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*Original Article*

# Association Between Pain and Radiological Changes in Patients with Knee Osteoarthritis

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## ABSTRACT

**Background**: Knee osteoarthritis (OA) is a leading cause of disability worldwide, characterized by joint degeneration, pain, and functional limitations. Despite the prevalence of knee OA, the relationship between radiographic changes and the severity of pain remains complex. Previous studies have offered conflicting views on the association between structural joint alterations and clinical symptoms.

**Objective**: The aim of this study was to investigate the association between radiographic degenerative changes in the knee, as classified by the Kellgren and Lawrence grading system, and the severity of resting pain measured using the Numeric Pain Rating Scale (NPRS).

**Methods**: This cross-sectional study was conducted on 70 patients diagnosed with knee OA at multiple healthcare facilities in Lahore, Pakistan, from July 2022 to January 2023. Participants aged between 40 and 80 years, both males and females, were included. The severity of knee OA was determined using the Kellgren-Lawrence grading system through X-ray evaluations. Pain severity was assessed using the NPRS. Data were analyzed using SPSS version 25.0, with chi-square tests applied to explore the association between radiographic grades of knee OA and pain severity.

**Results**: The distribution of knee OA severity among participants was as follows: Grade I (22.9%), Grade II (25.7%), Grade III (32.9%), and Grade IV (18.6%). Pain severity reported by participants was predominantly mild (55.7%), followed by moderate (37.1%) and severe (7.1%). Statistical analysis revealed a significant association between the grade of knee OA and the severity of resting pain (Chi-square = 30.06, $p < 0.0001$), indicating that higher grades of knee OA were correlated with increased pain severity.

**Conclusion**: The study confirmed a significant association between radiographic degenerative changes in knee OA and the severity of resting pain. These findings suggest the need for comprehensive clinical assessments in patients with knee OA, incorporating both radiographic evaluations and pain severity measures to guide management and treatment strategies.

**Keywords**: Knee Osteoarthritis, Radiographic Changes, Pain Severity, Kellgren-Lawrence Grading System, Numeric Pain Rating Scale, Cross-sectional Study.

## INTRODUCTION

Osteoarthritis (OA), a predominant cause of disability worldwide, is characterized by the progressive degeneration of joint structures, notably the cartilage, alongside osteophyte formation and various structural abnormalities (1). This condition, particularly affecting the knee, stands as a leading source of pain and functional limitation, significantly impacting the quality of life among the elderly (4). The global burden of knee OA has seen a marked increase, with a 30.8% rise in disability-adjusted life years from 2007 to 2017, underscoring a growing concern tied to non-communicable diseases as the population ages and obesity rates escalate (2). Despite advancements in diagnostic imaging, the relationship between radiological findings and the clinical manifestation of pain remains

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complex, with studies indicating a variable correlation between the severity of radiographic lesions and the patient-reported pain or disability (3).

The Kellgren-Lawrence (KL) grading system is commonly employed to assess the severity of knee OA through radiographic imaging, categorizing the condition from grade 0 (normal) to grade 4 (severe joint space narrowing) (5). Although severe knee OA, as identified through X-rays, has been associated with greater pain in community-based studies, significant discordance between clinical and radiographic findings is often observed (6). Patients with identical radiographic grades in both knees may report varying degrees of pain, sometimes experiencing discomfort in only one knee. This disparity suggests that the genesis of pain in OA is multifaceted, involving not just the structural changes observed through imaging but also factors such as muscle strength, limb loading, and possibly other systemic conditions like diabetes and hormonal imbalances (7, 8, 9).

The challenge in correlating radiographic characteristics of knee OA with pain stems from the limitations of traditional radiographs, which may not capture subtle osteoarthritic changes or fully depict the condition in non-weight-bearing views (10). Research has thus shifted towards employing weight-bearing views, which reveal joint space narrowing more accurately, suggesting that a comprehensive assessment might improve the detection of radiographic changes linked to OA (11). Nevertheless, there is no consensus on the optimal radiographic technique for evaluating the severity of knee OA, underscoring the need for further study in this area.

The relationship between radiographic evidence of knee OA and the clinical presentation of pain is intricate, influenced by the definition of pain, the characteristics of the study population, and the clinical context (12). Many individuals with radiographic knee OA may be asymptomatic, whereas others with knee pain suggestive of OA may not have corresponding radiographic evidence. This discrepancy emphasizes the importance of a holistic clinical evaluation that encompasses both history and physical examination alongside radiographic findings (13).

A study involving 86 participants investigated the relationship between pain, function, and quality of life in knee OA patients, in relation to radiographic findings. Employing the visual analogue scale (VAS) for pain assessment, the Kellgren-Lawrence (K&L) scale for radiographic evaluation, and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for measuring disability and functional status, the study found a significant correlation between VAS scores and K&L grades. Interestingly, a negative correlation was observed between physical function and general health with K&L grades, suggesting that radiographic severity may inversely affect physical function and overall health (14).

This study aimed to explore the association between pain severity and radiological changes in knee OA patients, positing an alternative hypothesis that suggests a significant association exists, contrary to the null hypothesis which proposes no such relationship.

## MATERIAL AND METHODS

This cross-sectional study was conducted to explore the association between pain severity and radiological changes in patients diagnosed with knee osteoarthritis. The research took place across several medical institutions in Lahore, Pakistan, including Bahria International Hospital, Farooq Hospital (Westwood branch), and Akhtar Saeed Trust Hospital (EME) from July 2022 to January 2023. Participants were recruited from a population aged between 40 and 80 years, including both males and females, who had been clinically diagnosed with primary (idiopathic) knee osteoarthritis (17).

Prior to the commencement of the study, ethical approval was secured from the ethics review committee of Akhtar Saeed College of Rehabilitation Sciences, Lahore, ensuring adherence to the ethical principles outlined in the Declaration of Helsinki. The sample size was determined to be 70 participants, calculated using a specific statistical formula that accounted for the desired power of the study and the expected effect size (15). This calculation was aimed at achieving sufficient power to detect a significant correlation between the severity of knee pain and the degree of radiological changes. The sampling method employed was non-probability convenience sampling, allowing for the expedient recruitment of subjects who met the inclusion criteria.

Data collection was carried out through a structured questionnaire administered to participants who provided informed consent prior to their inclusion in the study. This process was conducted with full transparency regarding the potential benefits and risks associated with participation, ensuring that all subjects were fully informed about the nature and objectives of the research. The severity of knee pain was quantitatively assessed using the Numeric Pain Rating Scale (NPRS) (16), a validated tool for measuring pain intensity.

For the analysis of collected data, the Statistical Package for the Social Sciences (SPSS) version 25.0 was utilized. This involved the presentation of quantitative data through means, standard deviations, ranges, and histograms, while categorical data were summarized using frequencies, percentages, cross-tabulations, bar charts, and pie charts. The association between the severity of

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knee pain and radiographic findings indicative of degeneration was examined using the chi-square test. A p-value of less than 0.05 was considered statistically significant, indicating a meaningful association between the variables under investigation.

## RESULTS

Table 1 presents the distribution of knee osteoarthritis severity among the study participants, classified according to the Kellgren-Lawrence grading system. The data showcases a total of 70 subjects divided into four grades: Grade I with 16 individuals (22.9%), Grade II comprising 18 subjects (25.7%), Grade III including 23 participants (32.9%), and Grade IV consisting of 13 individuals (18.6%). This distribution indicates a higher prevalence of moderate to severe osteoarthritis (Grades II, III, and IV) among the participants, suggesting that the majority of the study population is experiencing significant structural changes in the knee joint attributable to osteoarthritis.

Table 1 Grade/Stage of Knee Osteoarthritis as per Kellgren and Lawrence Scale

| Kellgren-Lawrence Grade | Frequency | Percent |
|---|---|---|
| Grade I | 16 | 22.9% |
| Grade II | 18 | 25.7% |
| Grade III | 23 | 32.9% |
| Grade IV | 13 | 18.6% |
| Total | 70 | 100.0% |

The Pain Severity Distribution Among Participants, as delineated without explicit table numbering but serving as a complementary section to Table 1, details the self-reported pain severity experienced by the same cohort of 70 participants. This portion reveals that 39 individuals (55.7%) reported mild pain, 26 (37.1%) experienced moderate pain, and 5 (7.1%) suffered from severe pain. The predominance of mild to moderate pain levels underscores the subjective experience of discomfort among the majority of the participants, providing insight into the clinical manifestation of knee osteoarthritis in relation to its radiographic grading.

Table 2 Pain Severity Distribution Among Participants

| Pain Severity | Frequency | Percent |
|---|---|---|
| Mild | 39 | 55.7% |
| Moderate | 26 | 37.1% |
| Severe | 5 | 7.1% |
| Total | 70 | 100.0% |

Table 3 Association Between Grade of Knee Osteoarthritis and Severity of Pain at Rest

| Grade/Stage of OA | Severity at Rest | | | Total | Chi-square | P-value |
|---|---|---|---|---|---|---|
| | Mild | Moderate | Severe | | 30.06 | 0.000 |
| Grade I | 15 | 1 | 0 | 16 | | |
| Grade II | 15 | 2 | 1 | 18 | | |
| Grade III | 7 | 14 | 2 | 23 | | |
| Grade IV | 2 | 9 | 2 | 13 | | |

Table 3 delves into the association between the grade of knee osteoarthritis and the severity of pain at rest, employing a chi-square statistical analysis to explore this relationship. The table shows a significant association (P-value = 0.000) across different grades of osteoarthritis (I through IV) and varying levels of pain severity (mild, moderate, severe) at rest. Specifically, it highlights a trend where higher grades of osteoarthritis (III and IV) are more frequently associated with moderate to severe pain, whereas lower grades (I and II) are mostly linked to mild pain. This significant statistical finding, represented by a chi-square value of 30.06, confirms the hypothesis of a correlation between the structural severity of knee osteoarthritis and the intensity of pain experienced by patients, offering valuable insights for clinical assessment and management strategies.

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## DISCUSSION

The present study elucidated a significant correlation between radiographic manifestations of knee osteoarthritis (OA) and the severity of resting pain, gauged by the Numeric Pain Rating Scale (NPRS). Utilizing the Kellgren and Lawrence grading system to classify the severity of knee OA based on X-ray findings, this study aligns with the body of existing research that has similarly identified a strong association between the degree of radiological changes and the intensity of pain experienced by individuals with knee OA. This observation substantiates the premise that radiographic alterations, indicative of osteophytes, bone deformities, and joint space narrowing, are reflective of the pain severity associated with the condition (18).

Contrasting views in the literature have underscored the discrepancy between radiographic findings and clinical symptoms, emphasizing the influence of various factors such as X-ray angles, definitions of pain, and demographic variables on these outcomes (18). This variability points towards the complexity of knee OA as a disease entity, where pain perception is not solely dependent on radiographic evidence of degeneration. Furthermore, the study's findings resonate with previous research indicating gender-specific differences in the correlation between radiographic findings and pain, where men exhibited a stronger link between joint space narrowing and pain, whereas women reported pain even in the absence of significant radiographic changes (20).

Despite the consensus on the association between pain and radiographic findings in knee OA, this relationship has often been portrayed as limited in existing studies (22). Our study contributes to the dialogue by reinforcing the connection between structural knee lesions and pain, thereby challenging the notion of a weak correlation. However, it is essential to acknowledge the study's limitations in isolating the impact of individual risk factors on pain due to its design, underscoring the need for a nuanced understanding of knee OA's multifactorial nature.

One noteworthy limitation of this research and similar studies is the reliance on non-standardized radiographic techniques, which could potentially obscure the precision of the relationship between radiographic changes and pain severity (24). This limitation highlights the necessity for standardized imaging protocols to enhance the reliability of findings concerning the structural-pathological correlates of pain in knee OA.

Moreover, the study's results indicated that most patients were classified as Grade III on the Kellgren and Lawrence scale, with a smaller proportion falling into Grade IV, suggesting that as radiographic deterioration progresses, so does the intensity of pain experienced by patients. This gradient of pain in relation to radiographic severity underscores the critical role of joint space narrowing, a hallmark of advanced OA, in pain manifestation. Nonetheless, the infrequent representation of patients in the most severe category (Grade IV) warrants further investigation to elucidate the dynamics of joint space narrowing and pain intensity with greater clarity (23).

## CONCLUSION

In conclusion, our findings corroborate the significant association between radiographic degenerative changes and pain severity in knee OA, as demonstrated by a statistically significant p-value (≤0.05). This study not only reinforces the established link between structural changes and symptomatic pain but also highlights the intricate interplay of factors contributing to the clinical presentation of knee OA. Moving forward, research efforts should aim to adopt standardized radiographic methodologies and explore the multifaceted nature of pain in OA, incorporating both radiological and clinical perspectives to foster a comprehensive understanding of this debilitating condition.

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