# Correlation Between Radiological Grading and Clinical Scoring in Knee Osteoarthritis Patients

Kshitiz Sapkota,[1] Sandesh Gautam,[2] Prajjwol Luitel,[2] Radhika Sapkota,[3] Sabin Pokharel [1]

[1]Department of Orthopaedics and Trauma Surgery, National Trauma Centre, National Academy Of Medical Sciences, [2]Maharajgunj Medical Campus, Tribhuvan University Teaching Hospital, [3]Shree Birendra Hospital, Nepalese Army Academy of Health Sciences.

## ABSTRACT

**Background:** Osteoarthritis is characterized by mechanical joint abnormalities, primarily involving articular cartilage and subchondral bone degradation. Diagnosis of knee osteoarthritis relies on American College of Rheumatology criteria, and severity assessment utilizes the Western Ontario and McMaster Universities Osteoarthritis Index score and Kellgren and Lawrence grading. Despite reported associations, discrepancies persist in the correlation between Western Ontario and McMaster Universities Osteoarthritis Index and Kellgren and Lawrence grade.

**Methods:** Descriptive cross-sectional study was conducted at the National Trauma Centre, over six months with consecutive convenience sampling. Demographic and clinico-radiological data were collected. Mean, SD and correlation coefficient was calculated.

**Results:** Consecutive convenient sampling yielded 80 participants meeting American College of Rheumatology criteria, aged 52-81 years, predominantly female (67.50%). Significant positive correlations were identified between age, Western Ontario and McMaster Universities Osteoarthritis Index score, and KL grade. Results showed most cases with Kellgren and Lawrence grade III and strong correlations (r=0.73, p=0.00) between total Western Ontario and McMaster Universities Osteoarthritis Index scores and Kellgren and Lawrence grading. Notably, pain, stiffness and physical functions individually exhibited a significant possitive correlation with Kellgren and Lawrence grading. The study affirms age-related influences on osteoarthritis, emphasizes female predilection, and underscores the importance of assessing both clinical and radiological parameters.

**Conclusions:** In conclusion, this study supports Western Ontario and McMaster Universities Osteoarthritis Index efficacy in dynamic disease assessment and management, especially in settings where radiological examinations may be impractical, thus establishing Western Ontario and McMaster Universities Osteoarthritis Index as a versatile tool for systematic monitoring and intervention in knee osteoarthritis.

**Keywords:** knee osteoarthritis; radiology; rheumatology; scoring; X-Ray.

## INTRODUCTION

Osteoarthritis (OA) encompasses mechanical joint abnormalities, involving articular cartilage and subchondral bone degradation. [1] American College of Rheumatology (ACR) criteria diagnose OA based on knee pain plus one of three factors: age >50 years, stiffness <30 minutes, and crepitus or osteophytes. [2] Assessing clinical and radiological severities employ the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score and Kellgren and Lawrence (KL) grading respectively.[3] The KL grading system is widely employed and relies on a weight-bearing anteroposterior (AP) X-ray of both knees and WOMAC score is a patient-reported outcome measure in those with lower limb osteoarthritis giving pain, stiffness and function scores individually.[4] While some studies indicate a strong/significant association,[1, 5-6] others reveal a moderate to poor and insignificant correlation between WOMAC and KL grade.[4,7] This study seeks to address this gap by

**Correspondence: Dr Prajjwol Luitel, Maharajgunj Medical Campus, Tribhuvan University Teaching Hospital, Kathmandu, Nepal. Email: drprajjwolluitel@gmail.com, Phone: +9779869497794.**

examining the association between KL grade and WOMAC score in the Nepalese population, providing valuable insights into Knee osteoarthritis severity assessment in patients presenting to the Outpatient Department (OPD) of the tertiary care center.

## METHODS

This hospital-based cross-sectional descriptive study was conducted at the National Trauma Center, Mahaboudha, Kathmandu, Nepal spanning six months from July 2020 to January 2021. The study commenced after clearance from the Institutional review committee (IRC) of National Academy of Medical Sciences (NAMS) (876/076/77). Consecutive convenient sampling was employed, enrolling patients clinically diagnosed with knee osteoarthritis from the OPD of the Department of Orthopedics based on ACR criteria. Inclusion criteria included a clinical diagnosis of knee osteoarthritis, completion of a routine knee X-rays consisting of Antero posterior view and lateral view and willingness to provide written informed consent. Exclusion criteria encompassed age below 50 years, a history of knee trauma or surgery of the ipsilateral side, known inflammatory disorders, other arthropathies, metabolic bone diseases, serious systemic diseases, neoplasms, and a history of previous intra-articular injections on the same knee.

The sample size was determined based on a prior study by Singh et al. [1] in India who reported a correlation (r) of 0.325 between radiographic grading and WOMAC-C score in India. To determine the sample size for a study with 95% confidence and 80% power, the formula $N= [(Z\alpha+Z\beta)/C]2 + 3$, $C=0.5\times\ln[(1+r)/(1-r)]$ was used. With $r=0.325$, $Z\alpha=1.960$, $Z\beta=0.842$, and $C=0.337$, the calculated N was 72. Considering a 10% non-response rate, the final sample size was adjusted to 80. Following approval by the IRC of NAMS, participants meeting selection criteria in the OPD were informed about the study, and written informed consent was obtained. The primary investigator systematically documented demographic details and medical history on the proforma, while the WOMAC osteoarthritis index was meticulously administered utilizing a Likert scale. WOMAC score is a patient-reported outcome measures in patients with lower limb osteoarthritis giving pain, stiffness and function scores individually and total score as well.[8] Some of the WOMAC questionnaires did not have cultural connect to our populations. So for substitution of suitable questions we used "putting on or taking off of suruwal" which is commonly worn in Nepali population instead of "putting on or taking off of stockings" and "getting in and out of rickshaw or taxi" instead of "getting in and out of car". [9] Subsequently, routine knee X-rays comprising of Antero posterior view and lateral view were acquired. The KL grading was done by a radiologist while clinical scoring information being held confidential through a blinded approach.

Data collected were entered into Microsoft Office Excel 2010 and analyzed using Statistical Package for Social Sciences (SPSS) version 16.0. Descriptive statistics, including mean, standard deviation was used for variables. The correlation between radiological and clinical grading was assessed using the Spearman correlation coefficient. The p- value less than 0.05 was considered statistically significant.

## RESULTS

The study enrolled a total of 80 patients, with a mean age of 67.85 years (Range 52 to 81 years), with the majority falling within the 71-80 age group (Figure 1). The study population comprised 54 females, accounting for 67.50%, while males constituted 32.50%.

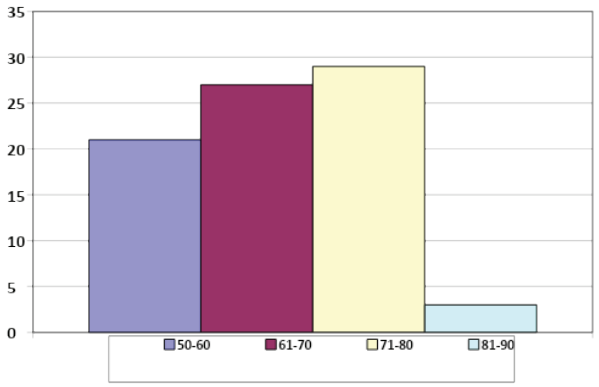


**Figure 1. Bar diagram showing age distribution among patients.**

The results as detailed in Table 1, displays individual and total WOMAC scores and KL grading.

**Table 1. Individual and Total WOMAC scores and KL grading.**

| Variables/ Result | Pain Score (WOMAC-A) | Stiffness Score (WOMAC-B) | Physical Function Score (WOMAC-C) | Total WOMAC Score | KL Grading |
|---|---|---|---|---|---|
| Mean, n=80 (mean + SD) | 12.00 ± 3.46 | 5.41 ± 1.62 | 37.10 ± 9.14 | 54.81 ± 13.13 | 2.66 ± 0.85 |
| Minimum | 5.00 | 1.00 | 16.00 | 25.00 | 1.00 |
| Maximum | 18.00 | 8.00 | 56.00 | 82.00 | 4.00 |

Most of the female and male patients were of KL grading II and III. The patients enrolled belonged least in KL grade I. (Table 2)

**Table 2. Distribution of KL grading with gender.**

| Variables | | KL GRADING | | | | Total |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | |
| Gender | Female(n=54) | 5 | 16 | 20 | 13 | 54(67.50%) |
| | Male(n=26) | 2 | 10 | 14 | 0 | 26(32.5%) |
| Total | | 7(8.75%) | 26(32.50%) | 34(42.50%) | 13(16.25%) | 80(100%) |

Notably, a significant positive correlation was identified between pain score and KL grading ($r=0.57$, $p < 0.05$), stiffness score and KL grading ($r=0.42$, $p <0.05$), Physical Function score and KL grading ($r=0.71$, $p < 0.05$), and total WOMAC and KL grading ($r=0.73$, $p<0.05$). (Tables 3)

**Table 3. Correlation of Pain Score, Stiffness Score, Physical Function score, Total WOMAC Score with KL Grading.**

| | | Pain Score | Stiffness Score | Physical Function score | Total WOMAC Score |
|---|---|---|---|---|---|
| KL Grading | Correlation Coefficient | 0.57 | 0.42 | 0.71 | 0.73 |
| | P value | 0.00** | 0.00** | 0.00** | 0.00** |

**** Statistically significant**

Additionally, age demonstrated a statistically significant positive correlation with KL grade ($r=0.52$, $p < 0.05$) and WOMAC score ($r=0.52$, $p < 0.05$). (Tables 4)

**Table 4. Correlation of Age with KL Grading and WOMAC scoring.**

| | | KL Grading | WOMAC Score |
|---|---|---|---|
| Age | Correlation Coefficient | 0.52 | 0.52 |
| | P value | 0.00** | 0.00** |

**** Statistically significant**

## DISCUSSION

In this descriptive cross-sectional study, we investigated the correlation between clinical scoring and radiological grading in knee OA patients. We also studied the correlation of age and those clinical and radiological gradings. Our findings revealed a statistically significant positive correlation between age and both WOMAC score and KL grading. This aligns with existing literature, emphasizing the impact of aging on OA development.[1, 10, 11] Changes in cartilage with aging, loss of chondrocytes and flexibility of subchondral bone and muscular weakness may contribute to

increasing prevalence of OA with aging.

The study observed a notable female predominance (67.5%), consistent with previous reports indicating a higher prevalence of OA in females. Increased risk of primary knee osteoarthritis has been described in females as compared to males.[12] Plausible explanations include increased ligamentous laxity, estrogen deficiency in postmenopausal females, and specific daily activities contributing to OA in the female population.[13] In menopausal women, increased production of interleukin-1 contributes to cytokine response in OA.[14] Prior studies have shown that sitting crossed legged and squatting increased knee osteoarthritis.[15, 16, 17] The daily household activities in females like sitting cross legged and squatting and the difficult terrain may also be ascribed to the increased prevalence of osteoarthritis in the Nepalese female population.

Our investigation identified a strong and statistically significant correlation between WOMAC clinical grade and KL radiological grade, echoing findings from other studies. [10,18,19] A study conducted by Amir Herman et al. also found a statistically significant correlation between pain and KL grading, and physical function and KL grading. [6] In the next study, KL grade 3 and 4 were correlated to more severe clinical features. [16] Hence higher WOMAC clinical score can predict higher radiological KL grade and be used to counsel the patients. Notably, pain demonstrated a robust relationship with radiological features in severe disease, supporting the importance of assessing both clinical symptoms and radiological severity in OA patients. Pain is the primary factor motivating the patients for seeking the arthroplasty. [20] Also, the WOMAC scoring system is a reliable outcome measure of knee arthroplasty. [21] Its applicability extends to remote health centers without X ray facilities or circumventing need for radiation exposure while counseling the patients regarding need for arthroplasty and early referral.

Contrarily, few studies did not establish an association between WOMAC sub-scores and KL grade or WOMAC-A and KL grade. [7, 8, 17] A study that did not show a significant correlation had a lower proportion of severe radiological OA (KL Grade 4) (5%) than ours (16%). [8] We acknowledge conflicting evidence from studies that did not establish similar associations, potentially due to variances in radiological OA severity. Furthermore, pain is a result of multiple factors like cartilage damage, subchondral bone pathology, periosteum, synovium as well as soft tissues. [8, 18]

This study highlights the pragmatic adaptability of WOMAC in diverse clinical scenarios, offering a versatile modality for the systematic monitoring and resolution of challenges inherent to knee osteoarthritis. In conclusion, our study not only advances our comprehension of the intricacies inherent to OA but also affirms WOMAC's practical utility as an efficacious tool for clinical intervention and informed decision-making in the management of this pervasive musculoskeletal ailment.

Limitations of our study include its cross-sectional design, which precludes establishing causation, and the relatively small sample size from a single center, cautioning against broad generalizations. Future research in multicenter settings with larger participant pools could enhance the robustness of the evidence. Additionally, the absence of body mass index assessment, a major risk factor for OA, underscores the need for its inclusion in future studies.

## CONCLUSIONS

The clinical grade given by WOMAC Osteoarthritis Index and radiological grade given by KL grading correlate well. The WOMAC scoring system, emerges as a valuable instrument for the dynamic assessment of disease progression and the management of knee osteoarthritis (OA) also for counseling the patient for future arthroplasty when scoring is higher. Its applicative scope extends notably to remote health settings, where logistical constraints may render radiological examinations unfeasible.

## CONFLICT OF INTEREST

None

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