Original Research

CORRELATION BETWEEN BODY MASS INDEX AND SEVERITY OF KNEE OSTEOARTHRITIS: A CROSS-SECTIONAL STUDY

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ABSTARCT

Introduction: Knee osteoarthritis is a common degenerative joint disorder strongly influenced by mechanical and metabolic factors. Body Mass Index is an important modifiable risk factor that may influence both the onset and severity of knee osteoarthritis.

Aim: To evaluate the correlation between Body Mass Index and severity of knee osteoarthritis in a cross-sectional study.

Materials and Methods: This study was a hospital-based cross-sectional observational study conducted in the Department of Orthopaedics of a tertiary care teaching hospital over a period of 1 year. The study population included 100 patients diagnosed with knee osteoarthritis attending the outpatient department during the study duration who met the inclusion criteria. The main objective of the study was to evaluate the correlation between Body Mass Index and severity of knee osteoarthritis.

Results: In the present study, a total of 100 patients with knee osteoarthritis were analyzed to determine the association between gender and severity of disease. Among male patients (n = 55), 28 patients (50.9%) had mild osteoarthritis, 15 patients (27.3%) had moderate disease, and 12 patients (21.8%) had severe osteoarthritis. Among female patients (n = 45), 24 patients (53.3%) had mild disease, 11 patients (24.4%) had moderate disease, and 10 patients (22.2%) had severe osteoarthritis. No statistically significant association was found between gender and severity of knee osteoarthritis the p-value was 0.41.

Conclusion: Increased Body Mass Index is significantly associated with greater severity of knee osteoarthritis. Weight reduction may play an important role in preventing progression and improving clinical outcomes in knee osteoarthritis patients.

Keywords: Knee Osteoarthritis, Body Mass Index, Kellgren–Lawrence Grade, Obesity, Cross-Sectional Study, Joint Degeneration.

INTRODUCTION

Knee osteoarthritis is one of the most prevalent musculoskeletal disorders and a leading cause of chronic pain and disability worldwide, particularly among the elderly population.

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It is characterized by progressive degeneration of articular cartilage, subchondral bone remodeling, osteophyte formation, and synovial inflammation, ultimately resulting in joint space narrowing and functional impairment [1]. The burden of knee osteoarthritis is increasing globally due to aging populations, sedentary lifestyles, and rising obesity rates, making it a major public health concern [2].

Among the various risk factors associated with knee osteoarthritis, obesity has been consistently identified as one of the most important modifiable determinants. Body Mass Index is widely used as a simple and reliable indicator of obesity. Increased Body Mass Index not only contributes to excessive mechanical load on weight-bearing joints such as the

knee but also has systemic metabolic effects that promote inflammatory pathways involved in cartilage degradation [3]. It is estimated that each additional kilogram of body weight increases the load on the knee joint by approximately three to six times during daily activities such as walking and climbing stairs [4].

The pathophysiology linking obesity and knee osteoarthritis is complex and involves both biomechanical and biochemical mechanisms. Excess body weight leads to increased joint stress, accelerating cartilage wear and tear. In addition, adipose tissue acts as an active endocrine organ secreting adipokines such as leptin, resistin, and adiponectin, which contribute to low-grade systemic inflammation and cartilage breakdown [5]. These inflammatory mediators play a significant role in the progression of osteoarthritis, independent of mechanical loading, thereby explaining the higher severity of osteoarthritis observed in obese individuals [6].

Several epidemiological studies have demonstrated a strong association between elevated Body Mass Index and increased risk of knee osteoarthritis. Felson et al. reported that obesity is one of the strongest risk factors for knee osteoarthritis, with obese individuals having nearly four times higher risk compared to those with normal Body Mass Index [7]. Similarly, a population-based study by Nguyen et al. highlighted a dose–response relationship between Body Mass Index and radiographic severity of knee osteoarthritis, suggesting that even modest weight gain can significantly increase disease risk [8].

In developing countries, including India, the dual burden of malnutrition and obesity is becoming increasingly evident. Urbanization, dietary changes, and reduced physical activity have contributed to a rising prevalence of overweight and obesity, which in turn is expected to increase the burden of osteoarthritis in the coming decades [9]. Despite this, awareness regarding the impact of Body Mass Index on joint health remains limited among patients, and weight management is often underemphasized in routine clinical practice.

Radiographic assessment using the Kellgren–Lawrence grading system remains the most widely accepted method for evaluating the severity of knee osteoarthritis. It classifies osteoarthritis into five grades based on joint space narrowing, osteophyte formation, and subchondral sclerosis, providing an objective measure of disease progression [10]. Correlating Body Mass Index with radiological severity helps in understanding the extent to which obesity influences structural joint damage.

The aim of this study is to evaluate the correlation between Body Mass Index and severity of knee osteoarthritis in patients attending the outpatient department. Knee osteoarthritis is a progressive degenerative joint disease, and obesity, as assessed by Body Mass Index, is considered a major modifiable risk factor that may influence both the development and progression of the disease. This study seeks to understand whether an increase in Body Mass Index is associated with greater radiological severity of knee osteoarthritis, thereby highlighting the role of body weight in disease progression.The primary objective of this study is to assess the relationship between Body Mass Index and severity of knee osteoarthritis as determined by the Kellgren–Lawrence grading system. The secondary objective is to categorize patients according to Body Mass Index and compare the distribution of osteoarthritis severity across different Body Mass Index groups. Additionally, the study aims to emphasize the importance of weight management as a preventive and therapeutic strategy in reducing the burden and progression of knee osteoarthritis.

MATERIALS AND METHODS

Study Design: This study is designed as a hospital-based cross-sectional observational study to evaluate the correlation between Body Mass Index and severity of knee osteoarthritis.

Study Place: The study will be conducted in the Department of Orthopaedics, College of Medicine and JNM Hospital, Kalyani, Nadia, West Bengal.

Study Duration: 1 year

Study Population: The study population will include patients diagnosed with knee osteoarthritis attending the outpatient department, who fulfill the inclusion criteria during the study period.

Sample Size: A total of 100 patients diagnosed with knee osteoarthritis.

Study variables:

- Body Mass Index Category
- Age Group (years)
- Gender
- Body Mass Index and Pain Severity (VAS Score Groups)
- Body Mass Index and Functional Disability (WOMAC Categories)

Inclusion Criteria:

Patients aged 40 years and above of either gender, clinically and radiologically diagnosed with knee osteoarthritis based on Kellgren–Lawrence grading, and willing to participate in the study after providing informed consent will be included.

Exclusion Criteria:

Patients with a history of previous knee surgery, inflammatory arthritis (such as rheumatoid arthritis, gout, or septic arthritis), traumatic knee injury, congenital or developmental knee deformities, and those unwilling to participate in the study will be excluded.

Data Collection: Data for the study on “Correlation between Body Mass Index and Severity of Knee

Osteoarthritis: A Cross-Sectional Study" will be collected from patients attending the Orthopaedics outpatient department and/or inpatient wards diagnosed with knee osteoarthritis based on clinical evaluation and radiological criteria. After obtaining informed consent, demographic details including age, sex, occupation, and comorbidities will be recorded using a structured proforma. Body Mass Index will be calculated for each participant using measured weight in kilograms divided by height in meters squared (kg/m²), recorded using standardized weighing scale and stadiometer. The severity of knee osteoarthritis will be assessed clinically and radiologically using a validated grading system such as the Kellgren–Lawrence scale based on knee X-rays. All data will be systematically documented, coded, and entered into a master sheet for statistical analysis to evaluate the correlation between Body Mass Index and severity of knee osteoarthritis.

Statistical Analysis: For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. Paired t-tests were a form of blocking and had greater power than unpaired tests. A chi-squared test ($\chi 2$ test) was any statistical hypothesis test wherein the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true. Without other qualification, 'chi-squared test' often is used as short for Pearson's chi-squared test. Unpaired proportions were compared by Chi-square test or Fischer's exact test, as appropriate.

Explicit expressions that can be used to carry out various t-tests are given below. In each case, the formula for a test statistic that either exactly follows or closely approximates a t-distribution under the null hypothesis is given. Also, the appropriate degrees of freedom are given in each case. Each of these statistics can be used to carry out either a one-tailed test or a two-tailed test.

Once a t value is determined, a p-value can be found using a table of values from Student's t-distribution .If the calculated p-value is below the threshold chosen for statistical significance (usually the 0.10, the 0.05, or 0.01 level), then the null hypothesis is rejected in favour of the alternative hypothesis.

P-value $\leq$ 0.05 was considered for statistically significant.

RESULT

Table 1: Association between Body Mass Index and Kellgren–Lawrence (K–L) Grade of Knee Osteoarthritis (n = 100)

Body Mass Index Category	Grade I n (%)	Grade II n (%)	Grade III n (%)	Grade IV n (%)	Total	P VALUE
Normal (18.5–24.9)	10 (33.3%)	12 (40.0%)	6 (20.0%)	2 (6.7%)	30	<0.001
Overweight (25–29.9)	5 (12.5%)	15 (37.5%)	10 (25.0%)	10 (25.0%)	40	
Obese (≥30)	2 (6.7%)	8 (26.7%)	10 (33.3%)	10 (33.3%)	30	
Total	17	35	26	22	100	

Table 2: Association between Age Group and Severity of Knee Osteoarthritis (n = 100)

Age Group (years)	Mild n (%)	Moderate n (%)	Severe n (%)	Total	P VALUE
40–50	18 (72.0%)	5 (20.0%)	2 (8.0%)	25	0.02
51–60	20 (50.0%)	12 (30.0%)	8 (20.0%)	40	
61–70	14 (40.0%)	9 (25.7%)	12 (34.3%)	35	
Total	52	26	22	100	

Table 3: Association between Gender and Severity of Knee Osteoarthritis (n = 100)

Gender	Mild n (%)	Moderate n (%)	Severe n (%)	Total	P VALUE
Male	28 (50.9%)	15 (27.3%)	12 (21.8%)	55	**0.41**
Female	24 (53.3%)	11 (24.4%)	10 (22.2%)	45	
Total	52	26	22	100	

Table 4: Association between Body Mass Index and Pain Severity (VAS Score Groups) (n = 100)

Body Mass Index Category	Mild Pain n (%)	Moderate Pain n (%)	Severe Pain n (%)	Total	P VALUE
Normal	14 (46.7%)	12 (40.0%)	4 (13.3%)	30	**<0.001**
Overweight	8 (20.0%)	18 (45.0%)	14 (35.0%)	40	
Obese	3 (10.0%)	10 (33.3%)	17 (56.7%)	30	
Total	25	40	35	100	

Table 5: Association between Body Mass Index and Functional Disability (WOMAC Categories) (n = 100)

Body Mass Index Category	Mild Disability n (%)	Moderate Disability n (%)	Severe Disability n (%)	Total	P VALUE
Normal	16 (53.3%)	10 (33.3%)	4 (13.3%)	30	**<0.001**
Overweight	10 (25.0%)	18 (45.0%)	12 (30.0%)	40	
Obese	4 (13.3%)	12 (40.0%)	14 (46.7%)	30	
Total	30	40	30	100	

Table 6: Pearson Correlation between Body Mass Index (Body Mass Index) and Severity of Knee Osteoarthritis

Variables	Number of Patients (N)	Pearson Correlation (r)	p-value
Body Mass Index vs Severity of Knee Osteoarthritis (Kellgren–Lawrence Grade)	100	0.64	<0.001

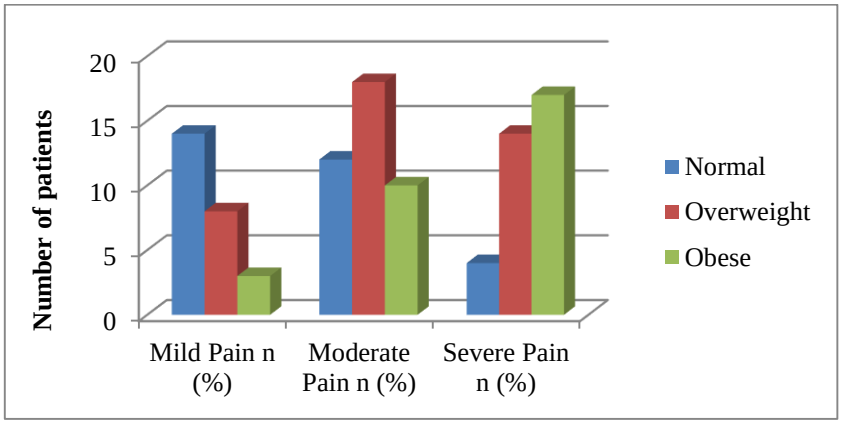

Figure: Association between Body Mass Index and Pain Severity (VAS Score Groups) (n = 100)

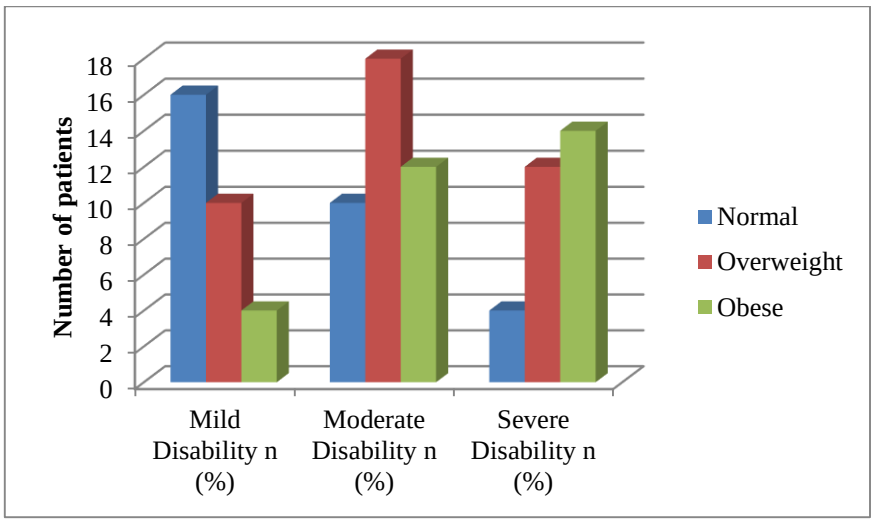

Figure: Association between Body Mass Index and Functional Disability (WOMAC Categories) (n = 100)

In the present study, a total of 100 patients with knee osteoarthritis were evaluated to assess the association between Body Mass Index and severity of disease as per Kellgren–Lawrence grading. Among patients with normal Body Mass Index (n = 30), 10 patients (33.3%) had Grade I osteoarthritis, 12 patients (40.0%) had Grade II, 6 patients (20.0%) had Grade III, and 2 patients (6.7%) had Grade IV. In the overweight group (n = 40), 5 patients (12.5%) patients had Grade I, 15 patients (37.5%) had Grade II, 10 patients (25.0%) had Grade III, and 10 patients (25.0%) had Grade IV osteoarthritis. Among obese patients (n = 30), 2 patients (6.7%) had Grade I, 8 patients (26.7%) had Grade II, 10 patients (33.3%) had Grade III, and 10 patients (33.3%) had Grade IV osteoarthritis. This association between Body Mass Index category and radiological severity of knee osteoarthritis was found to be statistically highly significant with a p-value of <0.001**.**

In the present study, a total of 100 patients with knee osteoarthritis were assessed to evaluate the association between age and severity of disease. Among patients aged 40–50 years (n = 25), 18 patients (72.0%) had mild osteoarthritis, 5 patients (20.0%) had moderate disease, and 2 patients (8.0%) had severe osteoarthritis. In the 51–60 years age group (n = 40), 20 patients (50.0%) patients had mild disease, 12 patients (30.0%) had moderate disease, and 8 patients (20.0%) had severe osteoarthritis. Among patients aged 61–70 years (n = 35), 14 patients (40.0%) had mild osteoarthritis, 9 patients (25.7%) had moderate disease, and 12 patients (34.3%) had severe osteoarthritis. This association between age group and severity of knee osteoarthritis was found to be statistically significant with a p-value of 0.02.

In the present study, a total of 100 patients with knee osteoarthritis were analyzed to determine the association between gender and severity of disease. Among male patients (n = 55), 28 patients (50.9%) had mild osteoarthritis, 15 patients (27.3%) had moderate disease, and 12 patients (21.8%) had severe osteoarthritis. Among female patients (n = 45), 24 patients (53.3%) had mild disease, 11 patients (24.4%) had moderate disease, and 10 patients (22.2%) had severe osteoarthritis . No statistically significant association was found between gender and severity of knee osteoarthritis The p-value was 0.41 .

In the present study, a total of 100 patients with knee osteoarthritis were evaluated to assess the association between Body Mass Index and pain severity measured by Visual Analogue Scale (VAS). Among patients with normal Body Mass Index (n = 30), 14 (46.7%) reported mild pain, 12 patients (40.0%) reported moderate pain, and 4 patients (13.3%) reported severe pain. In the overweight group (n = 40), 8 patients (20.0%) patients had mild pain, 18 patients (45.0%) had moderate pain, and 14 patients (35.0%) had severe pain. Among obese patients (n = 30), 3 patients (10.0%) reported mild pain, 10 patients (33.3%) reported moderate pain, and 17 patients (56.7%) reported severe pain. This association between Body Mass Index category and pain severity was found to be statistically highly significant with a p-value of <0.001.

In the present study, a total of 100 patients with knee osteoarthritis were assessed to evaluate the association between Body Mass Index and functional disability. Among patients with normal Body Mass Index (n = 30), 16 patients (53.3%) had mild disability, 10 patients (33.3%) had moderate disability, and 4 patients (13.3%) had severe disability. In the overweight group (n = 40), 10 patients (25.0%) patients had mild disability, 18 patients (45.0%) had moderate disability, and 12 patients (30.0%) had severe disability. Among obese patients (n = 30), 4 patients (13.3%) had mild disability, 12 patients (40.0%) had moderate disability, and 14 patients (46.7%) had severe disability. This association between Body Mass Index category and severity of functional disability was found to be statistically highly significant with a p-value of <0.001.

In the present study, Pearson correlation analysis was performed to evaluate the relationship between Body Mass Index and severity of knee osteoarthritis assessed using the Kellgren–Lawrence grading system among 100 patients. A significant positive correlation was observed between Body Mass Index and severity of knee osteoarthritis ($r = 0.64$, $p < 0.001$), indicating that patients with higher Body Mass Index had greater severity of osteoarthritic changes in the knee joint.

DISCUSSION

The present study demonstrated that higher Body Mass Index was significantly associated with more advanced radiological grades of knee osteoarthritis. Pearson correlation analysis showed a significant positive correlation between Body Mass Index and severity of knee osteoarthritis assessed using the Kellgren–Lawrence grading system among 100 patients ($r = 0.64$, $p < 0.001$), indicating that patients with higher Body Mass Index had greater severity of osteoarthritic changes in the knee joint. Similar findings were reported by Kokkotis C et al. [11], who identified obesity as one of the strongest modifiable risk factors for knee osteoarthritis progression. Likewise, Shumnalieva R et al. [12] in a systematic review concluded that overweight and obesity significantly increase both the incidence and severity of knee osteoarthritis. In addition, Chen L and Jordan JM [13] explained that increased mechanical loading due to excess body weight accelerates cartilage degeneration and joint space narrowing.

Age was also found to be significantly associated with severity of knee osteoarthritis in the present study ($p = 0.02$), with increasing severity observed

in older age groups. This finding is consistent with Motta F [14], who described osteoarthritis as a progressive degenerative joint disease strongly associated with aging. Similarly, ur Rehman S et al. [15] reported that prevalence and severity of osteoarthritis increase with age due to cumulative joint stress and reduced cartilage repair capacity.

In contrast, gender did not show a statistically significant association with severity of knee osteoarthritis ($p = 0.41$). This is supported by Peshkova M et al. [16], who reported that although osteoarthritis is more common in females, severity differences between males and females are not statistically significant in many populations. Similar observations were also reported by Segal NA et al. [7].

Pain severity measured by VAS score showed a significant increase with increasing Body Mass Index in the present study ($p < 0.001$). This is in agreement with Binvignat M [18], who explained that excessive mechanical stress along with inflammatory mediators from adipose tissue contributes to joint pain. Furthermore, Wood MJ et al. [19] highlighted that inflammation and structural damage are major contributors to pain severity in osteoarthritis patients.

Functional disability was also significantly associated with Body Mass Index ($p < 0.001$), with obese patients showing greater impairment in daily activities. Similar findings were reported by Tong B et al. [20], who demonstrated that obesity significantly worsens physical function and quality of life in patients with knee osteoarthritis. And Cahyadi IK et al. (2026), which reported that higher BMI was significantly associated with increased functional limitation in patients with knee osteoarthritis, as measured by the WOMAC functional scale. The study concluded that excess body weight contributes to increased mechanical load on the knee joint, leading to reduced mobility and greater difficulty in performing routine activities such as walking, climbing stairs, and standing for prolonged periods.

CONCLUSION

The present study demonstrated a significant positive correlation between Body Mass Index and severity of knee osteoarthritis, indicating that increased Body Mass Index is associated with more advanced radiological changes, greater pain severity, and increased functional disability. Age was also significantly associated with disease severity, whereas gender showed no significant relationship. These findings suggest that obesity is an important modifiable risk factor in the progression of knee osteoarthritis. Early identification and management of overweight and obesity through lifestyle modification, weight reduction, and preventive strategies may help reduce disease progression, improve functional outcomes, and enhance quality of life in patients with knee osteoarthritis.

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