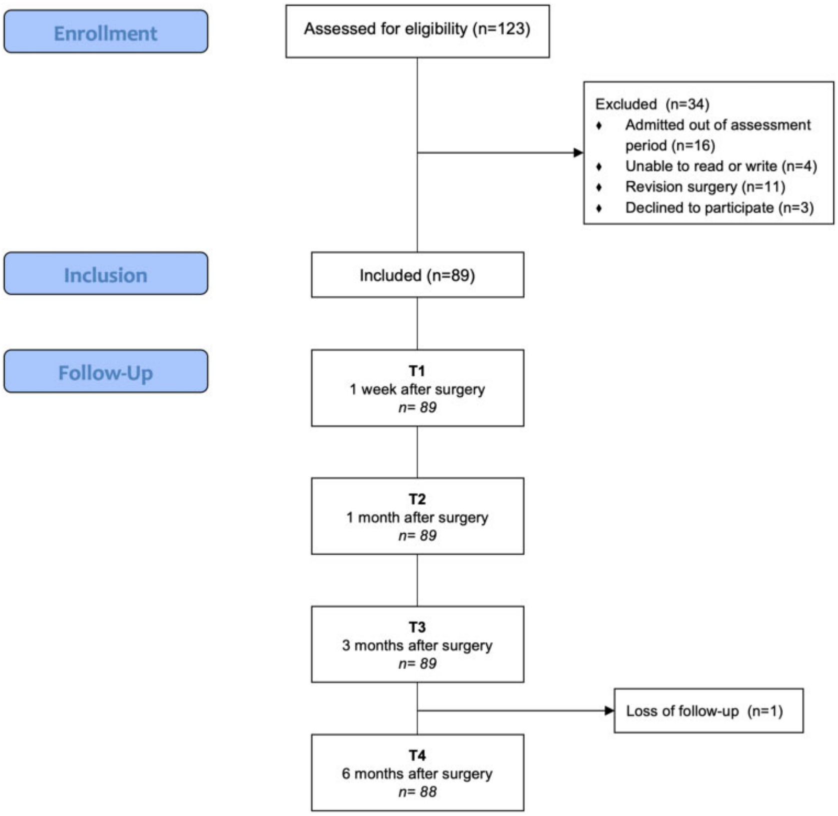

Figure 1. Flowchart of KA subjects (screening, inclusion and assessment at each follow-up).

Variance estimates decreased over time as the trajectory approaches the ceiling value in quality of life utility (week-1 = 0.079 ± 0.012, week-3 = 0.057 ± 0.009, week-12 = 0.042 ± 0.006, week-24 = 0.046 ± 0.007, respectively).

Sociodemographic and Procedure Related Covariates

None of the proposed sociodemographic or procedure related variables reached the significance level when were included as covariates for the WOMAC total score model ($P > .05$). However, the interaction between gender and time showed to be close to significance ($P = .064$). Detailed analysis revealed that, the improvement over time on WOMAC total score for men was statistically significant across all measurement moments. Nevertheless, women did not reach a significant improvement between the week-12 and week-24 follow-up, showing a deceleration on their improvement from week-12 on. Therefore, the interaction between gender and time was retained as a controlling variable. Age, type of surgery, and BMI were considered as noninfluential and were not further considered as controlling variables (Table 3).

Concerning the EQ-5D-5L model, age was found to have a significant statistical influence in the model for quality of life improvement. For every 10 years of age eldering from the average age, the average utility at week-1 showed an increase of 0.075 points (SE = 0.025) and surprisingly, being 10 years younger represented a worsening after intervention of 0.075 points. Therefore, age was retained as a controlling variable but not the interaction with the moment of measurement (Table 3).

Psychosocial Covariates

The univariate analysis revealed that, on explaining the WOMAC total score, every proposed variable achieved a significant effect ($P < .001$) in the corresponding model, when controlling for time and the interaction of time and gender, except for SOPA-B Solitude ($P = .053$) which only was close to significance (Table 4).

In all models, a one-unit higher score of deterioration at baseline would explain a higher WOMAC score at the week-1 first measurement, except for the pain control score measured by the SOPA-B which showed a reduction in the starting impairment level by unit change (B = −5.118). Given that each dimension was measured in a different scale it is not possible to directly compare the size of the estimated effects, instead, the value of the test-statistic should be compared. In order of decreasing effect, anxiety level (F = 120.8), pain catastrophizing (F = 103.9), depression level (F = 93.6), and pain VAS score (F = 72.8) were the most influential variables.

As expected by the results from the EFA (see below) it was not possible to include all covariates in the multivariate model. Due to the existing multicollinearity between

Table 1. Sample characteristics at baseline

Variable	Robust statistics median (IQR)	Asymptotic statistics mean (SD)
Age (years of age)	70.99 (12.1)	70.271 (7.988)
Sex (female), n (%)	59 (66.3%)	–
Body mass index (BMI), n (%)		
Normal	11 (12.4%)	–
Overweight	31 (34.8%)	
Obesity	47 (52.8%)	
Charlson Comorbidity Index (CCI)	3 (2 and 4)	3 (1.168)
Smoking habit, n(%)	61 (68.5%)	–
Never smoked	22 (24.7%)	
Quit smoking	6 (6.7%)	
Smoker		
Alcohol habit, n (%)	33 (37.1%)	–
Never	50 (56.2%)	
Minimal consumption	6 (6.7%)	
Usual consumption		
Type of surgery, n (%)	38 (42.7%)	–
TKA	51 (57.3%)	
UKA		
Education level, n (%)	33 (37.1%)	–
Read and write	34 (38.2%)	
Elementary, intermediate	20 (22.5%)	
Secondary, vocational	2 (2.2%)	
University		
WOMAC total score (0–96)	39 (24)	40.64 (17.662)
EQ-5D-5L (0–1)	0.565 (0.308)	0.484 (0.283)
Pain (0–100)	4 (4)	40.110 (24.633)
PCS (0–52)	14 (19)	17.170 (13.476)
TSK-11 (11–44)	29 (8)	29.490 (5.829)
HADS	5 (8)	6.110 (5.006)
Anxiety (0–21)	4 (7)	4.870 (4.143)
Depression (0–21)		
SOPA-B	1.4 (1.30)	1.492 (0.914)
Solicitude (0–4)	1.5 (1.88)	1.860 (1.045)
Emotion (0–4)	2.2 (1.20)	1.991 (0.794)
Pain Control (0–4)	1.4 (0.70)	1.488 (0.581)
Harm (0–4)	2.333 (1.33)	2.348 (0.871)
Disability (0–4)	2.333 (0.673)	2.543 (0.679)
Medical Procedures (0–4)		

EQ-5D-5L=EuroQoL 5-Dimensions and 5-Levels; IQR=interquartile range; PCS=pain catastrophizing scale; SD=standard deviation; SOPA=Survey of Pain Attitudes; TKA=total knee arthroplasty; TSK=Tampa Scale of Kinesiophobia; UKA=unicompartmental knee arthroplasty; WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index.

predictors, only anxiety level (B = 2.02, $P < .001$), medical procedures (B = 4.5, $P = .002$) and pain control (B=−3.1, $P = .01$) were statistically significant, pointing out the three main axes of possible improvement over pain management.

Attending to the EQ-5D-5L quality of life, all individual covariates achieved statistical significance ($P < .05$) when controlling for time and age (Table 5). Again, only pain control scores presented a switched sign (B = 0.056), and all other predictors presented a negative sign indicating a lowering in quality of life. In order of decreasing effect, anxiety level (F = 98.5), pain catastrophizing (F = 79.8), depression level (F = 78.3), and pain VAS score (F = 45) were the most influential variables.

Similar results were found for the multivariate model for EQ-5D-5L utility values. Due to the existing multicollinearity between predictors, only anxiety level (B=−0.04, $P < 0.001$), analgesic medication (B = 0.04, $P = .044$), and pain control (B = 0.03, $P = .023$) were statistically significant.

Exploratory Factor Analysis

EFA results showed that explanatory variables were highly correlated and could be explained by a very small number of dimensions. Most variables loaded in the first main dimension. Such dimension mainly gathers the relations between pain VAS score and the psychosocial variables of PCS, TSK, HADS-A, HADS-D, SOPA-B Emotion, SOPA-B Harm, and SOPA-B Disability (Table 6). A second dimension could be extracted gathering the variability related to pain control.

Discussion

The present study examined the evolution of health functioning and quality of life during a 6-months period after

Table 2. Baseline models: Health functioning and quality of life averages and parameter estimates at each time measurement

Parameter	Mean Score (SD)	Deviation estimate	SE	df	t	*P*-value	95% CI LL	95% CI UL
WOMAC total score								
Intercept	–	17.727	1.638	89.080	10.820	.000	14.471	20.982
1 week	40.640 (1.862)	22.913	1.490	89.016	15.375	.000	19.952	25.875
1 month	27.629 (1.677)	9.903	1.122	89.078	8.825	.000	7.673	12.132
3 months	21.236 (1.809)	3.509	1.043	88.520	3.364	.001	1.437	5.582
6 months	17.727 (1.638)	0*	0	–	–	–	–	–
EQ-5D-5L								
Intercept	–	0.786	0.023	89.305	34.428	.000	.741	.832
1 week	0.484 (0.030)	−0.302	0.024	89.308	−12.556	.000	−.350	−.254
1 month	0.651 (0.025)	−0.135	0.020	88.912	−6.888	.000	−.175	.096
3 months	0.755 (0.022)	−0.031	0.016	88.485	−1.970	.052	−.063	.000
6 months	0.786 (0.023)	0*	0	–	–	–	–	–

*Reference category.

CI=confidence interval; df=degrees of freedom; EQ-5D-5L=EuroQoL 5-Dimensions and 5-Levels; LL=lower limit; SD=standard deviation; SE=standard error; UL=upper limit; WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index.

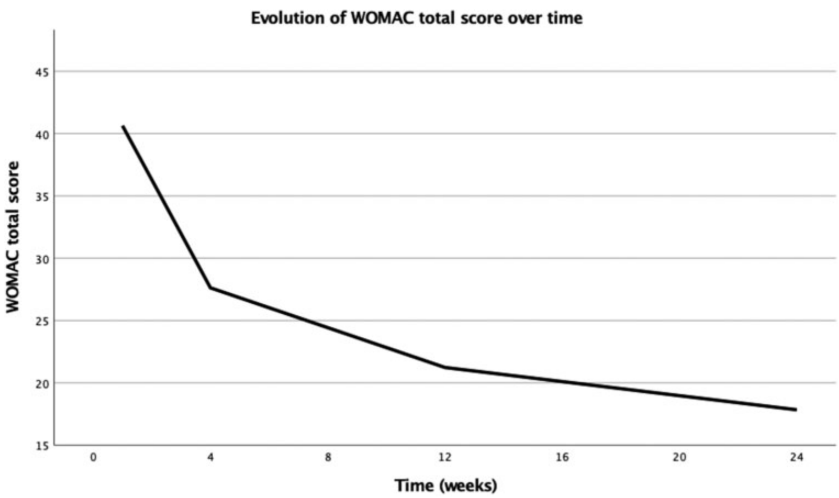

Figure 2. Evolution of WOMAC total score over time.

a KA. The aim was to investigate the prognostic value of pain-related postoperative psychosocial factors in health functioning and quality of life.

There are recent studies that found that variables such as gender [34–36], BMI [37, 38], or age [39] predict postoperative activity level or functional improvement. For this reason, these variables have also been included in the analysis to retain them as possible controlling variables. In contrast with such studies, our results showed that these variables were not predictors of health functioning improvements. Despite that, different trends of improvement in health functioning were observed depending on the gender, showing a lack of improvement since 3-months follow-up in females. Regarding quality of life, age was considered as influential, and in accordance with previous studies, younger age was associated with worse postoperative outcomes [40, 41]. In addition, the type of surgery was also assessed but it did not influence the outcomes.

The KA procedure carries a significant risk for severe acute postoperative pain with implications for the patients' recovery during rehabilitation [42]. Hence, acute postoperative pain intensity has been mainly investigated as a prognostic factor for chronic postoperative pain after KA [9, 43]. However, its influence on health functioning and quality of life remains unclear. According to our results, postoperative pain intensity might be a significant predictor for health functioning and quality of life improvements after a KA. Therefore, identifying and managing subjects with high acute pain levels could lead to better outcomes after a KA.

Alongside clinical factors as acute pain, previous studies have shown that psychological factors such as pain

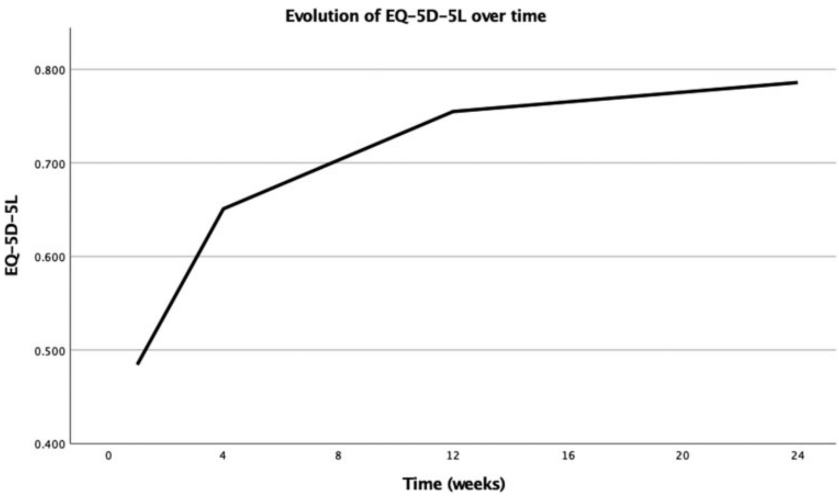

Figure 3. Evolution of EQ-5D-5L total score over time.

Table 3. Sociodemographic covariates effect estimates

	WOMAC total score			EQ-5D-5L		
Parameter	B (SE)	F	*P*-value	B (SE)	F	*P*-value
Gender	0.052 (3.462)	0.051	.821	0.015 (0.048)	0.160	.690
Time × Gender	−2.888 (3.134)	2.503	.064	0.045 (0.051)	0.563	.641
Type of surgery	0.398 (3.311)	0.002	.965	0.003 (0.046)	0.124	.725
Time × Type of surgery	1.085 (3.010)	0.912	.439	−0.26 (0.049)	0.239	.869
Age (decades)	−0.379 (0.102)	2.600	.110	0.075 (0.028)	5.059	.027
Time × Age	0.231 (0.186)	1.185	.320	−0.004 (0.003)	0.728	.538
BMI	0.005 (0.309)	0.000	.983	−0.001 (0.004)	0.443	.508
Time × BMI	0.027 (0.281)	0.098	.961	0.001 (0.005)	0.548	.650

BMI=body mass index; EQ-5D-5L=Euro Quality of Life 5-Dimensions and 5-Levels; SE=standard error; WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index.

Table 4. Individual covariates effects for WOMAC total score

Parameter	Estimate	F	*P*-value	Lower bound	Higher bound
Included variables					
Pain	4.010	72.758	.000	3.076	4.944
PCS	0.803	103.948	.000	0.646	0.959
TSK	1.364	35.319	.000	0.908	1.820
HADS-A	2.238	120.782	.000	1.833	2.642
HADS-D	2.540	93.624	.000	2.018	3.061
SOPA-B Emotion	8.333	42.743	.000	5.800	10.865
SOPA-B Pain Control	−5.118	7.361	.008	−8.866	−1.370
SOPA-B Harm	7.470	8.657	.004	2.425	12.515
SOPA-B Disability	8.390	29.352	.000	5.313	11.467
SOPA-B Med. Procedures	8.686	16.731	.000	4.467	12.905
Excluded variables					
SOPA-B Solicitude	3.262	3.857	.053	−0.038	6.563

HADS=hospital anxiety and depression scale; PCS=pain catastrophizing scale; SOPA=Survey of Pain Attitudes; TSK=Tampa Scale of Kinesiophobia; WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index.

catastrophizing, anxiety, depression, and kinesiophobia, may influence postoperative outcomes after KA [44–47]. Some of these factors have been widely investigated and have been shown to contribute to altered central thresholds of excitability, the amplification of pain signals, or the development of long-term disability [48–50]. In order to explain how psychological processes mediate the transition from episodic acute pain to chronic pain with an associated disability, the fear-avoidance model emerged as one of the most widely recognized theoretical constructs [51]. The underpinnings of the fear-avoidance model of pain are key psychological processes, including emotions, cognitions, attention,

Table 5. Individual covariates effects for EQ-5D-5L

Parameter	Estimate	F	*P*-value	Lower Bound	Higher Bound
Included variables					
Pain	−0.045	44.991	.000	−0.058	−0.032
PCS	−0.010	79.755	.000	−0.012	−0.008
TSK	−0.017	30.065	.000	−0.023	−0.011
HADS-A	−0.029	98.516	.000	−0.035	−0.023
HADS-D	−0.032	78.253	.000	−0.039	−0.025
SOPA-B Emotion	−0.096	34.044	.000	−0.128	−0.063
SOPA-B Pain Control	0.056	5.280	.024	0.008	0.104
SOPA-B Harm	−0.072	4.584	.035	−0.138	−0.005
SOPA-B Disability	−0.091	18.538	.000	−0.133	−0.049
SOPA-B Med. Procedures	−0.087	9.694	.002	−0.142	−0.031
SOPA-B Solicitude	−0.059	8.054	.006	−0.100	−0.017

EQ-5D-5L=Euro Quality of Life 5-Dimensions and 5-Levels; HADS=hospital anxiety and depression scale; PCS=pain catastrophizing scale; SOPA=Survey of Pain Attitudes; TSK=Tampa Scale of Kinesiophobia.

Table 6. Exploratory factor analysis

Variables	Factor 1	Factor 2	Factor 3
Pain	0.696	−0.156	0.464
PCS	0.893	−0.069	0.006
TSK	0.779	0.061	−0.180
HADS-A	0.870	0.021	−0.014
HADS-D	0.883	−0.124	0.017
SOPA-B Emotion	0.742	0.405	0.109
SOPA-B Harm	0.501	−0.246	−0.588
SOPA-B Disability	0.511	−0.290	−0.030
SOPA-B Med. Procedures	0.476	0.005	0.519
SOPA-B Control	−0.158	0.824	0.160
SOPA-B Solicitude	0.485	0.647	−0.380

EQ-5D-5L=Euro Quality of Life 5-Dimensions and 5-Levels; HADS=hospital anxiety and depression scale; PCS=pain catastrophizing scale; SOPA=Survey of Pain Attitudes; TSK=Tampa Scale of Kinesiophobia; WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index.

and behaviors. These combine to form fear-avoidance beliefs and behaviors, which, in turn, become the key drivers of pain-related disability [50]. Despite that, the influence of pain attitudes on KA postoperative outcomes had not been widely assessed. The findings of the present study support the results of previous studies, showing that pain catastrophizing, anxiety, depression, and kinesiophobia might influence KA outcomes [44–47], in terms of health functioning and quality of life. In a recent meta-analysis performed by Sorel et al. [16] , preoperative psychological distress (pain catastrophizing and high mental distress) and psychological disorders (somatization dysfunction and anxiety and/or depression) were shown to negatively affect pain and function 1 year after surgery. Consequently, several authors highlight the importance of identifying such psychologic risk factors and providing targeted interventions [44, 46, 52, 53] Our results also showed that pain attitudes might have an even more significant influence on KA outcomes. Therefore, they should be identified and considered during rehabilitation as well.

Even though the influence of psychologic variables on KA outcomes has mainly been investigated when measured before surgery, the importance of assessing potential postoperative risk factors has been also noted in the literature [9]. In fact, some factors may be more associated with outcomes when measured in the postoperative period [9]. The present study's findings support those observations and highlight the importance of the assessment of postoperative pain intensity and pain-related psychologic factors during KA rehabilitation to identify subjects at risk for poor outcomes after KA. Early postoperative physiotherapy interventions usually aim to improve outcomes such as range of motion, pain intensity, and physical function and they have shown little or no effect on long-term outcomes [12]. This may be because these interventions require evaluation in trials that are focused on high-risk participants.

Finally, the exploratory factor analysis revealed that most of the psychologic factors and pain intensity could be gathered into one single dimension. This dimension could be defined as pain-related psychologic distress. This fact raises several questions that should be considered when interpreting the results. On the one hand, pain intensity and pain-related psychosocial factors are highly correlated, and pain itself may likely contribute to heightened psychological distress. Previous studies have shown that factors such as pain catastrophizing may act as a dynamic state that is partially dependent on pain intensity, rather than a personality trait [54]. Therefore, it is difficult to know if a high score of the PCS truly captures a subject who catastrophizes his pain or a subject who suffers from a high pain intensity. In this line, psychologic distress assessment in a painful postoperative period may limit the ability to identify subjects with psychosocial risk factors. On the other hand, such results may reinforce the biopsychosocial model of pain [55], showing that cognitions, beliefs, pain attitudes and pain itself are strongly interrelated and essential factors to explain how adults experience and adjust to pain problems.

This study has limitations and strengths that should be considered when interpreting the results. Since subjects were admitted to the rehabilitation service 1 week after surgery, the subjects were not assessed before surgery.

Therefore, relevant preoperative information was not available. Also, variables such as mental health, social support, or expectations may influence postoperative outcomes and should be considered in future studies. In addition, the fact that the physiotherapists who collected the data are the same clinicians as the authors, it could induce some source of bias. Finally, as a result of performing all the assessments at the participants' homes, the dropout rate was meager compared to other similar studies. Hence, it should be considered a strength.

Conclusion

Postoperative acute pain and postoperative psychosocial factors of pain catastrophizing, anxiety, depression, and pain attitudes might influence health functioning and quality of life during the rehabilitation process after KA. Such factors could be gathered into one single dimension, which could be defined as pain-related psychologic distress. More research is needed to investigate whether screening for and targeting such factors postoperatively has either a direct or indirect benefit on outcomes after KA.

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