ORIGINAL RESEARCH

Clinicoradiographic correlation between the Western Ontario and McMaster Universities Osteoarthritis Index and Kellgren–Lawrence system assessments among patients with osteoarthritis of the knee presenting at a tertiary hospital in southeastern Nigeria

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Abstract

Background
In the evaluation of patients with knee osteoarthritis, surgeons use clinical instruments and heavily rely on radiographic parameters, especially when considering invasive treatment options. Research exploring the agreement between clinical and radiographic tools in Caucasian and Asian populations has yielded mixed results. This study aimed to examine—using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Kellgren–Lawrence (K–L) grades—whether a correlation exists between clinical and radiographic findings in a sample of Nigerian patients with osteoarthritis.

Methods
We enrolled patients with knee osteoarthritis from the orthopaedic clinic at a tertiary hospital in Nnewi, Nigeria. We calculated their WOMAC knee scores using the WOMAC questionnaire and performed knee radiographs in anteroposterior, lateral, and skyline views. We assigned K–L grades based on radiographic findings. We used Spearman correlation analysis to determine the correlation between the WOMAC knee scores and K–L grades.

Results
The study included 128 patients (215 knees) with a mean age of 64.8 years. The median WOMAC score was 58.0, and the most common K–L grade was grade III. Among the 40- to 59-year and ≥70-year age groups, women had lower WOMAC scores, even in combination with K–L grade IV. Overall, there was no significant correlation between WOMAC scores and K–L grades (P=0.59, Spearman ρ=0.012).

Conclusions
There was no correlation between clinical and radiographic features in knee osteoarthritis in this sample of patients managed at a tertiary hospital in southeastern Nigeria.

Keywords: osteoarthritis, knees, Kellgren–Lawrence, WOMAC, correlation, Nigeria

Introduction

In 1957, following the first large-scale epidemiological study on osteoarthritis (OA) in England, Kellgren and Lawrence developed a grading system to evaluate the severity of OA based on radiographs.[1]-[3] Today, this scale bears their names and defines OA severity through 5 incremental grades, ranging from 0 (normal) to IV (presence of large osteophytes, significant joint space narrowing, severe sclerosis, and bony contour deformity).[3] The threshold defining true OA by Kellgren–Lawrence (K–L) grade is grade II.[4] K–L grading is considered the standard for radiographic assessment of OA, serving as an invaluable tool for surgeons, particularly when considering invasive treatment options. However, the K–L grading system has its drawbacks, including

its subjective nature and reliance on terms like 'mild', 'moderate', 'doubtful', 'possible', and 'definite', which can compromise interobserver reproducibility.[1] Moreover, it indirectly assesses articular cartilage, which is among many contributors to joint-space narrowing.[5] The cut-off for the radiographic diagnosis of OA by the K–L grading (grade II and above, requiring 'definite osteophytes') may exclude certain individuals.[2] Furthermore, K–L grading largely relies on anteroposterior views, which do not provide optimal visualization of the femoral condyles where significant cartilage degeneration occurs. This limitation is addressed by views such as the 45° posteroanterior flexion weight-bearing radiograph.[6] Relying on radiographs for interpretation also risks errors, such as the variation in joint space width documented in radiographs of OA patients taken 7 to 14 days apart after the resolution of an acute flare of pain.[7] These limitations of the K–L grading system have raised questions about its reliability in decision-making, especially regarding invasive treatment options like total knee replacement. It has also spurred questions about whether the K–L grading truly reflects clinical findings in patients.

Research on Caucasian populations to evaluate the level of dichotomy or synchrony between the K–L grading and clinical symptom expression has produced mixed results.[8]-[13] To our knowledge, no similar studies have been conducted in a Black population. This study aimed to examine if there is a correlation between clinical and radiographic findings using the Western Ontario and McMaster University Osteoarthritis Index (WOMAC) as the clinical assessment tool and the K–L grade as the radiographic index in a sample of Black patients in sub-Saharan Africa presenting with knee OA.

We chose the WOMAC knee score for this study due to its ease of administration. Comprising 2 subscales and 24 items, the WOMAC score assesses pain during various positions or movements, the severity of joint stiffness, and difficulty in performing activities of daily living. The 24 items within the 3 subscales are graded from 0 to 4 in the Likert version, with 'none' represented as 0, 'mild' as 1, 'moderate' as 2, 'severe' as 3, and 'extreme' as 4. A maximum of 96 points can be scored, and a percentage can be deduced for lower scores. The WOMAC knee score is easy to interpret; thus, a patient with a WOMAC score of 50 can be assumed to have moderate pain with exercise. However, the WOMAC score also faces some challenges, including the impact of environmental factors and how they relate to the content of the scale. For example, the ease of use of transportation facilities—a concept tested on the WOMAC scale—varies geographically according to financial resources and other capacity measures. While well-resourced countries may have facilities that enable patients with musculoskeletal challenges to get onto and alight from buses, resource-constrained countries may lack such provisions. Thus, the expression of 'difficulty level' may vary from patient to patient across regions. Additionally, finding equivalent words in different languages becomes more challenging as the points in the Likert format increase. Nevertheless, the WOMAC knee score remains among the leading measures of knee function.

Methods

We conducted a prospective study using a consecutive sampling technique to enrol all new cases of knee OA presenting at our centre in Nnewi, Nigeria, from January 2017 through December 2018. We obtained ethical clearance from the hospital's ethical committee (Nnamdi Azikiwe University Teaching Hospital Ethics Committee, NAUTH/CS/66/VOL 9/156/2016/137) and informed consent from all patients who met the inclusion criteria for the study. We included all patients with primary knee OA and K–L grades of II or higher. We excluded patients with K–L grades of I, all patients with previously surgically treated knee OA, and all patients who had undergone knee osteotomies for diagnoses other than OA.

We administered the WOMAC questionnaire to patients in English. For patients who spoke only the Igbo language, we used the services of an Igbo linguist interpreter, fluent in both Igbo and English, to explain the WOMAC questions. Patients then underwent knee radiographs in anteroposterior, lateral, and skyline views, which are the minimum diagnostic views for evaluating knee OA.[14]

Anteroposterior views

Anteroposterior views were taken in full weight bearing with the toes pointing forward, knees fully extended, and weight equally distributed on both feet, except where not possible due to severe deformities. Patients with fixed flexion deformities were allowed to stand facing forward to their maximum possible extension without discomfort. The x-ray beam was directed at the lower pole of the patella. For patients with bilateral OA, the beam was centred midway between both knees. X-ray tubes were placed 100 cm from the erect Bucky.

Lateral views

Lateral views were captured with the knee in 90° of flexion and the patient lying on the side to be imaged. For patients with fixed flexion deformities preventing this degree of flexion, knees were placed in a comfortable degree of flexion. Padding was used for bony prominences to enhance patient comfort. The x-ray beam was centred at the middle of the superior border of the medial tibial condyle, and cassettes were placed level with the medial tibial condyle.

Skyline views

For the skyline view, the patient sat on the x-ray table with the knee flexed to 45° and supported on a pad placed beneath the knee. The patient held the cassette against the distal part of the anterior thigh, with a nonopaque pad placed at the point of contact with the patient's skin to prevent discomfort. The tube was positioned so that the central beam was directed cranially to pass through the apex of the patella along its long axis. All radiographs were taken by radiographers with a minimum of 3 years of on-the-job experience.

A single consultant radiologist with 11 years of experience, who was blinded to the WOMAC scores of the individual patients, interpreted the radiographs and assigned the K–L grades.

Table 1. Sex distribution of patients and knee osteoarthritis laterality

Laterality	n (%)		
	Women	Men	Total
Unilateral	25 (19.5)	16 (12.5)	41 (32.0)
Left	17 (13.3)	7 (5.5)	24 (18.8)
Right	8 (6.3)	9 (7.0)	17 (13.2)
Bilateral	46 (35.9)	41 (32.0)	87 (68.0)
Total	71 (55.5)	57 (44.5)	128 (100)

Table 2. Mean distribution of WOMAC knee scores by age and gender

Age group, years	WOMAC score[a], mean ± SD		*P* value[b]
	Women[c]	Men[d]	
40-59	49.3±13.7	49.8±13.1	0.89
60-69	55.0±15.4	51.6±11.9	0.34
≥70	65.5±12.5	68.0±12.8	0.38

[a]The maximum WOMAC score is 96. [b]*t* test; [c]118 knees among 71 women; [d]97 knees among 57 men

SD, standard deviation; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index

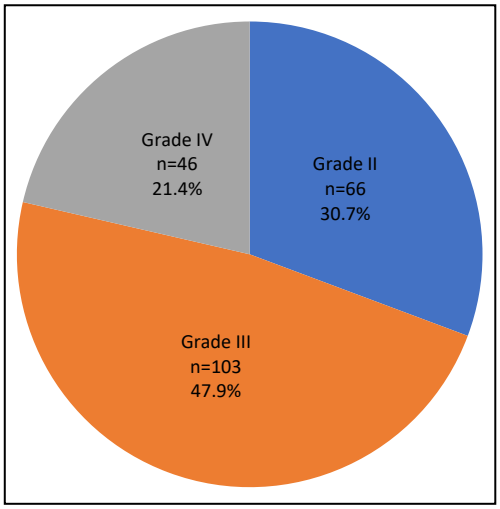

Figure 1. Percentage distribution of Kellgren–Lawrence grades of outpatients with knee osteoarthritis managed at a tertiary hospital in Nnewi, Nigeria (N=215 knees from 128 patients)

Correlation and data processing

We calculated the WOMAC knee score, subscale scores, and the K–L grade for each participant. Using the Spearman correlation (ρ) of ranked data in SPSS Statistics for Windows, version 21 (IBM Corp., Armonk, NY, USA), we determined the correlation between the WOMAC knee scores and the K–L grades. We tested ρ for statistical significance and deduced the presence or absence of a correlation based on this.

Results

The study included 57 men (44.5%) and 71 women (55.5%), for a total of 128 patients and a male-to-female ratio of 1:1.25 (Table 1). The patients' ages ranged from 42 to 85 years, with a mean age of 64.8±11.5 years. Eighty-seven patients (68%) had bilateral knee OA, and 41 (32%) had unilateral disease, amounting to a total of 215 knees. Unilateral disease was more common in women (n=25, 61%), and women also had more cases of bilateral disease (n=46, 52.9%) than men. Among patients with unilateral disease, the left knee was more commonly affected in women (n=17, 68%), and the right knee was more affected in men (n=9, 56.3%). The range of WOMAC knee scores in the study was 25 to 90. In the 40- to 59-year age group, the mean WOMAC score for women's knees was 49.3±13.7, compared with 49.8±13.1 for men (*P*=0.89). In the 60- to 69-year age group, the mean WOMAC scores were 55.0±15.4 among women and 51.6±11.9 among men (*P*=0.34). Regarding patients ≥70 years old, the mean WOMAC scores were 60.5±12.5 among women and 68.0±12.8) among men (*P*=0.38) (Table 2). The most common K–L grade was grade III, observed in 103 knees (47.9%), while K–L grades II and IV were determined for 66 (30.7%) and 46 (21.4%) knees, respectively (Figure 1). There was no linear correlation between the WOMAC knee score and the K–L grade (clinicoradiographic correlation) (ρ=0.012, *P*=0.59) (Figure 2).

Discussion

A key finding of this study was the predominance of K–L grade III. This reflected the tendency for late presentation in sub-Saharan Africa and the general pattern of health-seeking behaviour in low-income countries, where the timing of presentation at hospital facilities is affected by an interplay of economic, religious, and sociocultural factors. In a longitudinal study conducted in Baltimore, USA, assessing the association between radiographic features and knee pain, a predominance of K–L grade II was noted among study patients. [15] The ease of access to healthcare and the availability of functional health insurance policies in well-resourced countries may explain the predominance of early radiographic OA seen in their study. However, despite the predominance of K–L grade III in our study, we did not observe consistently high WOMAC scores among these patients, but rather a wide range of WOMAC scores. One possible reason for the disparity between clinical and radiographic features in these patients may be variations in symptom tolerance thresholds, with some patients better able to tolerate symptoms than others at the same K–L grade. However, considering where this study was conducted, a high WOMAC score at a K–L grade of III may also indicate a longer period of searching for financial resources or seeking alternative remedies rather than a truly higher symptom tolerance threshold. Patients of higher socioeconomic status may, therefore, present with much lower WOMAC scores.

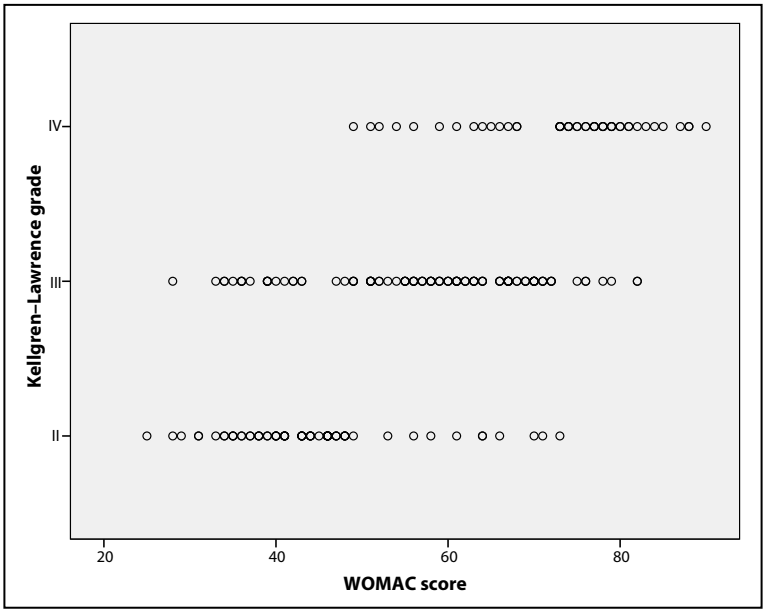

Figure 2. Scatterplot of WOMAC scores vs Kellgren–Lawrence grades of outpatients with knee osteoarthritis

This scatterplot depicts the relationship between clinical findings, as measured by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores (x-axis), and radiographic findings, as represented by the Kellgren–Lawrence grades (y-axis), in a sample of patients with knee osteoarthritis managed at a tertiary hospital in Nnewi, Nigeria (N=215 knees from 128 patients). Each point represents an individual patient. The analysis revealed no significant correlation between WOMAC scores and Kellgren–Lawrence grades (P=0.59, Spearman ρ=0.012), indicating that the clinical and radiographic assessments of osteoarthritis severity in this patient population are not significantly correlated.

Women had significantly lower mean WOMAC scores in 2 of the 3 age groups studied (40-59 and ≥70 years of age, respectively), even in combination with K–L grade IV. This observation suggests a protective role of oestrogen on female knees in OA, as proposed by Sowers and colleagues, who found that the risk of developing knee OA is highest with low levels of oestrogen and its metabolites.[16] Our findings seem to support this theory, indicating that oestrogen may be a contributing factor in the clinicoradiographic discordance noted for women. We generally observed the lowest WOMAC scores among women in the 40- to 59-year age bracket, who were likely to have higher oestrogen levels than older participants. As women transitioned from premenopausal to perimenopausal and menopausal age groups, their mean WOMAC scores increased. However, we cannot determine whether this potential protective role of oestrogen relates to disease progression, symptom perception, or both. Further studies are needed to clarify this.

Overall, we found no correlation between WOMAC knee scores and K–L grades across 215 knees among 128 patients (ρ=0.012, *P*=0.59). This suggests that symptoms do not accurately reflect the radiographic progression of the disease and vice versa. These findings are consistent with some studies conducted on Caucasian populations.[8],[11],[17],[18] However, other studies investigating Caucasian and Indian participants have reported different findings.[13],[15],[19]-[21]

Limitations

While our study of this patient population of African descent suggests an absence of correlation, we acknowledge that certain content in the WOMAC questionnaire may not accurately reflect the typical lifestyle practices of the population studied, which could affect the responses and, consequently, the total WOMAC scores determined. For instance, asking a female patient about the difficulty level when putting on and taking off socks may not yield accurate responses, given that this study was conducted in a tropical climate where wearing socks for warmth is rarely practised. Furthermore, the absence of K–L grade I in the presence of low WOMAC scores may have contributed to the lack of correlation found. Additionally, using an Igbo linguist to help patients without formal education understand the WOMAC questionnaire may have inadvertently introduced changes in meaning that affected the WOMAC scores obtained. Lastly, this was a single-centre study with a limited sample size, and future multicentre studies encompassing broader populations could help establish a basis for generalizability.

Conclusions

This study, which used the WOMAC knee score and K–L grading scale as assessment tools, found no correlation between clinical and radiographic features of knee OA in this sample of indigenous Nigerians. This lack of correlation was particularly pronounced among patients with advanced disease (higher K–L grades).

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