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ORIGINAL PAPER

Social determinants associated to chronic pain after total knee arthroplasty

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Abstract

Aim of the study Analyze the association between social health determinants (SHD) and chronic post-surgical pain (CPSP) after total knee arthroplasty (TKA).

Method A cross-sectional study was performed in 58 TKA patients. The subjects were classified in two groups: with ($n = 22$) or without ($n = 36$) CPSP. SHD considered were gender, age, educational level, economic income, and labour conditions.

Results Significant differences were found concerning educational level when comparing subjects with or without CPSP, with a low educational level of 22.4% and 19%, respectively. 15.5% of patients with persistent pain had a high educational level compared with 43.1% of the patients without persistent pain ($p = 0.032$). No significant differences were found for the other categories ($p > 0.05$). The odds ratio (95% confidence interval) was 3.28 (1.09–9.93) for lower educational level compared with high educational level.

Discussion CPSP must be considered a severe health problem. In addition to SDH, there are multiple factors associated with chronic pain after TKA that must be considered for an effective treatment.

Conclusions Patients with lower educational level showed a three-time higher association to develop CPSP. Considering SHD could be of relevance when elaborating new interventions or health strategies and more specialized counseling for patients with persistent pain after TKA.

Keywords Post-surgical pain · Total knee replacement · Social determinants of health · Arthroplasty · Knee · Pain

Introduction

Total knee arthroplasty (TKA) has been proven to be an effective treatment for knee osteoarthritis, providing functional and quality of life improvements to the patients, and a decrease in complication rates [1]. However, it has been shown that 50% of the patients complain of significant persistent pain during the first post-operative month [1]. Moderate-to-severe pain lasting for at least three months after surgery has been defined as chronic post-surgical pain (CPSP) [2, 3]. The prevalence of CPSP in patients undergoing TKA is 20 to 44% [4–6], generating a high impact in patient's daily life activities and quality of life [5], added to a higher economic cost for the health system [7]. Neurogenic pain [4, 6], central sensitization [8], myofascial pain [9], and prosthetic instability [4] have been mentioned amongst the known causes of this phenomenon; However, recent studies have reported that 15 to 20% of TKA patients are not satisfied with the surgical results, with no evident clinical nor radiologic reason [5, 6], being pain the main reason for dissatisfaction in most of these patients.

Multiple risk factors have been reported about CPSP. Bossmann et al. [10] found a relationship between nociceptive misregulation and autonomic nervous system with pain

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severity at six months after joint replacement surgery. On the other hand, Lewis et al. [11] proposed that catastrophizing, mental health, pre-operative knee pain, and pain at other sites are the strongest independent predictors of persistent pain after TKA. Psychosocial (i.e., depression, anxiety, catastrophizing) [12–15] and demographic (i.e., gender, age) [10, 16] variables have also been considered associated risk factors for chronic post-operative pain.

Social determinants of health (SDH) are defined as the current conditions in which people are born, grow, work, live, and age, and the set of forces and systems which make up the daily life conditions [17]. SDH have shown to be associated with people's morbidity and mortality [18]. Although contribution of SDH to chronic pain has been shown [19–21], little has been studied about its implications in post-operative populations and in the development of persistent pain after TKA. For example, ethnical origin and level of poverty have been shown to be related with higher pain scores in other similar post-surgical conditions (i.e., hip arthroplasty), but not so the educational level [22]. Also, the lack of university studies was associated to higher pain scores in patients before and after TKA [23]. A low educational level has proven to be related to persistent pain [21], as also to lack of knowledge of the patients about their disease [21] and negative beliefs associated to pain.

To study the importance of SDH in persistent pain after TKA may be of relevance at the moment of elaborating new interventions or educational strategies and more specialized counselings, so as to minimize the negative impact of CPSP in the quality of life and the associated economic costs for the patients. The aim of our study was to analyze the association between social determinants for health and chronic postoperative pain after a total knee arthroplasty.

Materials and methods

Participants and design

An observational cross-sectional study was performed in 58 patients undergoing TKA at the Hospital Clínico La Florida, a Chilean public hospital. All the patients operated in our centre between October 2017 and March 2018 were included, and all were dated for a single clinical assessment in August 2018. The presence of chronic post-operative pain was defined as whether the patient presented persistent pain greater than 40 mm in the visual analogue scale (VAS), of at least three months after the TKA, not relieved by oral medications nor conventional physical therapy techniques [9]. The subjects were classified in two groups: with CPSP ($n = 22$) or control group without CPSP ($n = 36$) according to the fulfillment of this definition. For calculations of the sample size, and based upon previous studies [19], a G*Power 2.1 was used, with a significance level of 0.05 and statistic potency of 80%, and considering a 20% of possible losses, the minimum sample size required was 56 patients.

Outcome measure

All patients were cited in August 2018 to complete a self-report questionnaire of the sociodemographic variables related to the structural health; the variables were classified according to the following categories: gender (male, female); age (< 60 years, ≥ 60 years); educational level (low educational, high educational); monetary income (< $270 USD, ≥ $270 USD), and labour condition (active, inactive). To determine pain perception, visual analogue scale (VAS) was used, which consists of a 100-mm line that goes from "no pain at all" to "the worst possible pain imaginable." This is a valid and reliable measurement to assess post-operative pain [24].

Statistical analyses

The data normality was verified by a Shapiro-Wilk test; all the quantitative data had a normal distribution. Mean and standard deviations were calculated for the quantitative variables, and the percentages for the categorical variables. Chi-square was used to compare between groups, and the association between variables was determined using the odds ratio (OR) with a confidence interval of 95%. Statistical significance was established in $p < 0.05$. All the statistical analysis was performed in SPSS version 22.0 (IBM Corporation, Armonk, NY).

Results

A total of 58 subjects made up the sample, 22 assigned to the CPSP group and 36 to the control group. Table 1 shows the sociodemographic characteristics of the subjects, and Fig. 1 represents the flow diagram of the participants. Significant differences were found for the educational level when comparing patients with or without CPSP; 22.4% of patients with CPSP had a low level of education compared with 19% of patients without CPSP. In addition, 15.5% of patients with CPSP had a high level of education compared with 43.1% of patients without CPSP ($p = 0.032$). No differences were observed for the other categories (Table 2).

For the association measures, an odds ratio (95% confidence interval) of 3.28 (1.09–9.93) was obtained for low educational level compared with a high level ($p = 0.032$). A logistic regression analysis discarded the influence of possible confusing factors (age, gender, BMI) in the association between pain and educational level. There were no participants with lack of data for each variable of interest.

Table 1 Baseline characterization of patients

	All subjects ($n = 58$)	CPSP ($n = 22$)	Control ($n = 36$)	p value
Age (years)	69.1 ± 6.6	67.3 ± 5.3	69.8 ± 6.9	0.156
BMI (kg/m^2)	30.2 ± 4.9	29.7 ± 3.8	30.7 ± 5.8	0.464
Duration of TKA (months)	7.7 ± 1.3	7.5 ± 1.1	7.8 ± 1.5	0.376
Pain (VAS)	34.1 ± 26.1	61.4 ± 12.6	13.6 ± 12.7	<0.001

CPSP, chronic postsurgical pain; *BMI*, body mass index; *TKA*, total knee arthroplasty; *VAS*, visual analogue scale. Values are mean ± SD unless otherwise indicated

Discussion

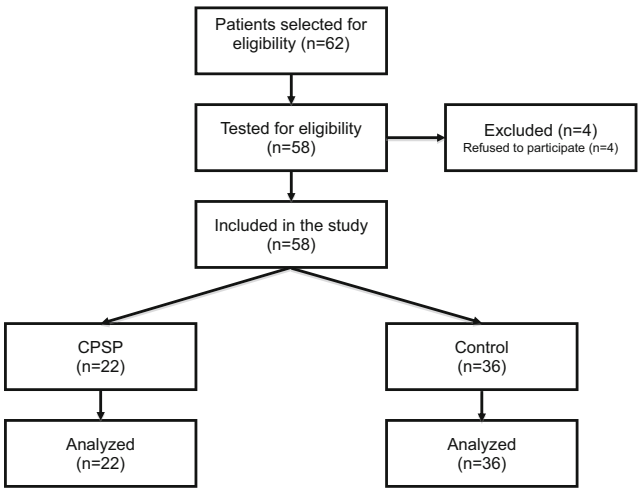
The aim of our study was to analyze the association between the social determinants of health and chronic post-operative pain after TKA. Our results suggest that patients with persistent post-operative pain had a lower educational level compared with the controls. In addition, patients with a lower educational level showed a three-time higher association to develop post-operative chronic pain.

In our study, only 15% of the subjects with CPSP had a high educational level versus 49% in the control group. These results confirm what has been said in other studies, where a lower educational level was associated to greater pain in patients undergoing TKA [23]. We think that these results could be partly explained by the relationship that exists between a lower educational level and the possibilities to develop pain-associated negative beliefs and maladaptive coping strategies [25], for psychosocial factors such as the emotional status and catastrophizing have shown to be good predictors of persistent pain in TKA [11–14].

On the other hand, Barrack et al. [26] found that having a low income is associated with worse patient satisfaction after TKA, but not with pain. About the age range, our results are similar to other published studies where no relationship with CPSP was found [11, 27]. Only one study has reported that age below 60 years could be a predictor to develop persistent pain [28]. Respecting gender, O'Connor [29] reported the existence of female gender influences over post-operative pain severity and prevalence of persistent pain after TKA, while Lewis et al. [11] did not find differences.

Chronic post-operative pain must be considered a severe health problem due to the prolonged post-operative use of opioids and adjuvant analgesics, which may cause dependence and addiction in TKA patients [30], thus generating a considerable economic cost in this group of subjects [7]. Therefore, it is necessary to know the associated factors which contribute to this phenomenon, so as to implement cost-effective strategies to decrease this health problem.

In addition to SDH, there are multiple factors associated with chronic pain after TKA, such as personality characteristics [31], surgeon-patient communication [32], early



Abbreviations: CPSP; Chronic postsurgical pain.

Fig. 1 Patient flow diagram. *CPSP*, chronic post-surgical pain

Table 2 Comparison between groups

	Groups		All subjects	p value
	CPSP	Control		
Sex				
Female (%)	12 (20.7%)	25 (43.1%)	37 (63.8%)	0.252
Male (%)	10 (17.2%)	11 (19%)	21 (36.2%)	
Total (%)	22 (37.9%)	36 (62.1%)	58 (100%)	
Age				
< 60 years (%)	7 (12.1%)	9 (15.5%)	16 (27.6%)	0.573
≥ 60 years (%)	15 (25.9%)	27 (46.6%)	42 (72.4%)	
Total (%)	22 (37.9%)	36 (62.1%)	58 (100%)	
Educational level				
Low (%)	13 (22.4%)	11 (19.0%)	24 (41.4%)	0.032*
High (%)	9 (15.5%)	25 (43.1%)	34 (58.6%)	
Total (%)	22 (37.9%)	36 (62.1%)	58 (100%)	
Economic income				
< 270 USD (%)	16 (27.6%)	25 (43.1%)	41 (70.7%)	0.790
≥ 270 USD (%)	6 (10.3%)	11 (19%)	17 (29.3%)	
Total (%)	22 (37.9%)	36 (62.1%)	58 (100%)	
Work				
Active (%)	4 (6.9%)	6 (10.3%)	10 (17.2%)	0.882
Inactive (%)	18 (31%)	30 (51.7%)	48 (82.8%)	
Total (%)	22 (37.9%)	36 (62.1%)	58 (100%)	

CPSP, chronic postsurgical pain; *USD*, United States dollar. *Statistically significant difference ($p < 0.05$)

psychological stress [33], patient expectations [34], and emotional status [15]. Future studies should evaluate how these variables interact together with patient's educational level in the appearance of persistent post-operative pain.

The treatment of CPSP after TKA is challenging; combined treatments and individually targeted treatments matched to patient characteristics are recommended [35]. During the pre-operative period, interventions such as high-intensity strength training reduce post-operative pain [36]. Before and during TKA, the pharmacological treatment (i.e., duloxetine) for central sensitization could contribute to minimize the possibility of persistent pain after surgery [37]. In post-operative interventions, dry needling combined with physical therapy [9] and home-based functional exercises aimed at managing kinesiophobia has been effective in reducing the severity of pain after total knee replacement [38]. On the other hand, the analgesic efficacy of periarticular injections compared with nerve blocks for post-operative pain management still remains controversial [39]. Periarticular multimodal injection, which includes bupivacaine, morphine, and ketorolac, has been used preferably as a preventive method for post-operative pain [40], and multisite infiltration analgesia is recommended for pain relief and rapid rehabilitation after TKA [41]. For the nerve blocks, the lumbar plexus block; the femoral nerve block, with or without a concomitant sciatic nerve block; and the saphenous nerve block also generate benefits for the post-operative pain control in patients undergoing TKA [42].

The present study is one of the few which considers the importance of the SDH in the study of persistent pain after a joint replacement surgery. We think that this study contributes to the current paradigm change to focus the research towards the social aspects involved in chronic pain [43] and to move the future clinicians to complement the patient's assessment with the social circumstances in which their vital cycle develops, identifying, for example, the educational level of patients waiting for surgery, and developing education strategies, and counseling focused on conduct or negative beliefs changes concerning their health condition. These interventions must also be adapted to patient understanding and preferences, so as to achieve the best possible post-operative results and minimize the patient-associated negative CPSP in the quality of life and economic costs after a TKA.

A limitation of this study is that we do not know the patient's presurgical status; therefore, we cannot determine the existence of previous differences in pain intensity before TKA between both groups. These results must be interpreted with caution, because we cannot establish a cause-effect relation with the study design. It is also important to mention that our results apply only to the reality of one country; multicenter studies are needed to confirm these results. Future studies should investigate how the education level may affect pain and how it is also related to functional results in postsurgical populations. In addition, the pain control protocol must include both the assessment of pain severity and the mechanisms and risk factors involved. A comprehensive understanding of the problem is necessary to propose the most effective treatment options.

Conclusion

Patients with persistent postoperative pain had a lower educational level compared with patients without it. Also, patients with a lower educational level showed a three-time higher association to develop post-operative chronic pain. Consideration of social determinants may be of relevance at the moment of elaborating new interventions or education and more specialized counseling strategies for persistent pain patients. Future studies must be directed to determine the causes for the association between persistent pain and the educational level of patients undergoing TKA.

Compliance with ethical standards All the procedures performed in this study were approved by the Ethics Committee of the Southwest Metropolitan Health Service (Santiago, Chile), which were performed in accordance with the principles of the Declaration of Helsinki of the World Medical Association and its revision in 2013.

Conflict of interest The authors declare that they have no conflict of interest.

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