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Association between ongoing pain intensity, health-related quality of life, disability and quality of sleep in elderly people with total knee arthroplasty

Associação entre a intensidade da dor, a qualidade de vida relacionada com a saúde, a incapacidade e a qualidade do sono em idosos com artroplastia total de joelho

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Abstract *The scope of this paper was to study the relationship between pain intensity, health-related quality of life, disability, sleep quality and demographic data in elderly people with total knee arthroplasty (TKA). 24 subjects who had been subjected to TKA the previous month (4 females; 66 ± 9years) and 21 comparable controls (8 male; 70 ± 9years) participated in the study. Intensity of pain, and highest and lowest pain intensity experienced in the preceding week were collected. The Western Ontario and McMaster Universities index function, quality of life (Medical Outcomes Study Short Form 36), and Pittsburgh Sleep Quality Index were assessed. Age, gender, weight, height, body mass index were also collected. Individuals with TKA presented worse physical function (P < 0.01), social role (P = 0.01), physical performance (P < 0.01), pain (P = 0.04), disability (P = 0.04) and sleep quality (P = 0.03) than the controls. Higher intensity of pain was associated with lower physical function, social role, mental health, vitality and general health, and with higher disability and sleep quality. Disability and sleep quality were negatively associated with several quality of life domains. The associations between the intensity of pain, disability, quality of life and sleep reveal the multidimensional experience of TKA.*

Key words *Arthroplasty of the knee, Elderly, Quality of Life, Disability, Sleep*

Resumo *Objetivo: Identificar as relações entre intensidade da dor, qualidade de vida relacionada à saúde, incapacidade, qualidade do sono e dados demográficos em idosos com artroplastia total de joelho (ATJ). Métodos: Participaram vinte e quatro pacientes que receberam ATJ no mês anterior (4 mulheres; 66 ± 9 anos) e 21 controles comparáveis (8 homens; 70 ± 9 anos). Foram coletadas a intensidade da dor no momento da avaliação, a maior e a menor intensidade de dor sentida na semana anterior. A função (*Western Ontario and McMaster Universities index*), a qualidade de vida (*Medical Outcomes Study Short Form 36*), e a qualidade do sono (*Pittsburgh Sleep Quality Index*) foram avaliadas. Idade, sexo, peso, altura, índice de massa corporal também foram coletados. Resultados: Indivíduos com ATJ mostraram pior função física (P < 0,01), papel social (P = 0,01), desempenho físico (P < 0,01), dor (P = 0,04), incapacidade (P = 0,04) e qualidade do sono (P = 0,03) do que os controles. Maior intensidade da dor foi associada com menor função física, papel social, saúde mental, vitalidade e saúde geral, e com maior incapacidade e qualidade do sono. Incapacidade e qualidade do sono estiveram associadas negativamente com vários domínios de qualidade de vida. As associações entre a intensidade da dor, incapacidade, qualidade de vida e do sono mostram a experiência multidimensional da ATJ.*

Palavras-chave *Artroplastia do joelho, Idoso, Qualidade de vida, Incapacidade, Sono*

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Introduction

Osteoarthritis (OA) is the most prevalent medical arthritic condition worldwide. For instance, it affects 3532 per 100.000 people in the United States of America[1,2]. Population based longitudinal studies in the USA have shown that the lifetime risk of knee OA increases with age[3]. In fact, more than 10% of elder people in the USA will suffer knee OA[4]. Total knee arthroplasty (TKA) is one of the main therapeutic options for subjects with chronic knee OA. Therefore, the number of TKA will further increase in the next decades because of the aging population and an associated increasing in prevalence of arthritic diseases and joint degeneration[5,6].

Patients who had received TKA differ greatly in length and quality of their recovery, as indicated by their reports of pain and the speed with which they are able to recover independency[7]. Although primary TKA has revolutionized the management of patients with end-stage OA, 11%-19% of patients with TKA are not satisfied with their recovery[8]. Subjects undergoing TKA are less active according to recommendations for achieving health-enhancing activity levels, more than 10,000 steps per day[9].

Patients who undergo TKA sometimes report high levels of pain and disability. In fact, despite the enormous success of this procedure, chronic neuropathic pain can be developed postoperatively being distressing and difficult to treat once it is established[10]. The incidence of chronic neuropathic pain after TKA surgery has not decreased, in spite of advances in surgical procedures and anesthetic management. Pain that persists after the surgery is a major, if largely unrecognized, clinical problem for these patients[11]. In fact, neuropathic pain is as high as 12.7% at 6 month after the surgery[12]. Puolakka et al.[13] reported that the intensity of early postoperative pain and delayed surgery increase the risk of persistent pain after TKA. Nevertheless, the severity of pain and disability may depend of several factors including age, gender, body mass index, and sport activities[14]. However, with increasing life expectancy and elective surgery improving quality of life, age alone is not a factor that affects the outcome of TKA and should not be a limiting factor when considering who should receive the procedure[15].

One of the objectives of TKA is to improve the quality of life and function of patients with long-lasting and severe knee OA. Large improvements have been reported for pain and function after TKA, while small to moderate changes are also seen in other areas related to health-related quality of life[16]. An important point is that the intensity of pain is correlated with the decrease in both physical and mental component of the SF-12 quality of life questionnaire[17]. Further, an increase in postoperative pain could be able to decrease the quality of life of the patient in the immediate postoperative period[17]. It seems that physical function is substantially influenced by the pain experienced by the patients. Stratford et al.[18] found that improvements in self-rated recovery corresponded strongly with improvements in patient perceived pain. Patients who have advanced knee OA and subsequent TKA are not able of discriminating the experienced pain from their ability to perform functional tasks[19].

Finally, one important topic in chronic pain is the quality of sleep. Individuals with non-surgical chronic pain syndromes reporting more severe pain experience poorer sleep quality, delayed sleep onset, increased number of awakenings and fewer hours of sleep per night[20-22]. In fact, one of the most common complaints of the individuals following surgery is increase difficulty for sleeping. In such scenario, sleep difficulties have been related to higher intensity of pain[23] and lower functioning in patients with chronic pain, although this relation depends on the patient characteristics[24]. Therefore, interventions targeting sleep disruptions may improve the speed and quality of patient recovery after TKA and other possible surgical procedures, underscoring the importance of adequate sleep during the postsurgical recovery period[25]. For a better understanding of the complex clinical presentation of individuals after receiving TKA, the current study aims to identify the potential relationships between pain intensity, health related quality of life, disability and sleep quality in a sample of elderly people who had received TKA and to identify the behavioral differences of these variables in relation to age and body mass index.

Methods

Individuals with end-stage knee OA who had received total knee arthroplasty (TKA) from an Orthopedic Service of a Public Hospital were recruited. All participants underwent a TKA with a tri-compartmental, cemented endoprosthesis with a medial parapatellar surgical approach. In addition, sex- and age-comparable subjects who had no knee pain or other long lasting pain problems

in the past year were also included as controls. Participants were excluded if presented any of the following: 1, previous TKA; 2, previous lower extremity surgery; 3, cervical surgery; 4, diagnosis of radiculopathy or myelopathy; 5, diagnosis of fibromyalgia; 6, if they were cognitive impaired; or, 7, if they had received rehabilitation in the past 6 months before the study. The protocol was approved by the local human research committee and it was conducted according to the declaration of Helsinki. All subjects signed an informed consent prior to their inclusion in the study.

Demographic data including age, gender, weight, height, BMI, past medical history and location and nature of the symptoms were collected. An 11-point numerical pain rate scale (NPRS, 0: no pain; 10: maximum pain) was used to determine the mean current intensity of pain, worst and lowest intensity of pain experienced in the preceding week[26].

The functional status of the patients was evaluated using the Western Ontario and McMaster Universities (WOMAC) index. The WOMAC consists of a self-administered questionnaire reflecting 3 dimensions: pain (5 items), stiffness (5 items), and physical function (17 items) in individuals with OA in the lower limb[27]. The total score of the questionnaire has shown to have high reliability (ICC: 0.92-0.97) and a standard error of measurement (SEM) ranging between 5.1 and 7.2 points[28]. In the current study, we used the validated Spanish version of the WOMAC questionnaire which is a valid and reliable instrument in patients with knee OA[29].

The health-related quality of life was assessed with the Medical Outcomes Study Short Form 36 (SF-36) questionnaire which assessed 8 domains: physical function, physical role, bodily pain, general health, vitality, social function, emotional role, and mental health[30]. After summing the Likert-scaled items, each scale is categorized from 0 (lowest level of functioning) to 100 (highest level)[31]. The SF-36 questionnaire has demonstrated the best ability to discriminate between individuals with health problems and healthy people[32]. We used the validated Spanish version of the SF-36 which is a valid, reliable, and responsive instrument[33].

Sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI)[34]. This questionnaire appraises sleep quality over a 1-month period through a standardized questionnaire differentiating between good and poor sleepers. It consists of 19 self-rated questions and 5 questions answered by bedmates/roommates. PSQI items use varying response categories recording the usual bed time, usual wake time, number of actual hours slept, and number of minutes to fall asleep, as well as forced-choice Likert-type responses (0-3). The sum of the scores for the components yields one global score (0-21) where higher score indicates worse sleep quality[35]. Buysse et al.[35] reported that the PSQI has good internal consistency (α: 0.83) and test-retest reliability (r: 0.85). A total score > 8.0 has been found to be indicative of poor sleep quality[36].

Data were analyzed with the SPSS statistical package (18.0 Version). Descriptive data was collected on all patients. The Kolmogorov-Smirnov test showed that all data showed a normal distribution ($P > 0.05$); therefore, parametric tests were used in the analysis. The chi square (χ^2) test was used to analyze the differences in the distribution of sex between groups. The unpaired Student t-test was used for assessing differences in pain intensity (NPRS), disability (WOMAC), quality of life (SF-36) and sleep quality (PSQI) between groups. The Pearson correlation test (r) was used to determine the association between pain, function, health-related quality of life and sleep quality within the group of individuals who had received TKA. The statistical analysis was conducted at 95% confidence level, and a P value < 0.05 was considered statistically significant.

Results

Twenty-four (n = 24) subjects who had received TKA the previous month (mean: 28 days), 4 male-20 female, mean age: 66 ± 9 years, and 21 comparable controls, 8 male-13 females, mean age: 70 ± 9 years old, were included. No significant differences between groups were detected for age, weight, height and BMI (Table 1).

The analysis revealed significant differences between groups for physical function, social role, physical role, and bodily pain ($P < 0.05$): individuals who had received TKA exhibited lower quality of life than those in the control group. No significant differences for mental health, emotional role, vitality, and general health were observed (Table 1). Similarly, individuals who had received TKA exhibited lower function (WOMAC) and worse sleep quality (PSQI) than those within the control group ($P < 0.05$, Table 1).

The association between clinical and demographic data with health-related quality of life, disability, and sleep quality showed a complex pattern. Older age was associated with higher vi-

Table 1. Demographic and clinical data of patients with total knee arthroplasty (TKA) and controls.

	TKA (n = 24)	Controls (n = 21)	Significance
Gender (male/female)	4 / 20	8 / 13	$\chi^2 = 2.63$; P = 0.105
Age (years)	66 ± 9	70 ± 9	t = -1.613; P = 0.114
Weight (kg)	71 ± 12	72 ± 11	t = 0.177; P = 0.86
Height (cm)	169 ± 8	170 ± 8	t = 1.174; P = 0.247
BMI (kg/cm^2)	24.5 ± 3.2	24.9 ± 3.4	t = -0.928; P = 0.359
Affected side (right/left)	14 / 10	——	—-
Time from surgery (days)	28 ± 7	—-	—-
Current pain (NPRS, 0-10)	4.3 ± 2.1	——	—-
Worst pain last week (NPRS, 0-10)	5.2 ± 3.1	——	—-
Least pain last week (NPRS, 0-10)	3.6 ± 2.7	——	—-
Physical function (SF-36, 0-100)*	40.8 ± 22.9	68.3 ± 19.9	t = 4.269; P < 0.001
Social role (SF-36, 0-100)*	54.2 ± 24.4	75.6 ± 30.0	t = 2.645; P = 0.011
Physical role (SF-36, 0-100)*	3.13 ± 8.5	38.1 ± 47.8	t = 3.305; P = 0.003
Emotional role (SF-36, 0-100)	54.9 ± 46.1	61.9 ± 49.8	t = 0.487; P = 0.629
Mental health (SF-36, 0-100)	64.2 ± 19.6	66.2 ± 19.7	t = 0.347; P = 0.730
Vitality (SF-36, 0-100)	47.0 ± 23.0	58.7 ± 22.8	t = 1.710; P = 0.094
Bodily pain (SF-36, 0-100)*	37.5 ± 24.2	51.8 ± 19.7	t = 2.155; P = 0.037
General Health (SF-36, 0-100)	60.2 ± 15.6	56.0 ± 18.0	t = -0.831; P = 0.411
WOMAC score (0-96)*	35.0 ± 19.2	23.71 ± 15.04	t = -2.171; P = 0.036
PSQI score (0-21)*	11.2 ± 5.1	7.9 ± 4.4	t = -2.246; P = 0.03

Data are expressed as means ± standard deviation; BMI: body mass index; WOMAC: Western Ontario and McMaster Universities Arthritis Index; PSQI: Pittsburgh Sleep Quality Index. * Indicated statistically significant difference between groups.

tality and function (WOMAC). BMI was negatively positively associated with the worst pain (r = 0.409; P = 0.047) and the least pain (r = 0.513; P = 0.01) experienced the previous week: the higher the BMI, the higher the intensity of pain. No significant associations between time from surgery, weight or height with any other variable were found (Table 2).

The mean intensity of ongoing pain showed moderate-high negative associations with physical function, social role, mental health, vitality and general health domains of the SF-36 questionnaire (Table 2): the higher the intensity of ongoing pain, the lower the quality of life in these domains. Additionally, positive significant associations between the intensity of ongoing pain with disability (WOMAC, r = 0.669; P < 0.01) and sleep quality (PSQI, r = 0.450; P = 0.027) were also observed (Table 2): the higher the intensity of the pain, the lower the function or the worse the sleep quality.

Further, several associations between the different domains of the SF-36 quality of life questionnaire with disability and sleep quality were found (Table 2). Disability was negatively associated with physical function, mental health, vitality, bodily pain, or general health (all, p < 0.05): the higher the disability, the lower the quality of life in these domains. Finally, sleep quality was also negatively associated with social role, mental health, vitality, and general health (all, P < 0.05): the worse the sleep quality, the lower the quality of life in these quality of life domains (Table 2).

Discussion

The current study found that elder people who had received TKA exhibited lower physical function and worse sleep quality than comparable elder people without long lasting pain. Several associations between the intensity of ongoing pain, disability, quality of life, and sleep quality were observed within the TKA group demonstrating the multidimensional aspect of the TKA experience.

We found that higher intensity of ongoing pain after TKA was associated with worse quality of life, lower function, and worse quality of sleep; suggesting that pain after TKA plays an important role in the recovery of these patients. In fact, mechanisms regarding OA-related pain are not completely understood. There is increasing evidence suggesting that central sensitivity plays an important role in pain processes in patients with OA pain suggesting complex mecha-

Table 2. Correlations between demographic and all clinical data of individuals with total knee arthroplasty.

	Current pain	Worst pain	Least pain	Time from surgery	Physical function	Social role	Physical role
Age	NS	NS	NS	NS	NS	NS	NS
Weight	NS	NS	NS	NS	NS	NS	NS
Height	NS	NS	NS	NS	NS	NS	NS
BMI	NS	0.409*	0.513*	NS	NS	NS	NS
Time from surgery			NS	NS	NS	NS	NS
Current pain			NS	NS	-0.538**	-0.645**	NS
Worst pain			NS	NS	NS	NS	NS
Least pain			NS	NS	NS	NS	NS
Physical function							
Social role							
Physical role							
Emotional role							
Mental health							
Vitality							
Bodily pain							
General Health							
Pittsburgh score							

	Emotional role	Mental health	Vitality	Bodily pain	General health	Pittsburgh	WOMAC
Age	NS	NS	0.460*	NS	NS	NS	-0.500*
Weight	NS	NS	NS	NS	NS	NS	NS
Height	NS	NS	NS	NS	NS	NS	NS
BMI	NS	NS	NS	NS	NS	NS	NS
Time from surgery	NS	NS	NS	NS	NS	NS	NS
Current pain	NS	-0.469*	-0.660**	NS	-0.412*	0.450*	0.669**
Worst pain	NS	NS	NS	NS	NS	NS	NS
Least pain	NS	NS	NS	NS	NS	NS	NS
Physical function						NS	-0.671**
Social role						-0.508*	NS
Physical role						NS	NS
Emotional role						NS	NS
Mental health						-0.486*	-0.485*
Vitality						-0.704**	-0.827**
Bodily pain						NS	-0.449*
General Health						-0.565**	-0.429*
Pittsburgh score							0.573**

Values are expressed as Pearson *r* or Spearman *rho*; p-value. NS: not significant. * $P < 0.05$. ** $P < 0.01$.

nisms[37]. It has been found that the intensity of early postoperative pain and delayed surgery increase the risk of the persistent pain 3 months after surgery[13]. In this study, if the pain intensity during the first postoperative week was moderate or higher, the risk for the development of persistent pain was higher than in individuals with mild pain[13]. Similarly, the presence of acute postoperative pain was a risk factor for the development of chronic post-surgical pain[11]. It is important to note that acute postoperative pain after TKA is poorly managed[38] and interferes with walking, an action critical for postoperative recovery and achievement of rehabilitation goals[39]. Therefore, our study supports the relevance of the intensity of ongoing pain after TKA by influencing different aspects of the patients. Further, it is well known that pain negatively influences various domains of health suggesting a critical need for the dissemination of proper interven-

tions to enhance the recognition and treatment of pain among adult community-dwellers[40]. The relevance of proper treatment of the pain in patients with OA has been demonstrated in the study by Rodriguez-Raecke et al.[41]. This study found that gray matter decrease found in patients with hip OA was reversible when pain was successfully treated after a total hip arthroplasty. No similar study in TKA has been performed.

We also observed that obesity, higher BMI, was associated with higher intensity of pain. It seems that obesity contributes to chronic pain, but inactivity due to chronic pain may also lead to obesity[42]. Our results agree with previous studies where obesity had a negative impact on overall health, supporting the importance of assessing BMI in patients with chronic pain[42]. There is also a relationship between obesity and some co-morbid conditions (e.g., sleep problems)[43], leading to further reduction in health-related quality of life[44]. Our study would also support a relationship between these factors since several associations between the SF-36 quality of life questionnaire and sleep quality were observed in patients with TKA.

In addition, the influence of TKA in sleep and social life after long time follow-up has been described[45]. Subjects who had received TKA and report sleep disruptions after surgery exhibit greater disability after the surgery[25]. In fact, sleep disturbances are generally associated with chronic pain[20-22,40,46,47]. In fact, there are complex interactions between pain, fatigue, and sleep disturbances in rheumatic disorders[48]. In our study, the intensity of ongoing pain, disability and sleep quality were associated in individuals with TKA. Additionally, worse sleep quality can have a negative impact in cognition[49]. Functions related to operant memory and attention can be particularly affected by sleep disturbances[50]. It seems fairly obvious that individuals not getting sufficient sleep might have less energy during the day to be active and they report higher levels of fatigue than those with better sleep quality[51]. Therefore, our study supports the hypothesis that sleep, emotional distress, pain intensity and disability form a continuous cycle in subjects with chronic pain.

We should recognize some limitations of our study. First, the sample size was small which may explain the lack of significance in some outcomes. It is possible that some correlacional analyses were underpowered due to the small sample size. The small sample size did not permit to conduct regression analysis to determine the interactions among the outcomes. Second, the cross-sectional nature of the study limits the interpretation of our results. Therefore, current results should be considered as preliminary.

In conclusion, this study shows that TKA experience, as an intervention applied to subjects suffering from knee OA-related pain implies a decreased physical function and worse sleep quality. The associations found between the intensity of ongoing pain, disability, sleep quality, and different domains of quality of life, as occurs with physical function, social role, mental health, vitality, and general health can help to identify the multidimensional experience of the TKA. Our results support the continuous cycle of sleep alterations, emotional distress, pain intensity, and disability in patients suffering from chronic pain. Longitudinal studies investigating the evolution of the relationships are clearly needed.

Collaborations

MD Herrero-Sánchez, MC García-Iñigo, BS Nuño-Beato-Redondo, C Fernández-de-las-Peñas y F Albuquerque-Sendín participated equally in all stages of preparation of the article.

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