

# Psychosocial and Demographic Factors Influencing Pain Scores of Patients with Knee Osteoarthritis

Lauren A. Eberly, BS\*; Dustin L. Richter, MD†; George D. Comerchi, MD‡; Deana M. Mercer, MD†; Gary W. Mlady, MD§; Daniel C. Wascher, MD†; Robert C. Schenck Jr, MD†

\*School of Medicine, The University of New Mexico Health Sciences Center

†Department of Orthopaedics & Rehabilitation, The University of New Mexico Health Sciences Center

‡Department of Internal Medicine, The University of New Mexico Health Sciences Center

§Department of Radiology, The University of New Mexico Health Sciences Center

## Abstract

**Background:** Noted levels of pain in patients with diagnosed osteoarthritis (OA) of the knee are commonly assessed by using a numeric scoring system. However, the results of pain levels in patients with knee OA may be influenced by factors other than the patient's actual physical discomfort or disease severity, including demographic and psychosocial variables. We retrospectively examined 355 patients with knee OA who had reported associated pain levels using a 0- to 10-point rating scale.

**Methods:** Data obtained from the medical records of patients were Kellgren-Lawrence (KL) grade, demographic characteristics, body mass index (BMI), concomitant disorders, drug use, alcohol use, smoking, health insurance status, knee OA treatment, and knee-surgery recommendation. Univariate and multivariate analyses determined correlation with reported pain scores.

**Results:** KL grade showed no correlation with pain scores ( $P = 0.2$ ). Younger age, ethnicity, and higher BMI were significantly associated with higher scores ( $P = 0.03$ ,  $P < 0.001$ , and  $P < 0.001$ , respectively). Native American or Hispanic ethnicity remained significant on multivariate analysis ( $P < 0.001$ ). All psychosocial factors and other categories showed correlation, excluding diagnosis of posttraumatic stress disorder ( $P = 0.2$ ); current opioid prescription and depression retained significance with higher pain scores ( $P < 0.001$  and  $P = 0.002$ , respectively).

**Conclusions:** To provide more effective care, clinicians should be aware that demographic and psychosocial factors may be important determinants of pain levels reported by patients.

## Introduction

More than 9 million people in the United States have symptomatic knee osteoarthritis (OA),<sup>1</sup> with pain being the primary reason patients seek care and the leading cause of disability from the disease.<sup>2,3</sup> Patients who present with OA are usually asked to describe their level of pain, often by referencing a numeric rating scale. However, a discrepancy between patients' reports of their pain level and OA disease severity as assessed by radiographic studies has often been observed.<sup>4-6</sup> Therefore, it has been suggested that demographic and psychosocial factors may influence pain reports.

Factors that have been assessed for their possible relation to reports of OA-associated pain include age, sex, body mass index (BMI), race/ethnicity, substance abuse, and psychological variables such as depression, hopelessness, overall well-being, and social stress.<sup>4,7-10</sup> The results of such correlation studies have varied, however, and some factors that may affect pain-level reports have not been examined.

Because little research has been done on a possible link between patients' reported pain levels and clinical decision making, we examined possible correlation between pain score and severity of OA as assessed radiologically with use of the Kellgren-Lawrence (KL) classification system,<sup>11</sup> as well as several demographic and psychosocial characteristics. We posited that demographic and psychosocial variables would correlate with patients' reported levels of pain.

## Methods

We received approval from our Human Research Review Committee (HRR #13-523). We retrospectively reviewed the medical records of 611 new patients who presented to our orthopaedics clinic and received a primary diagnosis of

knee OA between January 1, 2013 and December 31, 2013. In each case, the diagnosis was confirmed by an evaluation of the patient's medical history, a physical examination, radiographic studies, or a combination of these methods. Patients with a concurrent ligamentous injury, inflammatory arthritis, or bilateral knee OA were excluded from the study; therefore, a total of 355 were enrolled.

The record review obtained the following data for each patient: age; sex; race or ethnicity (self-reported by patient checking a box on intake form); BMI; current tobacco, alcohol, and illicit drug use (both illegal drugs and overuse of legal drugs); current prescription for an opioid, gabapentinoid, or antidepressant agent; current diagnosis of depression, fibromyalgia, or posttraumatic stress disorder (PTSD); health-insurance status (yes or no); previous injection of a corticosteroid agent or hyaluronic acid in the affected knee; and whether the patient's clinician recommended surgical treatment of the knee OA during the initial presentation. Information on smoking, alcohol, and illicit drug use was obtained with a self-report intake form that did not allow specification of the level of use or the type of illicit drug.

Outcome measures included self-reported pain scores and radiographs. At their initial presentation, all patients had been asked to describe their pain level with respect to a number from 0 to 10, with 0 representing "no pain" and 10 "the worst pain imaginable." This numeric scale is commonly used to assess arthritic pain.<sup>12</sup> At the time of the medical-record review, radiographs obtained during the initial patient visit were assessed by a musculoskeletal radiologist who was blinded to all patient information in the records, including pain scores. The radiologist assigned each image a KL grade of 0, 1, 2, 3, or 4 on the basis of the extent of degenerative changes observed.

In estimating the appropriate sample size for the study, we assumed that most clinicians would consider a difference in pain score of 2 to be clinically important and we wanted to limit the Type I error to 0.05 or lower and achieve a power of 90%. Because we anticipated simultaneous analysis of up to 22 independent variables, we used a Type I error of 0.002 (on the basis of the Bonferroni inequality). Under these assumptions, we calculated that the study should include about 310 patients.

Standard summary statistics were calculated for all variables. Univariate analysis was used initially to assess the possible relation between pain score and each independent binary variable studied. The Student t-test or Mann-Whitney test was applied as appropriate. Analysis of variance was used to examine the possible relation between pain score and each of the following: age, BMI, race or ethnic group, and KL grade. A *P* value of less than 0.05 was considered to indicate a statistically significant difference.

Multivariate analysis was performed by using a general linear model algorithm and maximum-likelihood estimation. Variables that were significantly associated with pain score in the univariate analysis were sequentially fitted into the model with use of adjusted *R*<sup>2</sup> analysis. The variables were removed sequentially until only those that had a significant relation with pain score remained in the model. All statistical analyses were performed with Statgraphics Centurion XV software (StatPoint, Herndon, VA).

## Results

Table 1 shows characteristics of the 355 patients in the study. The overall mean (SD) pain score was 5.0 (2.9), whereas the most common KL score was 3, indicating moderate OA. KL grade was one of the three variables not related to reported pain scores (*P* = 0.2; Figure 1).

The mean pain scores (SD) according to KL grade were 4.33 (1.89) for grade 0, 4.93 (0.84) for grade 1, 4.70 (0.63) for grade 2, 4.89 (0.54) for grade 3, and 5.74 (0.65) for grade 4.

The patients ranged in age from 24 to 90 years. Most of the patients were white women, but our cohort was also diverse in that Native American and Hispanic patients each comprised more than 10% of the total. Average BMI was 31.0 kg/m<sup>2</sup> (range, 19.1–61.9 kg/m<sup>2</sup>). The mean pain scores in white, Native American, Hispanic, "other," and black patients were 4.5 (3.0), 6.3 (2.7), 6.4 (2.5), 4.7 (3.1), and 5.8 (2.8), respectively. The "other" category included two patients who indicated that they were Asian and 27 who reported that they were "other" than white, Native American, Hispanic, or black.

On univariate analysis, age had a significant inverse relation to pain score, with younger subjects having significantly higher scores (*P* = 0.03). Sex of the patient was not related to pain score (*P* = 0.2). Compared with white patients, Hispanic or Native American patients had significantly higher pain scores (*P* < 0.001 for both comparisons; Figure 2), but there were no other significant differences among racial or ethnic groups. Patients with higher BMIs also had higher pain scores (*P* < 0.001). On multivariate analysis, Native American or Hispanic ethnicity remained in the model, indicating a significant relationship with pain scores (*P* < 0.001).

With respect to binary variables of psychosocial factors (Table 2), patients with a current opioid prescription, depression, fibromyalgia, illicit drug use, current antidepressant or gabapentinoid prescription, uninsured status, and smoking had significantly higher pain scores than those without these characteristics. Patients who said that they drank alcohol had significantly lower pain scores than those who said that they did not. Diagnosis of PTSD

**Table 1.** Demographic and clinical variables for 355 patients with knee osteoarthritis<sup>a</sup>

Variable	Value <sup>b</sup>
Mean age, y (SD)	58.6 (11.8)
Male	139 (39)
Female	216 (61)
Mean BMI, kg/m <sup>2</sup> (SD)	31.2 (7.3)
Ethnicity <sup>c</sup>	
White	191 (64.7)
Native American	35 (11.9)
Hispanic	30 (10.2)
Black	10 (3.4)
Other	29 (9.8)
Comorbidities/insurance/history	
Current smoking	56 (15.9)
Alcohol use	157 (46.6)
Illicit drug use	18 (5.4)
Opioid-agent prescription	75 (21.6)
Gabapentinoid prescription	43 (12.4)
Antidepressant prescription	84 (24.2)
Depression	94 (27.1)
Fibromyalgia	22 (6.4)
Posttraumatic stress disorder	7 (2.0)
Health insurance	318 (91.4)
Previous knee injection	110 (32.3)
Surgery recommended by clinician	59 (16.8)
Kellgren-Lawrence grade <sup>d</sup>	
0	9 (2.8)
1	46 (14.2)
2	82 (25.4)
3	110 (34.1)
4	76 (23.5)

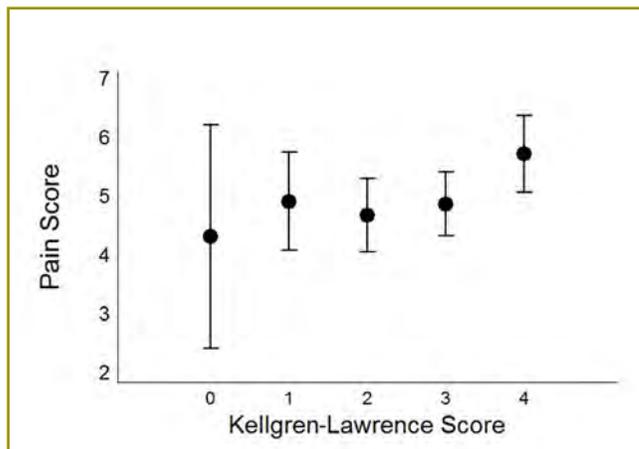
BMI, body mass index.

<sup>a</sup>There were no significant differences between the groups.

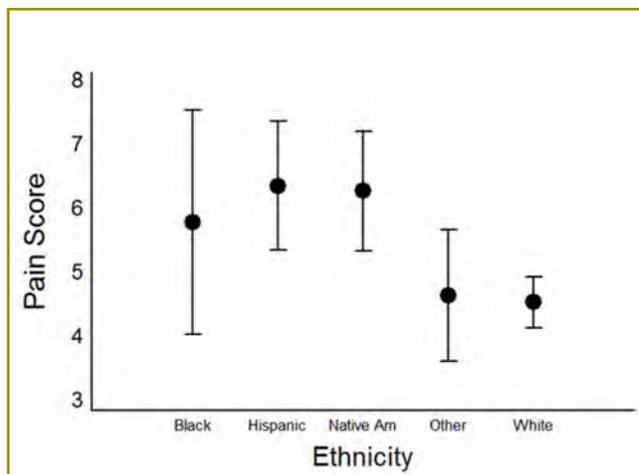
<sup>b</sup>Values represent number of patients (percentage of the indicated group), unless otherwise stated.

<sup>c</sup>Race or ethnic group was self-reported.

<sup>d</sup>A Kellgren-Lawrence grade of 0 (no osteophytes or joint-space narrowing) indicates no osteoarthritis; a grade of 1 (questionable osteophytes), possible osteoarthritis; a grade of 2 (definite osteophytes, no joint-space narrowing), mild osteoarthritis; a grade of 3 ( $\leq 50\%$  joint-space narrowing), moderate osteoarthritis; and a grade of 4 ( $\geq 50\%$  joint-space narrowing), severe osteoarthritis.



**Figure 1.** Mean knee-pain scores in 355 patients with knee osteoarthritis, according to Kellgren-Lawrence grade. The error bars represent 95% confidence intervals adjusted by using the Tukey procedure for multiple comparisons. There were no significant differences between groups.



**Figure 2.** Mean knee-pain scores in 355 patients with knee osteoarthritis, according to patients' ethnic or racial group. The error bars represent 95% confidence intervals adjusted by using the Tukey procedure for multiple comparisons. The difference between Hispanic and white patients and between Native American and white patients was significant ( $P < 0.001$  for both comparisons).

was not related to reported pain levels ( $P = 0.2$ ). On multivariate analysis, current opioid prescription and depression were significantly related with pain scores ( $P < 0.001$  and  $P = 0.002$ , respectively).

Pain scores also correlated with binary values of previous knee injections and surgeon recommendation for operative treatment of OA (Table 2). On univariate analysis, previous knee injections and surgeon recommendation were significantly related with pain scores ( $P = 0.03$  and  $P = 0.04$ , respectively).

**Table 2.** Binary variables independently and significantly associated with pain score on univariate analysis

Variable	Mean (SD) score, 95% CI	P value
Opioid-agent prescription		
Yes	6.84 (2.94), 6.36-7.32	
No	4.48 (2.08), 4.13-4.83	< 0.001
Depression		
Yes	6.19 (2.52), 5.67-6.71	
No	4.58 (2.94), 4.22-4.95	< 0.001
Fibromyalgia		
Yes	6.77 (2.07), 5.86-7.69	
No	4.86 (2.93), 4.54-5.18	0.003
Illicit drug use		
Yes	6.89 (2.58), 5.60-8.18	
No	4.88 (2.91), 4.55-5.20	0.004
Antidepressant prescription		
Yes	5.76 (2.77), 5.15-6.36	
No	4.73 (2.96), 4.37-5.09	0.005
Gabapentinoid prescription		
Yes	6.14 (2.53), 5.36-6.92	
No	4.82 (2.96), 4.48-5.15	0.006
Alcohol use		
Yes	4.53 (2.73), 4.10-4.96	
No	5.36 (3.04), 4.91-5.81	0.009
Health insurance		
Yes	4.90 (2.93), 4.57-5.22	
No	6.27 (2.66), 5.27-7.26	0.01
Smoking		
Yes	5.82 (2.39), 5.18-6.46	
No	4.85 (2.99), 4.50-5.19	0.02
Previous knee injection		
Yes	5.47 (2.94), 4.92-6.02	
No	4.75 (2.92), 4.37-5.13	0.03
Surgery recommended by clinician		
Yes	5.69 (2.94), 4.92-6.02	
No	4.87 (2.92), 4.53-5.20	0.04

CI, confidence interval.

## Discussion

Many of the factors analyzed have not, to our knowledge, previously been correlated with pain score: Hispanic or Native American ethnicity, age, opioid prescription, fibromyalgia, illicit drug use, antidepressant prescription, alcohol use (inverse relation), gabapentinoid prescription, health-insurance status, smoking, previous knee injections, and recommendation for surgical versus nonoperative

treatment of knee OA. In the current study, KL grade had no significant relationship with reported pain scores. This discordance has been seen in other studies.<sup>4-6</sup> Our findings may reflect another manifestation of a difference in health perception, or just differences in communication and reporting of pain and symptoms.

Demographic factors such as age, sex, ethnicity, and BMI that may influence reported pain levels have been somewhat explored in other studies. Interestingly, although the prevalence of knee OA increases with age, pain scores were significantly higher in our study's younger patients. In agreement with earlier findings,<sup>7,8</sup> the sex of the patient was not correlated with pain scores.

Earlier studies that examined a possible link between knee OA-associated pain and race/ethnicity included only black and white patients and provided evidence that black patients reported higher pain scores than white patients.<sup>4</sup> One of the few studies of the rheumatic disease experience to include Hispanic patients found that global estimates of their health were significantly poorer compared with physicians' estimates.<sup>13</sup> In our study, we found no differences between black and white, black and "other", or white and "other" patients, although it is important to note that we included only a small number of black patients. Additionally, findings may have been due to more demanding occupational tasks, higher rates of depression and emotion-focused coping rather than problem-focused coping, all of which have been suggested to explain higher knee-OA pain in black patients.<sup>14,15</sup>

Studies of arthritis-associated pain in Native Americans are scarce; however, in an investigation by Kramer et al<sup>16</sup> in which face-to-face interviews were conducted with 56 Native Americans living in an urban area, most interviewees commented on their cultural practice of minimizing pain complaints and reported that American Indians do not readily discuss pain. Because our multivariate analysis accounted for possible confounding factors, including age and obesity, this discrepancy may have resulted from differences in patient population. Nevertheless, both our study and that of Kramer et al indicate the importance of clinician awareness of possible ethnic-group differences in reporting their OA pain experience.

Obesity, a known risk factor for development of OA, has been linked to an increased severity of OA-related pain, although Somers et al<sup>17</sup> found that BMI was not correlated with pain scale scores. Our results show that patients with higher BMI were significantly more likely to have higher knee-pain scores. Clinicians counseling obese patients with OA knee pain should consider suggesting weight loss as a possible method for alleviating pain.

The association between a current opioid agent prescription and higher pain scores may have been due

to neuromodulation of pain sensitivity from chronic opioid use.<sup>18,19</sup> Although possible that some of our patients with an opioid prescription reported greater pain as a manifestation of drug-seeking behavior, the differences in pharmacodynamics and opioid receptor interactions as well as the bioavailability of a particular opioid dose in one patient versus another likely plays an important role in whether patients are getting sufficient pain relief. The use of a pain-assessment instrument that evaluates patients' functional abilities<sup>20</sup> might be useful when pain assessment is unclear.

Previous studies found that depression affects reported pain in patients with rheumatoid arthritis,<sup>21</sup> and an influence of depression on pain severity in patients with OA has been suggested.<sup>6,22</sup> The higher reported pain scores might reflect pain catastrophizing, which is a tendency to focus on negative pain sensations, thereby exaggerating the pain experience and enhancing feelings of helplessness.<sup>23</sup> It was previously shown that depression can lead to increased pain through pain catastrophizing in patients with musculoskeletal conditions,<sup>24</sup> and pain catastrophizing has been linked to higher pain scores in patients with OA.<sup>25</sup>

The association between current prescription for an antidepressant or gabapentinoid agent and higher pain scores may reflect the presence of a general chronic pain experience, as these agents are commonly prescribed for chronic pain. Although the relationship with antidepressants may simply reflect a link between chronic pain and depression,<sup>26</sup> it is also possible that the reported pain scores in patients prescribed these agents is instead a characterization of neuropathic pain, fibromyalgia-associated pain, or another form of chronic pain.

In terms of age, younger adults with OA have been shown to have higher rates of depression and depressive symptoms than older adults with the disease.<sup>27,28</sup> In addition, life stress and hypochondriasis, which are associated with higher pain scores, are more prevalent in younger people.<sup>10</sup>

Pain catastrophizing similar to that which can occur in patients with depression has been shown to be a prominent clinical symptom of fibromyalgia<sup>29</sup> and may explain the higher knee-pain scores in our patients with the disorder. Cognitive behavioral therapy aimed at reducing catastrophizing in patients with fibromyalgia has been observed to produce better outcomes than pharmacologic therapy.<sup>30</sup> Psychotherapy may be an effective approach to pain along with pharmacologic or surgical treatment in patients with a diagnosis of both OA and fibromyalgia or depression.

Earlier studies failed to show an association between knee pain from OA and behaviors such as substance abuse and smoking.<sup>7,8</sup> Our results suggest that it may be appropriate for clinicians to counsel patients that cessation of smoking

and illicit drug use, aside from its numerous other health benefits, may help alleviate OA-related pain.

The association between higher pain scores and uninsured status is probably related to socioeconomic status because OA pain and symptomatic knee OA have been correlated with lower income levels<sup>7</sup> and the poverty rate in a community,<sup>31</sup> respectively. In addition, "feeling helpless" has been found to constitute an important determinant of higher pain scores,<sup>8</sup> and patients without health insurance may have an increased tendency to experience this feeling, perhaps accompanied by a feeling of disenfranchisement.

The reason for the relation between pain-level reports and previous knee injections or a recommendation for surgery is unclear. Perhaps clinicians had an increased tendency to recommend a more invasive therapy to patients with more pain. However, some patients may have inflated their pain scores because nonoperative management had not provided sufficient pain relief and they wanted to be considered candidates for surgery. The prospect of surgical treatment was previously found to instill hope in some patients with knee OA.<sup>32</sup>

Our study had the usual limitations of a retrospective, observational investigation. In addition, there may have been interactions among the variables assessed that our study design could not identify. Some factors not examined, such as whether the patient was currently involved in a workers' compensation evaluation, might have influenced pain-score reports. Additionally our study had a small number of black patients, with a large percentage of Hispanic and Native American patients. This unique ethnic distribution, however, is a reflection of our state's composite population. Finally, the pain-evaluation method that was used was a simple numeric rating scale. This assessment can be administered quickly, but it may not sufficiently characterize a patient's pain experience.

Our results indicate that psychosocial and demographic factors significantly affect patients' reports of their level of OA-related knee pain and that patients with OA do not constitute a homogenous group for which the same management approaches will suffice. The usefulness of a pain assessment based primarily on a numeric pain score is of variable utility, and extensive reliance on such an assessment in clinical decision-making may be inappropriate, especially when invasive procedures are being contemplated. Moreover, pain-treatment decisions should not be based primarily on KL grade, but the entire patient presentation. Clinicians who are aware of the various psychosocial and sociodemographic characteristics that affect their patients' reports of OA-related knee pain may provide more effective, patient-centered care.

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## Conflict of Interest

The authors report no conflicts of interest.

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