Correlation of Pain and Physical Disability with Radiological Features of Knee Osteoarthritis

Krishna Bahadur Bista[1], Rabi Mohan Dhakal[1], Bodh Raj Gautam[2], Bhupendra Man Singh Shrestha[3]

[1]Department of Orthopedics and Trauma Surgery, Gandaki Medical College Teaching Hospital & Research Center
[2]Department of Orthopedics and Trauma Surgery, Kathmandu National Medical College and Teaching Hospital
[3]Department of Orthopedics and Trauma Surgery, Chinnamasta Educational Academy and Medical College
***Correspondence:** Dr. Bhupendra Man Singh Shrestha, Department of Orthopedics and Trauma Surgery, Chinnamasta Educational Academy and Medical College, Nepal*
Email: sthabhupendra1305@gmail.com
ORCiD: https://0009-0005-5315-2395

Abstract

Background: Knee osteoarthritis (OA) is a leading cause of pain and physical disability. A discordance often exists between radiological findings and clinical symptoms, creating a challenge in clinical decision-making. This study aimed to investigate the relationships among pain, physical disability, and radiographic findings in patients with knee Osteoarthritis (OA).

Methods: A total of 113 patients with knee OA who attended the knee clinic of GMCTH were included in the study. A descriptive, cross-sectional study was conducted over 1 year. Radiographic grading was assessed with the use of the Kellgren-Lawrence scale. The severity of knee pain, stiffness and disability was measured using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

Results: BMI is a major risk factor for osteoarthritis. On radiographic assessment, 15 patients (13.27%) were grade 1, 45 (39.83%) were grade 2, 34 (30.09%) were grade 3, and 19 (16.81%) were grade 4, according to the KL grading system. Mean VAS score was 6.53 ± 1.33 and was significantly associated with KL grading when $P<0.005$. Kellgren-Lawrence grading scale and age or disease duration were positively and significantly associated.

Conclusions: Knee pain, stiffness, and physical disability are significantly associated with radiological severity in knee osteoarthritis. There is a need for an integrated assessment combining clinical evaluation and radiological findings to guide treatment planning for patients with knee OA.

Keywords: Kellgren Lawarence Grading; Knee Pain; Osteoarthritis; Physical Disability; Womac Score

INTRODUCTION

Knee pain is one of the common musculoskeletal problems in older people, as its prevalence increases with age and is one of the major causes of physical disability that leads to decreased quality of life.[1] Osteoarthritis (OA) is the major cause of knee pain and physical disability in the

elderly, which makes the patient seek medical attention.[2] Osteoarthritis is a joint disease affecting the cartilage of the joint, altering the joint architecture and causing physiological alterations of joint tissue, bone remodeling, and formation of osteophytes, leading to clinical manifestations such as joint pain, stiffness, inability to run, and limitation of joint function. Not only does OA cause joint pain and stiffness, but in the long term, it leads to impairment of mental health, sleep, and decreased quality of life.[3]

Osteoarthritis, also known as degenerative joint disease, is a progressive degeneration of hyaline cartilage in joints due to repetitive wear and tear.[4] Pain and disability are major presenting features of knee osteoarthritis and are one of the leading causes of disability in the aging population.[5] OA is regarded as a leading cause of disability in adults over 60 years globally and has been one of the major sources of health expenditure. In 2020, 7.6% of the global population and 14.8% of the population aged 30 years or older were estimated to live with osteoarthritis.[6] Based on symptoms and clinical findings, approximately 27 million US adults and 8.5 million UK adults have Osteoarthritis.[7] The prevalence of Osteoarthritis of the Knee ranges from 13.8% to 71.1% in Asian populations.[8] In developing countries like Nepal, there are few studies done to evaluate the prevalence of Osteoarthritis, and many diseased populations do not seek medical attention.[9]

Disability can be defined as an impairment or a mental or physical outcome resulting from a medical condition; it can also be seen as a social construct arising from the physical and social environments in which a person lives.[10] Knee Osteoarthritis is one of the disabling conditions associated with difficulty with day-to-day activities such as walking or climbing stairs. Disability attributed to Osteoarthritis is approximately 16%.[11]

Various clinical instruments are available to quantify the health status of patients with knee osteoarthritis. The self-administered Western Ontario and McMaster Universities (WOMAC) index is a widely used clinical tool for assessing patients with knee Osteoarthritis. The WOMAC score is based on a subjective questionnaire and consists of five questions on pain, two on stiffness, and 17 on disability in day-to-day activities.[12] The Visual Analog Scale (VAS) is validated all over the world and is a subjective score used for the assessment of acute or chronic pain. It consists of a handwritten 10 cm scale that measures from "no pain" to "worst" possible pain.[13] VAS is a common and easy tool to assess pain and is widely used in the assessment of pain due to Osteoarthritis.[14]

Radiography is the first-line modality for evaluating knee Osteoarthritis, according to the European League Against Rheumatism (EULAR) and the American College of Radiology (ACR). Radiography is regarded as the gold-standard investigation for Osteoarthritis because of its ease of availability, low cost, and high specificity.[15] As radiography is the mainstay of evaluating knee osteoarthritis, Kellgren and Lawrence (KL) introduced a classification system to reduce inter- and intra-observer variability.[16] Thus, KL grading is commonly used as a radiographic tool for assessing knee osteoarthritis.[17]

Although knee pain is a major cause of knee pain, there is a significant difference between the radiological findings of knee osteoarthritis and the symptoms of knee pain in osteoarthritis. Some patients with high-grade radiological osteoarthritis may not be symptomatic or have a mild degree of symptoms. Also, patients with low-grade features of osteoarthritis may experience severe knee

pain.[18] The final stage for treatment of knee osteoarthritis is Total Knee Replacement (TKR). However, there are no standard guidelines or criteria to indicate the necessity of TKR beyond "enough pain" as reported by the patient, and not all patients completely improve after TKR. Pain and radiographic features are considered important variables in evaluating patients for TKR.[19] Hence, this study aims to correlate knee pain and physical disability with radiological features of knee osteoarthritis to help the treating physician and orthopaedic surgeon develop better evaluation and treatment plans for the patient.

METHODS

A quantitative, hospital-based, observational, descriptive, cross-sectional study was conducted.[2] The study was carried out at the Department of Orthopedics and Trauma Surgery, the Emergency Department, and the Inpatient Department of Gandaki Medical College Teaching Hospital and Research Center, Pokhara, Nepal. The study duration was one year, from 5th August 2023 to 4th August 2024.

Study Population and Sampling

A total of 113 patients with non-traumatic knee pain who presented to Gandaki Medical College Teaching Hospital (GMCTH) were involved in the study. A non-probability convenience sampling procedure was used.

Sample Size Calculation

The sample size was calculated using the formula for correlation:

$n = 4 [(z\alpha + z\beta) / \ln((1+\rho)/(1-\rho))]^2 + 3$

Where:

The standard normal deviate for $\alpha = z\alpha = 1.96$

The standard normal deviate for $\beta = z\beta = 1.65$

Assuming a correlation coefficient (ρ) = 0.331 between WOMAC functional score and KL grading[20], at a 5% significance level and 95% power, the calculated sample size was 113.

Inclusion and Exclusion Criteria

The inclusion criteria were: 1) Knee pain > 4 weeks, and 2) Age >50 years.

The exclusion criteria were: 1) Post-traumatic knee pain, 2) Other arthropathies (Rheumatoid arthritis, Seronegative arthropathies, Hyperuricemia, Pseudogout), 3) History of knee surgery, 4) Neoplasm, 5) Congenital anomalies of the lower extremity, and 6) Previous intra-articular injection.

Data Collection

Based on the inclusion criteria, 113 consecutive patients with non-traumatic knee pain for more than 4 weeks were included in the study. In patients with bilateral knee pain, the more painful side was included. Written and informed consent was obtained from all patients in the prescribed format.

Data collection involved the following instruments and procedures:

- A detailed history, along with general, physical, and systemic examination, was performed.
- Vitals and cardinal signs were recorded.
- The VAS score was assessed to quantify pain intensity.
- The WOMAC score was used to assess pain, stiffness, and physical function.
- A thorough knee examination was conducted.
- Radiological evaluation of the knee was done using anteroposterior (AP) and lateral view X-rays in a standing position.
- A semi-structured proforma containing all relevant information was filled out for each participant.
- The patient's condition was evaluated, and a diagnosis was made.
- Patients were treated as per their needs with medication and physiotherapy.

The semi-structured proforma was a "self-structured proforma", designed and adopted by the experts at the Department of Orthopedics and Trauma Surgery, GMCTH, Pokhara. It was used to collect relevant socio-demographic, VAS, WOMAC, clinical, and radiological information.

Ethical Consideration

Approval for the study was obtained from the Institutional Review Committee (IRC) of Gandaki Medical College Teaching Hospital and Research Center. Written informed consent was obtained from all patients who participated in the study. Privacy was maintained during the examination, and the information was kept strictly confidential. Data were entered and stored in a password-protected Excel sheet. The patient's management was not affected by their participation in the study.

Data Analysis

The collected data were stored safely. Data were entered into Excel for Mac and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0 for Mac. Frequencies and percentages were used to describe discrete variables. For continuous data, mean values were used to measure central tendency, while range and standard deviation were used to measure dispersion. The T-test was used to assess the significance of differences between continuous variables. Statistical significance was assessed at the 95% confidence level, and p-values < 0.05 were considered significant. Spearman's correlation was used to test the significant association between discrete variables.

RESULTS

A total of 113 patients with knee osteoarthritis were enrolled in this hospital-based, cross-sectional study. The findings describe the population's characteristics and analyze the core correlations between pain, physical disability, and radiological severity.

Socio-Demographic and Clinical Characteristics

The mean age of the study population was 63.60 years with a significant predominance of females (65.5%). Table 1 shows a significant finding of high prevalence of elevated BMI: 88.5% of participants were either overweight (60.2%) or obese (28.3%), with an average BMI of 28.34 kg/m2. The mean duration of the knee pain was 5.97 years, a chronic condition, with the right knee being more frequently involved (63.7%). Just over half of the participants (51.3%) reported having morning stiffness.

Table 1: Baseline Characteristics of the Study Population (n=113)

Characteristic	Value
Age (years)	
Mean ± SD	63.60 ± 9.02
Range	51 – 85
Gender, n (%)	
Female	74 (65.5%)
Male	39 (34.5%)
Body Mass Index (BMI), n (%)	
Normal	13 (11.5%)
Overweight	68 (60.2%)
Obese	32 (28.3%)
Mean ± SD	28.34 ± 3.10
Duration of Knee Pain (years)	
Mean ± SD	5.97 ± 4.46
Involved Side, n (%)	
Right	72 (63.7%)
Left	41 (36.3%)
Morning Stiffness, n (%)	
Present	58 (51.3%)
Absent	55 (48.7%)

Clinical and Radiological Severity Scores

Participants reported moderate to high level of pain with a mean VAS score of 6.53 (Table 2). The mean total score of the WOMAC was 38.86 indicating high symptom burden and functional limitation. Radiological assessment revealed that most patients had moderate to severe osteoarthritis, and KL grades 2 and 3 accounted for 69.9% of the group.

Table 2: Distribution of Clinical and Radiological Scores (n=113)

Assessment Tool	Score Range	Mean ± SD
VAS Pain Score (0-10)	3 - 9	6.53 ± 1.33
WOMAC Scores		
Pain Subscale (0-10)	2 - 11	6.46 ± 2.38
Stiffness Subscale (0-8)	0 - 5	1.53 ± 1.69
Function Subscale (0-68)	5 - 56	30.87 ± 9.13
Total Score (0-96)	14 - 68	38.86 ± 12.50

Kellgren-Lawrence (KL) Grade, n (%)	
Grade 1	15 (13.3%)
Grade 2	45 (39.8%)
Grade 3	34 (30.1%)
Grade 4	19 (16.8%)

Figure 1: Distribution of Kellgren-Lawrence Grades

Associations Between Clinical Variables and Radiological Severity

Spearman correlation analysis revealed statistically significant positive relationships between all clinical variables and the radiological KL grade (Table 3). The duration of knee pain was significantly positively correlated (ρ=0.15, p<0.001) with radiological severity, meaning that the longer the duration of symptoms, the worse the severity of radiology. This association remained after adjustment for age, gender and BMI (ρ=0.13, p<0.001).

KL grading was positively and strongly correlated with pain intensity as measured by the VAS and the WOMAC pain subscale. VAS score showed a particularly strong univariable correlation (ρ=0.53, p<0.001), which was also robust in multivariable model (ρ=0.47, p<0.001). Similarly, the WOMAC pain score was significantly associated with KL grade both before (ρ = 0.30, p < 0.001) and after adjustment (ρ = 0.25, p < 0.001).

Radiologic severity was also significantly correlated with stiffness and physical function. The correlation between the WOMAC stiffness score and the adjusted model was stronger (ρ from 0.30 to 0.40, p<0.001). The WOMAC function score and the total WOMAC score also showed significant, but weaker, positive correlations with KL grade that persisted after multivariable adjustment (p<0.001 for all).

Table 3: Association of Clinical Variables with KL Grading (Spearman's Correlation)

Variable	**Univariable Analysis**	**Multivariable Analysis***		
Beta Coefficient (ρ)	p-value	Beta Coefficient (ρ)	p-value	
Duration of Knee Pain	0.15	<0.001	0.13	<0.001
VAS Pain Score	0.53	<0.001	0.47	<0.001
WOMAC Pain Score	0.30	<0.001	0.25	<0.001
WOMAC Stiffness Score	0.30	<0.001	0.40	<0.001
WOMAC Function Score	0.08	<0.001	0.07	<0.001
Total WOMAC Score	0.06	<0.001	0.06	<0.001
Duration of Knee Pain	0.15	<0.001	0.13	<0.001
VAS Pain Score	0.53	<0.001	0.47	<0.001
WOMAC Pain Score	0.30	<0.001	0.25	<0.001
WOMAC Stiffness Score	0.30	<0.001	0.40	<0.001
WOMAC Function Score	0.08	<0.001	0.07	<0.001
Total WOMAC Score	0.06	<0.001	0.06	<0.001

Figure 2: Scatter Plot of Total WOMAC Score vs. KL Grade

DISCUSSION

This hospital-based, cross-sectional study aimed to investigate the correlation between knee pain, physical disability, and the radiological features of knee osteoarthritis. The key finding of this research is the demonstration of statistically significant positive correlations between clinical parameters—including the duration of pain, pain intensity (measured by VAS and WOMAC), severity of stiffness, and degree of physical dysfunction—and radiological severity, as assessed by the Kellgren-Lawrence (KL) grading system. These associations remained robust even after adjusting for potential confounders such as age, gender, and BMI.

The demographic details of the sample studied are consistent with the known profile of OA epidemiology. Participants were an average of 63.60 years, consistent with findings that OA becomes more prevalent with advancing age.[3] Studies have reported a female predominance, and this study was no exception. Major studies, including the meta-analysis of [21 studies], report that knee OA is more prevalent and incident in females than males. A range of anatomical, hormonal, and genetic aspects often explain this. A study notes that the increased susceptibility in older females is likely due to the postmenopausal loss of protective estrogen, which contributes to a decline in the protective cartilage covering the knee.[22]

This sample had a particularly high and prevalent modifiable risk factor: 88.5% were overweight or obese, with a mean BMI of 28.34 kg/m², indicating that obesity is significant in relation to the biomechanical stress associated with knee OA in this sample population. This sample's findings parallel the meta-analysis of a study that established obesity as a principal risk factor and reported that the risk of knee OA increases by 35% for every 5-unit increase in BMI.[23] The mechanistic link is explained by a study, which demonstrated that a 1 kg reduction in body weight results in a 4 kg reduction in load per step on the knee joint.[24]

The core objective of the study was to examine the relationship between clinical symptoms and radiological findings, a topic of considerable debate in the literature. The results demonstrate a significant positive association, consistent with findings reported by several other investigators. A study in India also found a significant and positive correlation between KL grading and both WOMAC and VAS scores. Furthermore, the finding that the duration of knee pain is positively associated with KL grading is supported by a study that linked higher KL grading to accelerated cartilage loss and greater knee pain.[25]

The KL grading data's strong, statistically significant correlations with all three WOMAC components (pain, stiffness, and function) clearly capture the burden of this condition. The correlation indicates that as imaged damage increases, so too do the patient's pain, stiffness, and functional deficit. This is consistent with the pathophysiology of OA as a disease of the whole joint, in which the structural degeneration directly alters the mechanics and function of the joint. This symptomatology is described in the literature.[26]

It is important to situate the results within the broader scope of the science, which within itself has unresolved disagreements. Some research has shown weak or no correlations. A study in South Africa, for example, found no correlation between clinical findings and the degree of radiological severity.[27] This may be the result of uneven methodologies, particularly patient selection. Their selection, which excluded the majority of patients, consisted only of those referred to a tertiary arthroplasty clinic after unsuccessful conservative management, which may represent selection bias. The same goes for a study that found only a weak correlation between the Oxford Knee Score

and KL grading.[28] The variation in findings across studies highlights the complex, multifactorial nature of pain in OA, which is influenced by structural damage, psychosocial factors, central sensitization, and individual pain thresholds (Neogi, 2013).[29]

There are some limitations of the study worth mentioning. The study was conducted in a single hospital setting with a small sample size and convenience sampling, so the findings cannot be assumed to represent the wider community. As a hospital-based study, there is an inherent selection of symptomatic individuals who are actively seeking care. This results in missing a segment of the population that may have radiological OA (KL grade 1 or 2) but is asymptomatic. This selection bias towards symptomatic patients may have contributed to the more pronounced correlation(s) observed in the study, which are likely to be weaker in a community-based sample that encompasses asymptomatic individuals with radiological changes. There are multiple factors influencing one's subjective experience of pain that go beyond radiographic severity and were not fully considered in this study.

CONCLUSION

The study shows a significant and positive correlation between pain and physical disability with radiological features of knee OA. This means patients with higher pain and physical disabilities are likely to have higher radiographic grades as per the KL grading. This gives the physician a rough idea of the patient's treatment plan. However, when planning an operative procedure such as TKA, we need to consider both clinical and radiological evaluation before surgery. Surgical planning is based on both clinical and radiological outcomes.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

REFERENCES

Kim IJ, Kim HA, Seo YI, Jung YO, Song YW, Jeong JY, et al. Prevalence of knee pain and its influence on quality of life and physical function in the Korean elderly population: a community-based cross-sectional study. J Korean Med Sci 2011;26(9):1140–1146.

Cubukcu D, Sarsan A, Alkan H. Relationships between pain, function and radiographic findings in osteoarthritis of the knee: a cross-sectional study. Arthritis 2012;2012:1–5.

Allen KD, Thoma LM, Golightly YM. Epidemiology of osteoarthritis. Osteoarthritis Cartilage 2022;30(2):184–195.

Springer BD. Management of the bariatric patient: implications of obesity and total joint arthroplasty from the orthopedic surgeon's perspective. J Arthroplasty 2018. doi: https://doi.org/10.1016/j.arth.2018

Zhang Y, Jordan JM. Epidemiology of osteoarthritis. Clin Geriatr Med 2010;26(3):355–369.

Steinmetz JD, Culbreth GT, Haile LM, Rafferty Q, Lo J, Fukutaki KG, et al. Global, regional, and national burden of osteoarthritis, 1990–2020 and projections to 2050: a systematic analysis for the Global Burden of Disease Study 2021. Lancet Rheumatol 2023;5(9):e508–e522.

Lawrence RC, Felson DT, Helmick CG, Arnold LM, Choi H, Deyo RA, et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. Part II. Arthritis Rheum 2008;58(1):26–35.

Zamri NAA, Harith S, Yusoff NAM, Hassan NM, Ong YQ. Prevalence, risk factors and primary prevention of osteoarthritis in Asia: a scoping review. Elderly Health J 2019;5(1):1–11.

Bahadur D, Kshetri B. Knee pain and knee pain related disability in adults of the Western Development Region of Nepal. Unpublished master's thesis; 2017.

Altman BM. Definitions, concepts, and measures of disability. Ann Epidemiol 2014;24(1):2–7.

McDonough CM, Jette AM. The contribution of osteoarthritis to functional limitations and disability. Clin Geriatr Med 2010;26(3):387–399.

Ebrahimzadeh MH. Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) in Persian-speaking patients with knee osteoarthritis. Arch Bone Jt Surg 2013;1(2):49–53.

Delgado DA, Lambert BS, Boutris N, McCulloch PC, Robbins AB, Moreno MR, et al. Validation of digital visual analog scale pain scoring with a traditional paper-based visual analog scale in adults. J Am Acad Orthop Surg Glob Res Rev 2018;2(3):e088.

Bjerre-Bastos JJ, Miller CP, Li Y, Andersen JR, Karsdal M, Bihlet AR. Associations between single-question visual analogue scale pain score and weight-bearing and non-weight-bearing domains of WOMAC pain: data from 2 phase 3 clinical trials. Pain Rep 2022;7(5):e1017.

Piccolo CL, Mallio CA, Vaccarino F, Grasso RF, Zobel BB. Imaging of knee osteoarthritis: a review of multimodal diagnostic approach. Quant Imaging Med Surg 2023;13(11):7582–7595.

Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. Ann Rheum Dis 1957;16(4):494–502.

Kohn MD, Sassoon AA, Fernando ND. Classifications in brief: Kellgren-Lawrence classification of osteoarthritis. Clin Orthop Relat Res 2016;474(8):1886–1893.

Fujii T, Oka H, Katsuhira J, Tonosu J, Kasahara S, Tanaka S, et al. Disability due to knee pain and somatizing tendency in Japanese adults. BMC Musculoskelet Disord 2018;19(1):1.

Verra WC, Witteveen KQ, Maier AB, Gademan MGJ, van der Linden HMJ, Nelissen RGH. The reason why orthopedic surgeons perform total knee replacement: a randomized study using case vignettes. Knee Surg Sports Traumatol Arthrosc 2016;24(8):2697–2703.

Singh A, Saran S, Thukral B, Kaushik R. Ultrasonographic evaluation of osteoarthritis-affected knee joints: comparison with Kellgren-Lawrence grading and pain scores. J Med Ultrasound 2021;29(1):39–45.

Cui A, Li H, Wang D, Zhong J, Chen Y, Lu H. Global, regional prevalence, incidence and risk factors of knee osteoarthritis in population-based studies. EClinicalMedicine 2020;29–30:100587.

Hame SL, Alexander RA. Knee osteoarthritis in women. Curr Rev Musculoskelet Med 2013;6(2):182–187.

Jiang L, Tian W, Wang Y, Rong J, Bao C, Liu Y, et al. Body mass index and susceptibility to knee osteoarthritis: a systematic review and meta-analysis. Joint Bone Spine 2012;79(3):291–297.

Messier SP, Gutekunst DJ, Davis C, DeVita P. Weight loss reduces knee-joint loads in overweight and obese older adults with knee osteoarthritis. Arthritis Rheum 2005;52(7):2026–2032.

Wang Y, Teichtahl AJ, Abram F, Hussain SM, Pelletier JP, Cicuttini FM, et al. Knee pain as a predictor of structural progression over 4 years: data from the Osteoarthritis Initiative. Arthritis Res Ther 2018;20(1):250.

Abhishek A, Doherty M. Diagnosis and clinical presentation of osteoarthritis. Rheum Dis Clin North Am 2013;39(1):45–66.

Steenkamp W, Rachuene PA, Dey R, Mzayiya NL, Ramasuvha BE. The correlation between clinical and radiological severity of knee osteoarthritis. SICOT J 2022;8:13.

Innmann MM, Lunz A, Fröhlich L, Bruckner T, Merle C, Reiner T, et al. Correlation between clinical and radiographic findings in advanced knee osteoarthritis. J Clin Med 2023;12(16):5219.

Neogi T. The epidemiology and impact of pain in osteoarthritis. Osteoarthritis Cartilage 2013;21(9):1145–1153.