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How much gloom is in groans? Depression and its determinants in Nigerian patients with knee osteoarthritis: a multi-center cross-sectional study

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Abstract

Objectives To determine the prevalence of depression and its determinants among Nigerian patients with knee osteoarthritis (OA).

Methods Two hundred and fifty patients satisfying the American College of Rheumatology classification criteria for knee OA were recruited from five centers. Pain was assessed using Western Ontario and McMaster Universities Index (WOMAC) pain subscale, functional status was determined by Steinbrokers criteria, radiographic knee OA was graded using Kellgren–Lawrence criteria, depression was determined using the Patient Health Questionnaire (PHQ-9), sleep quality by the Pittsburgh Sleep Quality Index (PSQI), and family functioning by Family APGAR (Adaptation, Partnership, Growth, Affection, and Resolve). Factors associated with depression in KOA following bivariate analyses were adopted as independent variables in logistic regression analysis to determine the predictors of depression in KOA. The study was approved by the Ethical Review Committee of each of the study centers.

Results The mean age of patients was 59.90 ± 10.62 years and 209 (83.6%) were females. Their mean PHQ-9 score was 4.68 ± 4.19 with 105 (42%) having depression (PHQ-9 ≥ 5). Eighty-four (80%) of patients with depression had poor sleep quality (PSQI ≥ 5.0). Depression was significantly associated with poor sleep, WOMAC pain scores, medial compartment KOA, lateral compartment KOA, and patellofemoral OA. Poor sleep quality was the best predictor of depression (OR 4.555, CI (2.241–9.257), $p < 0.001$) followed by moderate to severe pain (OR 2.490, CI (1.119–5.542), $p < 0.025$).

Conclusion Depression is common among patients with knee OA, and depression can be predicted by poor sleep quality and moderate to severe pain.

Keywords Depression · Family functioning · Knee osteoarthritis · Pain · Sleep quality

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Introduction

Musculoskeletal disorders are a major contributor to the burden of disease across the world accounting for up to 6.8% of the worldwide disability-adjusted life years (DALY); Osteoarthritis (OA) represents the single most important musculoskeletal disorder [1]. Clinically, OA is characterized by mechanical joint pains, stiffness, crepitus, progressive limitation of movement, and variable amounts of joint effusion [2]. Constant, poorly remitting pain is often seen in the late stages of the disease [3]. In addition, worsening destruction of the joint architecture and loss of articular cartilage lead to joint deformities and instability with an increased risk of falls, decline in levels of physical functioning, and compounding psychosocial problems such as depression [4]. Consequently, an

emerging insight into the role of both biological and psycho-social factors in the assessment and management of OA has been birthed [3].

Depression affects one-fifth of individuals with knee OA and is twice as common as in the general population [4]. The prevalence of depression among knee OA patient is variable and ranges between 19.16 and 39% [5, 6]. Odole et al [7] reported a frequency of 28.8% among 80 patients with knee OA seen at Ibadan, Nigeria.

Patients with OA and depression are less likely to cope well and may report higher levels of pain and overall OA-associated symptoms [3, 7]. The relation-ships between depression and pain are reciprocal and complex, with each predicting and worsening the out-come of the other [8]. The effect of depressive symp-toms in the reduction of physical activity, which in turn, leads to worsening of pain and disability is increasingly being recognized [9]. Similarly, complex interactions have been suggested in the pervasiveness and severity of depressive symptoms among OA patients living with poor daily sleep quality or in a dysfunctional family setting. Wang et al reported a higher rate of poor family functioning among patients with depression, and they observed that there is good agreement between the self-report of the family members and the documenta-tion of a trained evaluator about the family impairments in these subjects [10]. High-impact recommendations drafted by the European League Against Rheumatism (EULAR) and the American College of Rheumatology (ACR) on the treatment guidelines for OA recognizes that depression contributes to the weight of morbidity, and central pain perception is adversely affected in the patient with depression [11].

There are no multicenter studies on depression among knee OA patients in Nigeria and Africa. The objective of this study is to determine the prevalence of depression, the levels of family functioning, and the predictors of depression among patients with knee OA in a multicentral setting.

Methodology

Study design

This is a multicentral, hospital-based cross-sectional study conducted in the Rheumatology and General Out-Patient Department (GOPD) clinics of five tertiary institutions in Nigeria (University of Maiduguri Teaching Hospital, University of Jos Teaching Hospital, University of Ilorin Teaching Hospital, Lagos State University Teaching Hospital, and University of Uyo Teaching Hospital) spread across the northern, middle, and southern part of the country.

Study population

Individuals aged 18 years and above, satisfying the American College of Rheumatology (ACR) clinical classification criteria for knee OA [12] were recruited over a period of 3 months. Consenting patients aged 18 and older who satisfied the ACR clinical classification criteria for knee OA served as inclusion criteria. Patients with a history of previous knee surgery, known mental illness, inflammatory arthritis, system-ic infection, or malignancy and other symptomatic chronic diseases e.g., diabetes mellitus, chronic liver disease, and chronic obstructive lung disease were excluded from the study.

Sample size determination

Sample size was obtained using Fisher's statistical formula for estimating the minimum sample size in descriptive health studies when population size is greater than 10,000 [13]. Based on the reported knee OA prevalence of 11.5% deter-mined by Adebusoye et al in Ibadan, Nigeri [14], the calcu-lated sample size for the study was estimated to be 156. However, to increase the power of the study, we recruited a total of 250 patients at a rate of 50 patients per center.

Sampling method

Patients were recruited using a systematic random sampling method in which every other patient with knee OA were re-cruited. A prior communication with the coinvestigators representing each of the participating hospitals revealed that a median of 100 patients with knee OA was seen over a period of 3 months. With a recruitment plan of 50 participants per center, a sampling interval of two was chosen. The first patient seen each day meeting the inclusion criteria for the study was chosen followed by the third patient and so on. If an individual does not satisfy the inclusion criteria, or the person refused to participate, the next individual was recruited. Patients' folders were labeled, and a research register was kept to avoid double sampling. The procedure was repeated each day until the sam-ple size was attained.

Data collection

An informed verbal and written consent was obtained from all participants while a semi-structured interviewer questionnaire was administered to collect demographic and relevant clinical information. Pain severity was assessed using a 0–10 numerical rating scale (NRS), with 0 being no pain, while 10 is the maximum pain experienced. A score of 4 or less was considered mild pain, 5–7 as moderate, and 8 and above as severe pain. The Western Ontario and McMaster Universities index

(WOMAC) (Likert) pain subscale was also used to grade pain intensity. We considered cutoff points of less than 5, 6–10, and 11–20 as mild, moderate, and severe pain respectively. Individuals were grouped into four functional classes using the Steinbrocker functional classification [15]. Each knee was examined separately for the presence or absence of deformities, effusion, joint line tenderness, and crepitus. The range of motion (ROM) and alignment of the knee joint were measured using an International Standard Goniometer. Quadriceps strength was graded using the Medical Research Council grading scale.

The weight to the nearest 0.01 kg and height to the nearest 0.01 m were measured using a Seca electronic weighing/height scale (Seca Deutschland, Hamburg, Germany) using standard techniques. Body mass index (BMI) was calculated using the formula, weight (kg)/height^2 (m^2). For the purpose of our analysis, we dichotomized patients as not obese (BMI < 30 kg/m^2) or obese (BMI ≥ 30.0 kg/m^2).

Blood pressure (BP) was measured with a mercury sphygmomanometer (Accosson, England) using standard techniques [16].

Standard anteroposterior (AP) and lateral semi-flexed radiographs of knees in weight bearing position were taken by qualified radiographers of the radiology department of the hospitals. The radiographs were interpreted and graded by both the radiologists and the principal investigators using the Kellgren and Lawrence criteria [17]. The radiographs are graded after the two have agreed on a particular KL grade. The higher KL grade of the two knees was used in the final analysis.

Depression was assessed using the Patient Health Questionnaire (PHQ-9) [18]. It has a minimum score of 0 and maximum score of 27. Component scores are rated 0 to 3. The interpretation of the total scores is as follows: 0–4 = no depression; 5–9 = mild depression; 10–14 = moderate depression; 15–19 = moderately severe depression; 20–27 = severe depression. It has been validated for use in Nigeria, having a good concurrent validity with Beck's depression inventory (BDI) ($r = 0.84$, $p < 0.001$) and good 1 month test-retest reliability ($r = 0.84$, $p < 0.001$) [19]. The sensitivity and specificity with 5 as cutoff score for minor depressive disorder is 0.989 and 0.973 respectively, and 0.846 and 0.994 respectively with 10 as cutoff for major depression [19]. PHQ-9 has also been shown to be a valid and reliable tool for assessing depressive disorders and depression severity among patients with knee OA [20]. We dichotomized patients into two groups, PHQ-9 < 5 (no depression) and PHQ-9 ≥ 5 (has depression).

The sleep quality of respondents was assessed using the Pittsburgh Sleep Quality Index (PSQI) [21]. The 19-item questionnaire generates seven components: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications and daytime dysfunction. The global score ranges from 0 to 21, and a higher score is indicative of a poorer subjective sleep quality. PSQI has been validated in Nigeria by Aloba et al. with the best cutoff score set at 5 [22]. We dichotomized patients into two groups scores less than 5 (no sleep abnormality) and score ≥ 5 (poor sleep quality).

Family functioning was assessed by the Family APGAR (Adaptation, Partnership, Growth, Affection, and Resolve) questionnaire. The measure consists of five parameters of family function: Adaptability, Partnership, Growth, Affection, and Resolve. The instrument has a minimum score of 0 and a maximum score of 10. Family APGAR's scores are interpreted as follows: 7–10 = highly functional family; 4–6 = moderately dysfunctional family; 0–3 = severely dysfunctional family. The correlation of the instrument with the previously validated instrument (Pless–Satherwhite index) is 0.80, and the correlation with clinical report is 0.64 [23]. The Family APGAR has been validated and used for previous studies in Nigeria [24].

Data analysis

All data obtained were analyzed using statistical package for social science, IBM SPSS statistics® 2012 version 21.0 for windows by IBM USA, Armonk, NY, 10504. Demographic and clinical data were summarized using frequencies, percentages, and proportions. Test of normality was performed using Shapiro–Wilk statistics. Means of normally distributed continuous variables of participant with depression and those without depression were compared using T test, while the median of skewed variables was compared using Mann–Whitney U test. Test of association between depression and each of the determinants under consideration (KL grades, functional status, sleep quality, family functioning) were done using chi square test. Fisher's exact was used where frequencies are less than 5. Predictors of depression in patients with knee OA were determined using multiple logistic regression analysis with PHQ-9 score < 5 and ≥ 5 as a binary outcome, after controlling for age and sex. A P value < 0.05 was considered statistically significant for all tests.

Ethical considerations

The study was approved by the Ethical Review Committee of each of the study centers.

Results

Demographics

The 250 participants had a mean age of 59.90 ± 10.62 years. One hundred and sixty-four (65.6%) were 65 years or older. They comprised of 209 (83.6%) females and 41(16.4%) males. There was no significant difference in their mean ages ($p = 0.937$). Majority (74.4%) had one form of education, 185 (74%) were married, 66 (26.4%) were unemployed, and 179 (71.6%) of the females were postmenopausal. Table 1 shows the socio-demographic distribution of the patients.

Clinical features

One hundred and sixty-five (66%) participants had bilateral knee involvement; 44 (17.4%) and 41(16.4%) had unilateral right and left knee involvement respectively. The median duration of knee pain reported by all participants was 48 months (range 1–600). The total mean pain score was 8.83 ± 3.836 using WOMAC, indicating, on average that participants had moderate pain intensity at presentation. Crackling noise in the knee was the commonest symptom (73.2%) and 130 (52%) were in functional class II. Family history of knee OA was reported by 132 (52.8%) of the participants. Tables 2 and 3 show the clinical and radiographic features of the participants respectively.

Frequency of depression, sleep quality and family function

The mean PHQ-9 score of all participants was 4.68 ± 4.195, indicating, on average that most patients were not depressed when a cutoff point of ≥ 5 was used. One hundred and five (42%) had a PHQ-9 score of ≥ 5, while 26 (10.4%) had PHQ-9 score ≥ 10 (moderate to severe depression). Table 3 shows the distribution of participants across various grades of depression. There was no association between depression and gender ($p = 0.302$), BMI ($p = 0.189$), and functional class ($p = 0.748$). Participants with depression (PHQ-9 score ≥ 5) did not differ significantly in terms of age, proportion of males to females, BMI, duration of knee pain, and APGAR score; however, they have higher median PSQI score ($p < 0.0001$) and higher NRS and WOMAC pain scores ($p = 0.005$ and $p < 0.0001$ respectively) when compared with the participants without depression (Table 4).

The mean PSQI score for all participants was 6.46 ± 4.596. One hundred and five (56.4%) of them had score of ≥ 5, indicating poor sleep quality. Eighty-four (80%) of the participants with depression had poor sleep quality (PSQI median score = 9.0) and differed significantly from those without depression ($p < 0.0001$).

Table 1 Demographic characteristics of the participants

Characteristics	Analysis sample $N = 250$ (%)
Age	59.9 ± 10.62
Age category	
≤ 54	25 (10.0)
55–64	61 (24.4)
65–74	83 (33.2)
≥ 75	81 (32.4)
Sex	
Male	41 (16.4)
Female	209 (83.6)
Level of education	
None	46 (18.4)
Primary	43 (17.2)
Secondary	45 (18.0)
Tertiary	74 (29.6)
Postgraduate	24 (9.6)
Others	18 (7.2)
Marital status	
Single	5 (2.0)
Married	187 (74.8)
Separated	3 (1.2)
Divorced	5 (2.0)
Widowed	50 (20)
Ethnic group	
Yoruba	88 (35.2)
Igbo	19 (7.6)
Hausa	20 (8.0)
Others	123 (49.2)
Occupation	
Business	55 (22.0)
Civil servant	45 (18.0)
Farmer	10 (4.0)
Retired	59 (23.6)
Others	25 (10)
Unemployed	56 (22.4)
History of smoking	13 (5.2)
Alcohol use	36 (14.4)
Diabetes	39 (15.6)
Hypertension	162 (64.8)
Height (m)	1.62 ± 0.07
Weight (kg)	80.87 ± 15.45
Body mass index (kg/m^2)	30.82 ± 5.48

m meters, *kg* kilograms

The mean APGAR score was 8.09 ± 2.23. One hundred and ninety-nine (79.6%) participants had APGAR scores of 7–10 indicative of a highly functional family with only 11(4.4%) having a severely dysfunctional family. There was no association between gender of

Table 2 Clinical features of patients with knee osteoarthritis

Clinical features	$n = 250$ (%) of participant
Knee involved	
Unilateral right	44 (17.6)
Unilateral left	41 (16.4)
Bilateral	165 (66.0)
Duration of knee pain (median, range)	48 (1–600)
WOMAC pain score (total mean)	8.83 ± 3.84
Mild (≤ 5)	66 (26.4)
Moderate (6–10)	92 (36.8)
Severe (11–20)	92 (36.8)
Brief stiffness	149 (59.6)
Crackling	183 (73.2)
Giving way	138 (55.2)
Locking	112 (44.8)
Crepitus	161 (64.4)
Joint line tenderness	107 (42.8)
Valgus deformity	56 (22.4)
Varus deformity	70 (28.0)
Flexion contraction	40 (16.0)
Hyperextension	11 (4.4)
Effusion	49 (19.6)
OA at other site	
Cervical	23 (9.2)
Shoulder	49 (19.8)
Hand	30 (12.0)
Hip	38 (15.2)
Foot	25 (10)
Lumber spine	61 (24.4)
More than two sites	31 (12.4)
Functional Class	
Class I	58 (23.2)
Class II	130 (52.0)
Class III	55 (22.0)
Class IV	7 (14.3)

n number, *WOMAC* Western Ontario and McMaster Universities index, *OA* osteoarthritis

the participants and categories of APGAR score ($p = 0.093$).

Radiographic findings of participants with depression and those without depression

Depression was not associated with the severity of KL grades of the participants ($p = 0.698$); however, there was significant association between depression and the compartments affected (Table 5). The proportion of patients with medial, lateral, and patellofemoral involvement was higher in those with depression than those without depression ($p = 0.012$, $p = 0.005$, and $p = 0.007$ respectively).

Table 3 Radiographic findings of the study participants

Characteristic	Right knee *n* (%)	Left knee *n* (%)
Compartment		
Medial	162 (64.8)	140 (56.0)
Lateral	128 (51.2)	116 (46.4)
Patellofemoral	135 (54.0)	112 (44.8)
KL grade		
Grade I	18 (7.2)	50 (20.0)
Grade II	60 (24)	60 (24.0)
Grade III	107 (42.8)	85 (34.0)
Grade IV	65 (26)	55 (22.0)

KL Kellgren–Lawrence, *n* number

Predictors of depression

Multiple logistic regression analysis revealed poor sleep quality with cutoff of PSQI ≥ 5 as the best predictor of depression (OR 4.555, CI (2.241–9.257), $p < 0.001$). Individuals with PSQI score ≥ 5 were 4.6 times more likely to be depressed than those with good sleep quality. Moderate to severe pain as categorized using WOMAC pain subscale also predicted depression among the participants (OR 2.490, CI (1.119–5.542), $p < 0.025$). However, no individual knee compartment OA predicted depression (Tables 6 and 7).

Table 4 Distribution of participants across various grades of depression, sleep quality, and family functioning

Characteristic	Males *n* (%)	Females *n* (%)	Total *n* (%)	*p* value
PHQ-9 ≥ 5	14 (34.1)	91 (43.5)	105 (42.0)	0.055*
PHQ-9 ≥ 10	3 (7.3)	23 (11.0)	26 (10.4)	0.308*
PHQ-9 grade				
1–4	27 (65.9)	118 (56.5)	145 (58.0)	0.253#
5–9	11 (26.8)	68 (32.5)	79 (31.6)	
10–14	2 (4.9)	14 (6.7)	16 (6.4)	
15–19	1 (2.4)	7 (3.3)	8 (3.2)	
20–27	0 (0)	2 (1.0)	2 (0.8)	
APGAR score				
0–3	0 (0)	11 (100)	11 (4.4)	0.093#
4–6	5 (12.5)	35 (87.5)	40 (16.0)	
7–10	36 (18.1)	163 (81.9)	199 (79.6)	
PSQI score				
≤ 4	21 (19.3)	88 (80.7)	109 (43.6)	0.305#
≥ 5	20 (14.2)	121 (85.8)	141 (56.4)	

*Z test for difference in proportion, #chi square test (Fisher's exact), *PHQ-9* Patient Health Questionnaire score, *APGAR* Adaptation, Partnership, Growth, Affection, and Resolve, *PSQI* Pittsburgh Sleep Quality Index score, *n* number of participants

Table 5 Comparison of participants with and without depression

Characteristic		PHQ-9 < 5 without depression(145)	PHQ-9 ≥ 5 with depression (105)	p value (CI)
Age		60.59 ± 9.83	58.96 ± 11.62	0.234 (− 1.055, 4.303)*
Sex	Male	27(65.9)	14 (34.1)	0.302#
	Female	118 (56.5)	91 (43.5)	
BMI	Mean	30.77 ± 5.36	30.88 ± 5.67	0.885 (− 1.49, 1.28)*
	< 30	50 (34.5)	45 (42.9)	0.189#
	≥ 30	95 (65.5)	60 (57.1)	
KOA duration	Median M	48	48	0.188^
NRS	Median	5.0	5.0	0.005^
WOMAC score	Median	7.0	10.0	< 0.0001^
APGAR score	Median	9.0	9.0	0.398^
PSQI score	Median	4.0	9.0	< 0.0001^
Functional class	Class I	35 (24.1)	23 (21.9)	0.748#
	Class II	77 (53.1)	53 (50.5)	
	Class III	30 (20.7)	25 (23.8)	
	Class IV	3 (2.1)	4 (3.8)	

PHQ-9 Patient Health Questionnaire, *CI* confidence interval, *BMI* body mass index, *KOA* knee osteoarthritis, *M* month, *NRS* numeric rating pain score, *WOMAC* Western Ontario and McMaster Universities index pain score, *APGAR* Adaptation, Partnership, Growth, Affection, and Resolve, *PSQI* Pittsburgh Sleep Quality Index, *Student t test, #chi square test, ^Mann–Whitney test

Discussion

Depression is common among our participants, and it is associated with pain, poor sleep quality, and patellofemoral radiographic OA. There was no association between depression and age, gender, BMI, duration of symptoms, family function and functional status of our patients, in spite of previous reports. [25] The best predictors of depression in our participants were poor sleep quality and pain.

Our results revealed the frequency of depression to be 42.0% among patients with knee OA when a PHQ-9 cutoff of ≥ 5 was used to defined depression with only 10.4% having moderate to severe depression. Though, higher than the 19.9–

23% reported from a systematic review by Stubbs et al [5], some studies have reported higher frequencies of up 52% among patients with knee OA [26]. Axford et al [27] reported a frequency of 40.7% after evaluating 54 patients with lower limb OA. This variation in frequency may be explained by differences in methodology, depression assessment tools used, patient heterogeneity, and type of OA in question.

The age and gender distributions of our participants were similar to that seen in earlier reports [5, 25, 26]. We found no association between depression and age, however, Gignac et al, [28] reported that individuals with mean age of 50.8 years with OA reported more depression compared to elderly subjects having similar

Table 6 Association between radiographic findings and level of depression among participants with knee osteoarthritis

Characteristics		PHQ-9 < 5 without depression(145)	PHQ-9 ≥ 5 with depression (105)	p value*
KL grade	Grade I	4 (2.8)	3 (2.9)	0.698
	Grade II	34 (23.4)	27 (25.7)	
	Grade III	66 (45.5)	40 (38.1)	
	Grade IV	41 (28.3)	35 (33.3)	
Compartment				
Medial TF	Yes	101 (74.3)	85 (87.5)	0.012
	No	35 (25.7)	12 (12.4)	
Lateral TF	Yes	80 (63.0)	76 (80.0)	0.005
	No	47 (37.0)	19 (20.0)	
Patellofemoral	Yes	77 (62.1)	72 (80.0)	0.007
	No	47 (37.9)	18 (20.0)	

KL Kellgren–Lawrence, *PHQ-9* Patient Health Questionnaire, *TF* Tibiofemoral, *chi square test

Table 7 Logistic regression predicting depression from sleep quality, pain severity, and the knee compartments affected by OA

Predictor	B	Wald	P value	Odds ratio	Confidence interval
PSQI ≥ 5	1.516	17.56	< 0.001*	4.555	2.241–9.257
WOMAC mod/sev	0.912	12.37	0.025*	2.490	1.119–5.542
PF KOA	0.619	2.63	0.105	–	0.879–3.928
Medial KOA	0.420	0.92	0.337	–	0.646–3.583
Lateral KOA	0.554	2.17	0.141	–	0.832–3.639

PSQI Pittsburgh Sleep Quality Index, *WOMACmod/sev* Western Ontario and McMaster Universities index category of moderate or severe pain, *PF KOA* Patelofemoral osteoarthritis in either knee, *Medial KOA* Medial compartment osteoarthritis in either knee, *Lateral KOA* Lateral compartment osteoarthritis in either knee, *significant at p value < 0.05

OA severity. They attributed the difference to role limitation and dissatisfaction among middle-aged OA individuals. Regarding gender, Rosemann et al. [25] reported a similar frequency of depression between males and females (19.76% of males and 19.16% of females, PHQ-9 ≥ 15). We found a frequency of 34.1% in males and 43.5% in females (with PHQ ≥ 5) and 7.3% of males and 11.4% of females (with PHQ ≥ 10). There was no statistical difference in proportion of males and females with depression using both cutoffs ($p = 0.055$ and $p = 0.308$ respectively). Body mass index (BMI), being one of the major risk factors for incidence and progression of knee OA, is commonly associated with OA severity, pain, and limitation of activity [25, 29]; however, an intuitive association with depression was not established in this study.

Our participants had good family relationships reflected by the high number of participants (81.9%) with the APGAR score between 7 and 10. In contrast, Wang et al. reported a higher rate of poor family functioning among patients with depression, and they observed that there is good agreement between the self-report of the family members and the documentation of a trained evaluator about the family impairments in their subjects [11]. This difference may be explained by the fact that the African cultural setting provides care for ill elderly patients by children and other extended family members compared to what is obtained in western countries where they are often catered for in nursing homes.

Osteoarthritis has long been documented to be associated with sleep abnormalities, with OA patients having intermitted sleep, restlessness, and insomnia [30]. A recent study from Korea showed that the prevalence of OA was lowest in the participants who had 6–7 h of sleep and progressively increased with shorter sleep time [31]. It has also been suggested that the amount of improvement in sleep disturbance may serve as an indicator of assessing response to treatment of OA [30]. Taylor et al [32] in a report of 300 patients with knee OA found that 53% had insomnia similar to what we found. Strikingly, 80% of those with sleep abnormality in our study were depressed, further elucidating that.

We found no association between depression and radiographic grades of the knee. However, patellofemoral OA showed an association but failed to independently predict depression among our patients. Studies have shown that patellofemoral knee OA is common, predicts progression to structural damage, and is associated with pain and disability when compared with tibiofemoral knee OA (OR 2.25, $p = 0.005$) [33]. Poor sleep quality turned out to be the best predictor of depression seen in our study even after excluding factors like pain and age, similar to previous reports [25]. The relationship between sleep and pain might explain why pain, too, is an independent predictor of depression. Both are associated with poor quality of life, anxiety, and general feeling of lack of well-being.

The cross-sectional nature of the study allowed us to only assess information within the period of the study, and depression being a chronic illness that fluctuates might be missed in some patients. Participants were also not followed up to see if time-dependent changes in KL grades will be accompanied by concomitant changes in the psychosocial statuses.

In conclusion, depression is common among our patients with knee OA, and it can be predicted by poor sleep quality and moderate to severe pain.

Considering the complex association of pain, sleep abnormality, and radiographic findings, there is a need to carry out more studies to further understand the relationship and to improve the management of patients with knee OA and depression.

Compliance with ethical standards

The study was approved by the Ethical Review Committee of each of the study centers.

Disclosures None.

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