

Grading of Knee Osteoarthritis Based on Kellgren-Lawrence Classification and Finding an Association Between Radiographic Features and Pain: A Cross-Sectional Study at a Tertiary Health Care Hospital

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Mahesh Shinde^{1,2}, Disha Pardeshi¹, Mihir Patel¹, Lakshya Bhardwaj¹, Kshitij Sarwey¹, Sanskar Shyamsaika¹, Adi Siroya¹, Arnav Modi¹, Malay Tiwari¹, Aashita Bapat¹

1. Orthopaedics, HBT Medical College and Dr R.N. Cooper Hospital, Mumbai, IND 2. Orthopaedics and Traumatology, Government Medical College, Parbhani, IND

Corresponding author: Mahesh Shinde, mahesh.shinde.1466@gmail.com

Abstract

Introduction: Osteoarthritis leads to painful joints, disability, restriction of ambulation, and reduces the person's ability to perform activities of daily living. Pain is one of the major symptoms of osteoarthritis. Some patients presented with severe pain while some with severe deformity.

Method: Patients presenting with complaints of knee pain were screened. Written consent was taken from the patient. Radiographic data was collected and these patients were also shown the visual analogue scale (VAS) and asked to rate their pain. Further, the weight-bearing radiographs of both knees of patients in anteroposterior, lateral, and skyline views were also taken. The radiographs were evaluated using the Kellgren-Lawrence classification to determine the grade of osteoarthritis.

Results: For this study, radiographs of 116 patients (48 males (42%), 68 females (58%)) with knee OA who were eligible were included. The prevalence of the disease was highest among patients in the age group 51-60 years. The prevalence of bilateral knee osteoarthritis was observed in 98 patients (86.2%) and that of unilateral in 16 patients (13.8%). The prevalence of associated pain was comparatively higher in females than in males.

Conclusion: This study found there is no significant correlation between VAS pain score and the severity of radiological grading. Hence treatment should be tailored according to symptoms and not just the X-ray findings.

Categories: Rheumatology, Medical Education, Orthopedics

Keywords: knee joint, knee pain, osteoarthritis, vas scale, x-rays

Introduction

Osteoarthritis (OA) knee is a very common degenerative joint disorder. It is a worldwide public health problem, with its prevalence increasing from 5.8% to 11.8% between 2008 and 2019 [1]. It affects any hyaline cartilage-containing joint, of which the knee prevalence is 28.7% in India [2]. The risk factors for developing osteoarthritis include age, female gender, overweight and obesity, knee injury, repetitive use of joints, bone density, muscle weakness, and joint laxity all play roles in developing joint OA [3]. Osteoarthritis is traditionally thought of as a 'wear and tear' disease of the articular cartilage; however, recent studies have shown that the conditions involve the entire joint, which happens to occur as we start aging [4,5]. Osteoarthritis results from the failure of chondrocytes to maintain homeostasis between the synthesis and degradation of these extracellular matrix components [6]. This leads to thinning of the cartilage and subsequent bone-to-bone contact in the joint, inducing inflammation and a change in the biomechanics of the joint [7]. Frequent and prolonged squatting is a strong risk factor for tibiofemoral knee OA among the elderly. Occupation involving squatting or kneeling more than two hours daily was associated with a two-fold significantly increased risk of moderate to severe radiographic knee OA [8]. Osteoarthritis leads to painful joints, disability, and restriction of ambulation and reduces the person's ability to do activities of daily living independently [9].

In patients suspected of knee osteoarthritis, the presence of osteophytes in all knee radiographic views (anteroposterior (AP), lateral, or skyline) predicts knee pain more accurately than joint space narrowing on all knee radiographic views [10]. In a populous country like India, the number of cases of osteoarthritis of the knee is ever-increasing [11,12]. This puts an increased burden on the healthcare system of the country and can become a major cause of disability in the elderly unless managed adequately [13]. Pain is one of the major symptoms of osteoarthritis for which a patient seeks medical care [14]. Pain associated with

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osteoarthritis not only contributes to functional disability and limitation but leads to suboptimal quality of life, most commonly in the elderly population [15]. The main aim of this study was to thoroughly investigate the correlation between the severity of pain and radiological grading in osteoarthritis knee.

Materials And Methods

Study design

In this cross-sectional prospective study conducted from 2021 to 2023, the primary focus centered on individuals diagnosed with cases of osteoarthritis knee. Details of the patients were obtained from the clinical history proforma, and patient details were recorded in the tertiary care center. The objective was to thoroughly investigate the correlation between the severity of pain and radiographic grading of osteoarthritis knee.

Study population

A total of 116 patients diagnosed with osteoarthritis knee were enrolled in the study. Before each person was included in the study, their informed consent was acquired. The inclusion criteria comprised individuals with clinically diagnosed patients of osteoarthritis knee. Patients with rheumatoid arthritis, knee pain due to trauma, neuropathic pain, hip pain radiating to the knee, any autoimmune disorder leading to related knee pain, and any permanent disability that is leading to knee pain were excluded. Patients presenting to the outpatient department with complaints of knee pain were screened as per the inclusion and exclusion criteria. Written consent was taken from the patients. Those patients who gave consent were further evaluated. The selected patients were asked for a detailed history regarding the onset, duration, nature, and progression of knee pain. These patients were also rate their pain on a visual analogue scale where 0=no pain and 10= excruciating and debilitating pain. Further, the patients underwent weight-bearing radiographs of both knees. Anteroposterior and lateral views were taken. The radiographs were evaluated using the Kellgren-Lawrence classification [16-18] to determine the grade of osteoarthritis.

Kellgren-Lawrence radiographic grading of osteoarthritis of the tibiofemoral joint is as follows:

- Grade 0: No radiographic findings of osteoarthritis
- Grade 1: Minute osteophytes of doubtful clinical significance
- Grade 2: Definite osteophytes with unimpaired joint space
- Grade 3: Definite osteophytes with moderate joint space narrowing
- Grade 4: Definite osteophytes with severe joint space narrowing and subchondral sclerosis

The visual analogue scale (VAS) of pain at the knee joint was shown to patients and their response was noted (Figure 1).

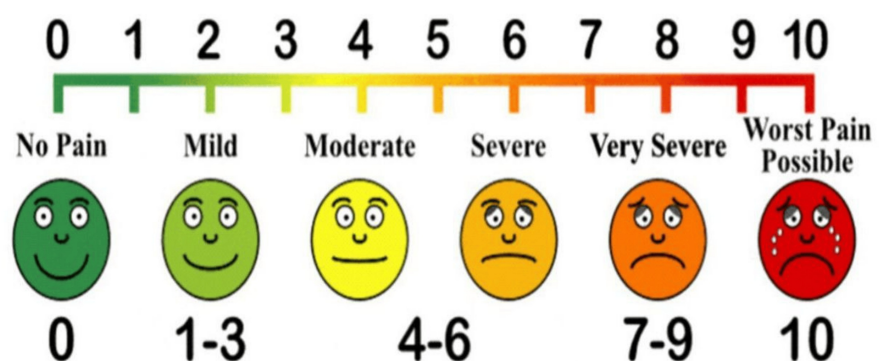


FIGURE 1: Visual analogue scale

Outcome measures

For demographic data, we used the chi-square test. The correlation between pain and radiographic grading was evaluated by the Pearson correlation test and classified as follows: 0.0 to 0.19 - very weak association; 0.2 to 0.39 - weak association; 0.4 to 0.69 - moderate association; 0.7 to 0.89 - strong association; and 0.9 to

1.0 - very strong association. The significance of a Pearson correlation coefficient is determined by comparing the p-value to the significance level, usually $\alpha = 0.05$. A significance level of 5% ($p < 0.05$) was considered statistically significant and IBM SPSS Statistics version 28.x (IBM Corp, Armonk, NY) was used for statistical analysis.

Results

A total of 116 radiographs of patients with OA knee who were eligible were included in this study. The age of the OA knee patients varied between 44 and 84 years (mean 58.7423 ± 9.1642). Most OA knee patients were females (68; 58.97%), and the remaining were males (48; 41.03%). Furthermore, the prevalence of bilateral OA knee was 86.2% (98 patients) and that of unilateral OA knee was 13.8% (16 patients) (Table 1).

Gender	Total number of individuals
Male	48
Female	68
Total	116
Chi-square value = 3.71, p-value = 0.054	

TABLE 1: Overall study population

The data was represented by the number of individuals with OA knee. Chi-square test was used to calculate the p-value (p-value < 0.001 was considered significant).

The prevalence of the disease is highest among the patients in the age group 51-60 years (24 males and 28 females) and least in the age group above 70 years (four males and four females). The population aged below 40 years is not commonly affected (Table 2).

Age	Total number of individuals
<40	0
40-60	24
50-60	52
60-70	32
70-80	4
>80	4
Chi-square value = 101.95, p-value<0.001	

TABLE 2: Study population overview

Data was represented as the number of participants. Chi-square test was used to calculate the p-value (p-value < 0.001 is considered significant).

Among all the types of associated pain, most individuals reported having severe pain and very few individuals reported with no pain. Also, the prevalence of associated pain was comparatively higher in female individuals than in males (Table 3).

Pain severity	Males	Females
No	4	0
Mild	6	14
Moderate	4	10
Severe	34	44
Total	48	68

Chi-square value = 8.92, p-value = 0.03

TABLE 3: Prevalence of pain

The data was represented by the number of participants. The chi-square test was used to calculate the p-value (p-value<0.001 is considered statistically significant).

According to the Kellgren-Lawrence scoring, the prevalence of grade 3 was most evident among individuals while that of grade 0 was least evident (Table 4).

Kellgren-Lawrence grade	Males	Females
0	10	0
1	2	14
2	8	8
3	14	28
4	14	18
Total	48	68

Chi-square value = 21.43, p-value < 0.001

TABLE 4: Kellgren-Lawrence radiographic grading

The data was represented by the number of participants. The chi-square test was used to calculate the p-value (p-value<0.001 is considered statistically significant).

According to Pearson's coefficient, a significant correlation (0.74) is seen between the visual analogue scale for pain and the Kellgren-Lawrence grading only at a p-value of 0.01 but not at a p-value of 0.05.

Overall, there is no significant correlation between VAS pain score and severity of osteoarthritis knee as per Kellgren-Lawrence grading (Figure 2).

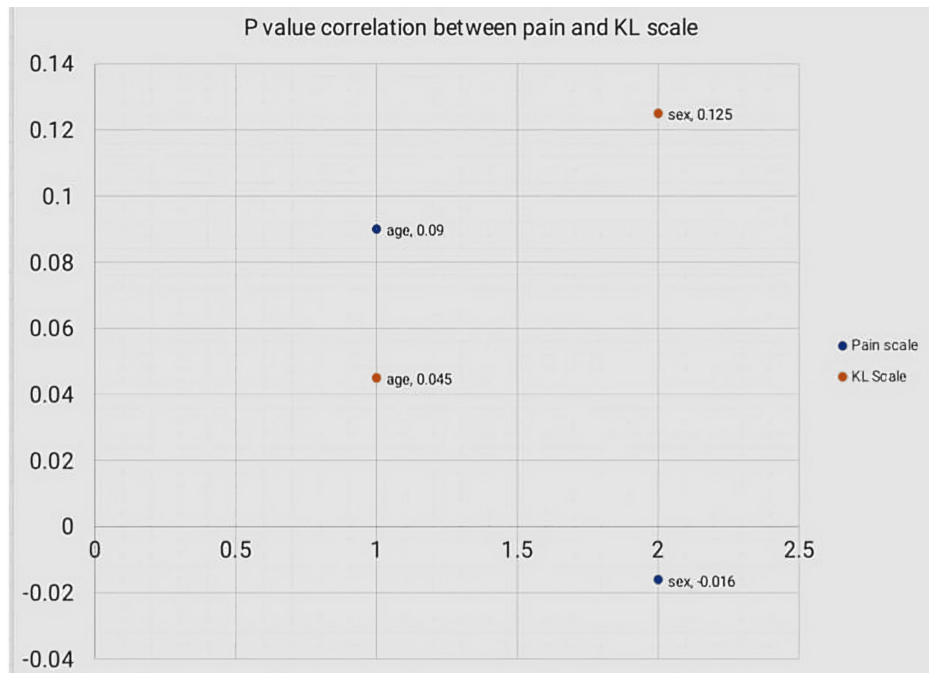


FIGURE 2: P value correlation between pain and Kellgren-Lawrence grading

Pearson coefficient test was used to calculate p-value (p-value <0.05 is considered significant). Data was represented as correlation coefficient (Pearson's r) and a value close to +1 indicates a strong positive correlation, while a value close to -1 indicates a strong negative correlation. Pearson coefficient test was used to calculate the p-value (p-value <0.05 was considered significant).

Discussion

This study shows that the prevalence of osteoarthritis (OA) knee increases with age (the most prone age group being 50-70 years) and that women 68(58%) are more likely than men 48(42%) to develop the condition. Zhang and Jordan also presented similar findings representing a relation between age, sex, and prevalence of osteoarthritis [19]. The findings could be explained by risk factors such as age, being overweight or obese, suffering a knee injury from repetitive use, having weak muscles and joints, having low bone density, and postmenopausal obesity evident in women. A similar finding was presented in a study by Ganvir and Zambare, which aimed to find the correlation between BMI, age, and sex with incidences of OA knee [20]. This study also showed the prevalence of bilateral OA knee was higher at 86.2% (98 patients) than that of unilateral knee OA (13.8%; 16 patients). Jaiswal et al. also showed that the majority of patients with OA knee have bilateral disease compared to unilateral disease [21].

This study also found a common link between OA knee and pain (via the visual analogue scale for pain). Particularly more incidences of severe pain were reported, which is followed by moderate and mild types of pain. With regard to age groups, women reported experiencing pain more frequently than males for all kinds of pain. According to a more detailed study by Szilagyi et al., moderate pain is more frequent in both men and women, while severe pain is more in women than men [22].

The results of the Kellgren-Lawrence grading indicated that the majority of OA knee cases had definite osteophytes along with moderate joint space narrowing (JSN), followed by severe joint space narrowing, subchondral sclerosis, and osteophytes without associated joint space narrowing, indicating that the severity of OA knee present in the study population is high. This study also showed the prevalence of grade 3 was most evident among individuals (38.18%; 42 patients) while that of grade 0 was least evident (8.7%; 10 patients). Similar findings were shown by Joo et al. [23]. Still, the relationship between the two scales of assessment (VAS pain score and KL scale) is not significant as the p values are found to be more scattered. This conclusion was shared by Kohn et al's study, which examined a correlation between the Kellgren-Lawrence grading and a scale based on JSN validated by an arthroscopic examination and focused more on OA knee cases with mild pain than all other types of pain [16]. The limitation of this study is that it involves only one radiologic scoring system and a pain scoring system.

Conclusions

This study concludes that there is no significant correlation between VAS pain and the severity of

osteoarthritis knee as per Kellgren-Lawrence grading. This clearly states that the pain in patients with osteoarthritis knee is multifactorial and just not related to cartilage damage, reduced joint space, osteophytes, and sclerosis of bone.

Using the radiological findings without clinical symptoms and signs of disease leads to the unnecessary use of drugs in elderly patients. Hence management in OA knee should be tailored towards the symptomatology of the patients and not just the severity as seen in X-ray.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Mahesh Shinde, Disha Pardeshi, Mihir Patel, Lakshya Bhardwaj, Kshitij Sarwey, Sanskar Shyamsaika, Adi Siroya, Arnav Modi, Malay Tiwari, Aashita Bapat

Acquisition, analysis, or interpretation of data: Mahesh Shinde, Disha Pardeshi, Mihir Patel, Lakshya Bhardwaj, Sanskar Shyamsaika, Adi Siroya

Drafting of the manuscript: Mahesh Shinde, Disha Pardeshi, Mihir Patel, Lakshya Bhardwaj, Kshitij Sarwey, Sanskar Shyamsaika, Adi Siroya, Arnav Modi, Malay Tiwari

Critical review of the manuscript for important intellectual content: Mahesh Shinde, Disha Pardeshi, Mihir Patel, Lakshya Bhardwaj, Sanskar Shyamsaika, Adi Siroya, Arnav Modi, Malay Tiwari, Aashita Bapat

Supervision: Mahesh Shinde, Disha Pardeshi, Mihir Patel, Kshitij Sarwey, Sanskar Shyamsaika, Adi Siroya, Malay Tiwari, Aashita Bapat

Disclosures

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References

1. Arslan IG, Damen J, de Wilde M, et al.: Incidence and prevalence of knee osteoarthritis using codified and narrative data from electronic health records: a population-based study. *Arthritis Care Res (Hoboken)*. 2022, 74:937-44. [10.1002/acr.24861](https://doi.org/10.1002/acr.24861)
2. Kumar H, Pal CP, Sharma YK, Kumar S, Uppal A: Epidemiology of knee osteoarthritis using Kellgren and Lawrence scale in Indian population. *J Clin Orthop Trauma*. 2020, 11:S125-9. [10.1016/j.jcot.2019.05.019](https://doi.org/10.1016/j.jcot.2019.05.019)
3. Reid CR, Bush PM, Cummings NH, McMullin DL, Durrani SK: A review of occupational knee disorders. *J Occup Rehabil*. 2010, 20:489-501. [10.1007/s10926-010-9242-8](https://doi.org/10.1007/s10926-010-9242-8)
4. Manlapaz DG, Sole G, Jayakaran P, Chapple CM: Risk factors for falls in adults with knee osteoarthritis: a systematic review. *PM&R*. 2019, 11:745-57. [10.1002/pmrj.12066](https://doi.org/10.1002/pmrj.12066)
5. Hulshof CT, Colosio C, Daams JG, et al.: WHO/ILO work-related burden of disease and injury: protocol for systematic reviews of exposure to occupational ergonomic risk factors and of the effect of exposure to occupational ergonomic risk factors on osteoarthritis of hip or knee and selected other musculoskeletal diseases. *Environ Int*. 2019, 125:554-66. [10.1016/j.envint.2018.09.053](https://doi.org/10.1016/j.envint.2018.09.053)
6. Fujii Y, Liu L, Yagasaki L, Inotsume M, Chiba T, Asahara H: Cartilage homeostasis and osteoarthritis. *Int J Mol Sci*. 2022, 23:6316. [10.3390/ijms23116316](https://doi.org/10.3390/ijms23116316)
7. Ostrowska M, Maśliński W, Prochorec-Sobieszek M, Nieciecki M, Sudoł-Szopińska I: Cartilage and bone damage in rheumatoid arthritis. *Reumatologia*. 2018:111-20. [10.5114/reum.2018.75523](https://doi.org/10.5114/reum.2018.75523)
8. Schram B, Orr R, Pope R, Canetti E, Knapik J: Risk factors for development of lower limb osteoarthritis in physically demanding occupations: A narrative umbrella review. *J Occup Health*. 2020, 62:e12103. [10.1002/1348-9585.12103](https://doi.org/10.1002/1348-9585.12103)
9. Clynes MA, Jameson KA, Edwards MH, Cooper C, Dennison EM: Impact of osteoarthritis on activities of daily living: does joint site matter?. *Aging Clin Exp Res*. 2019, 31:1049-56. [10.1007/s40520-019-01163-0](https://doi.org/10.1007/s40520-019-01163-0)
10. Muraki S, Oka H, Akune T, et al.: Prevalence of radiographic knee osteoarthritis and its association with knee pain in the elderly of Japanese population-based cohorts: the ROAD study. *Osteoarthritis Cartilage*. 2009, 17:1137-43. [10.1016/j.joca.2009.04.005](https://doi.org/10.1016/j.joca.2009.04.005)
11. Acharya RN, Patel HM: Prevalence of the knee osteoarthritis risk factors among young adult population - an observational study. *Int J Health Sci Res*. 2023, 13:158-63. [10.52403/ijhsr.20231022](https://doi.org/10.52403/ijhsr.20231022)

12. Singh A, Das S, Chopra A, et al.: Burden of osteoarthritis in India and its states, 1990-2019: findings from the Global Burden of Disease Study 2019. *Osteoarthritis Cartilage*. 2022, 30:1070-8. [10.1016/j.joca.2022.05.004](https://doi.org/10.1016/j.joca.2022.05.004)
13. Bhandarkar P, Priti P, Chander S, Nandan K: Prevalence of osteoarthritis knee: four year study based on digital records of comprehensive healthcare setup at Mumbai, India. *International Journal of Community Medicine and Public Health*. 2016, 3:1049-53. [10.18203/2394-6040.ijcmph20161356](https://doi.org/10.18203/2394-6040.ijcmph20161356)
14. Wood MJ, Miller RE, Malfait AM: The genesis of pain in osteoarthritis: inflammation as a mediator of osteoarthritis pain. *Clin Geriatr Med*. 2022, 38:221-38. [10.1016/j.cger.2021.11.013](https://doi.org/10.1016/j.cger.2021.11.013)
15. Palo N, Chandel SS, Dash SK, Arora G, Kumar M, Biswal MR: Effects of osteoarthritis on quality of life in elderly population of Bhubaneswar, India: a prospective multicenter screening and therapeutic study of 2854 patients. *Geriatr Orthop Surg Rehabil*. 2015, 6:269-75. [10.1177/2151458515604557](https://doi.org/10.1177/2151458515604557)
16. Kohn MD, Sassoon AA, Fernando ND: Classifications in brief: Kellgren-Lawrence classification of osteoarthritis. *Clin Orthop Relat Res*. 2016, 474:1886-93. [10.1007/s11999-016-4732-4](https://doi.org/10.1007/s11999-016-4732-4)
17. Kellegren JH, Lawrence JS: Radiological assessment of osteo-arthritis. *Ann Rheum Dis*. 1957, 16:494-502. [10.1136/ard.16.4.494](https://doi.org/10.1136/ard.16.4.494)
18. Brandt KD, Fife RS, Braunstein EM, Katz B: Radiographic grading of the severity of knee osteoarthritis: relation of the Kellgren and Lawrence grade to a grade based on joint space narrowing, and correlation with arthroscopic evidence of articular cartilage degeneration. 1991, 34:1381-6. [10.1002/art.1780341106](https://doi.org/10.1002/art.1780341106)
19. Zhang Y, Jordan JM: Epidemiology of osteoarthritis. *Clin Geriatr Med*. 2010, 26:355-69. [10.1016/j.cger.2010.03.001](https://doi.org/10.1016/j.cger.2010.03.001)
20. Ganvir SD, Zambare BR: Prevalence and identification of risk factors for knee osteoarthritis among elderly men and women. *Sch J App Med Sci*. 2013, 1:700-3. [10.36347/sjams.2013.v01i06.0011](https://doi.org/10.36347/sjams.2013.v01i06.0011)
21. Jaiswal A, Goswami K, Haladar P, Salve HR, Singh U: Prevalence of knee osteoarthritis, its determinants, and impact on the quality of life in elderly persons in rural Ballabgarh, Haryana. *J Family Med Prim Care*. 2021, 10:354-60. [10.4103/jfmpc.jfmpc_1477_20](https://doi.org/10.4103/jfmpc.jfmpc_1477_20)
22. Szilagyi IA, Waarsing JH, Schiphof D, van Meurs JB, Bierma-Zeinstra SM: Towards sex-specific osteoarthritis risk models: evaluation of risk factors for knee osteoarthritis in males and females. *Rheumatology (Oxford)*. 2022, 61:648-57. [10.1093/rheumatology/keab378](https://doi.org/10.1093/rheumatology/keab378)
23. Joo SH, Song JW, Shin K, Kim MJ, Lee J, Song YW: Knee osteoarthritis with a high grade of Kellgren-Lawrence score is associated with a worse frailty status, KNHANES 2010-2013. *Sci Rep*. 2023, 13:19714. [10.1038/s41598-023-46558-2](https://doi.org/10.1038/s41598-023-46558-2)