

Association Between Obesity and Severe Knee Osteoarthritis

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Received: 01 May 2026; Accepted: 17 June 2026; Available online: 10 July, 2026

ABSTRACT

Background: Knee osteoarthritis is a common degenerative joint disease that causes pain, functional limitation, and reduced quality of life, especially among adults and older individuals. Obesity is an important modifiable risk factor that may contribute to disease progression and structural joint damage. This study aimed to evaluate the association between obesity and severe knee osteoarthritis based on the Kellgren–Lawrence classification.

Subject and Methods: This analytical observational study used a cross-sectional design and secondary data from medical records of patients diagnosed with knee osteoarthritis at PKU Muhammadiyah Bantul Hospital from November 2024 to November 2025. A total of 104 eligible patients were selected using total sampling. Osteoarthritis severity was classified as mild (Kellgren–Lawrence grades 1–2) or severe (grades 3–4). The independent variables were age, sex, and obesity status, while the dependent variable was knee osteoarthritis severity. Data were analyzed using the Independent t-test and Chi-square test, with statistical significance set at $p < 0.05$.

Results: The mean age of participants was 58.59 ± 11.03 years, and 75.0% were female. Obesity was found in 72.1% of participants, while severe knee osteoarthritis was identified in 33.7%. Patients with severe osteoarthritis were significantly older than those with mild osteoarthritis (61.69 ± 9.25 vs. 57.01 ± 11.58 years; $p = 0.041$). Obesity was significantly associated with severe knee osteoarthritis ($p = 0.028$), with obese patients having 3.20 times higher odds of severe disease than non-obese patients (95% CI: 1.10–9.32). Sex was not significantly associated with severity ($p = 0.281$).

Conclusion: Obesity and older age were significantly associated with severe knee osteoarthritis, while sex was not. Weight management may help reduce the risk of disease progression.

Keywords: Age Factors; Knee Osteoarthritis; Obesity; Radiographic Severity; Risk Factors.

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Cite this as:

Prisila E, Ramadhani SC, Pratama RA, Oktaviana AW (2026). Association Between Obesity and Severe Knee Osteoarthritis. Indones J Med. 11(03): 176-186. <https://doi.org/10.26911/theijmed.2026.957>



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BACKGROUND

Knee osteoarthritis (OA) is one of the most common degenerative joint diseases. It is a leading cause of pain, limited physical activity, and reduced quality of life in adults

and the elderly. OA is characterized by progressive damage to articular cartilage. This cartilage damage, along with remodeling of the subchondral bone, formation of osteophytes, and changes in the synovial

membrane, together cause impaired joint function (Hunter & Bierma-Zeinstra, 2019; Kraus et al., 2015). As life expectancy rises and lifestyles change, the burden of knee osteoarthritis continues to increase and has become a significant public health issue in many countries (Elmajee et al., 2025).

Globally, osteoarthritis is one of the leading causes of musculoskeletal disability. Recent epidemiological studies show that knee osteoarthritis is becoming more common, with prevalence and incidence rising over the past few decades. This increase is largely due to several factors, most notably an aging population and rising obesity rates. Advanced age and obesity have been reported by Cui et al. as the most consistent risk factors, directly contributing to both the onset and progression of knee osteoarthritis across different populations (Cui et al., 2020). In Indonesia, osteoarthritis is also one of the degenerative diseases most commonly encountered in primary care settings and hospitals, particularly among the elderly (Vina & Kwoh, 2018).

The severity of knee osteoarthritis (OA) is generally assessed using the Kellgren–Lawrence (KL) classification based on radiographic findings. This classification system evaluates the presence of osteophytes, joint space narrowing, subchondral bone sclerosis, and bone deformities. Therefore, identifying factors associated with severe knee OA is crucial to preventing and controlling disease progression (Kohn et al., 2016).

Several factors contribute to the development and progression of knee osteoarthritis (OA), including age, gender, obesity, genetics, prior joint trauma, physical activity, and occupation. Obesity is a modifiable risk factor. As obesity rates rise globally, it increasingly contributes to the burden of knee OA. Understanding the

impact of obesity on knee OA severity is crucial for prevention and management (Cui et al., 2020; Shumnalieva et al., 2023).

The link between obesity and knee osteoarthritis (OA) extends beyond increased mechanical stress. On one hand, excess body weight increases compressive stress during activities such as walking, standing, and climbing stairs, thereby accelerating cartilage damage and subchondral bone changes. On the other hand, recent research shows that adipose tissue acts as an endocrine organ, producing inflammatory mediators and adipokines, such as leptin, resistin, and adiponectin. As a result, these compounds contribute to chronic inflammation and further accelerate cartilage degradation and the progression of osteoarthritis (Chen et al., 2020; Shumnalieva et al., 2023).

Previous studies have shown a link between obesity and knee osteoarthritis severity. Specifically, Shumnalieva et al. found that obesity contributes to progression through biomechanical and systemic inflammatory mechanisms (Shumnalieva et al., 2023). The study by Hao et al. also showed that obesity is associated with more severe knee osteoarthritis, as assessed by radiographic evaluation (Hao et al., 2024). In Indonesia, a study by Mutiwara et al. found a significant association between body mass index and the degree of joint damage in patients with knee osteoarthritis, with patients in the obese category more likely to experience more severe joint damage (Mutiwara et al., 2016).

SUBJECTS AND METHOD

1. Study Design

This analytical observational study employed a cross-sectional design to evaluate the association between obesity and the severity of knee osteoarthritis. The study was conducted at PKU Muhammadiyah

Bantul Hospital using secondary data obtained from medical records and radiographic examination results of patients diagnosed with knee osteoarthritis between November 2024 and November 2025.

2. Population and Sample

A total of 104 patients fulfilled the eligibility criteria and were included in the final analysis. A total sampling technique was applied because this study used retrospective secondary data from medical records, and all eligible patients within the study period were included. Therefore, an a priori sample size calculation was not conducted. The final sample consisted of 104 patients, including 35 patients with severe knee osteoarthritis. The available sample was able to detect a statistically significant association between obesity and severe knee osteoarthritis. However, the confidence interval of the estimated odds ratio was relatively wide, indicating limited precision. Thus, while the sample was considered sufficient to identify the observed association, the study may have had limited statistical power to detect smaller effects.

3. Study Variables

This part consists of dependent and independent variables under study. The dependent variable was the severity of knee osteoarthritis based on the Kellgren–Lawrence classification. The independent variables were age, sex, and obesity status.

4. Operational Definition of Variables

Knee osteoarthritis severity was assessed using the Kellgren–Lawrence (KL) grading system and categorized into:

- Mild osteoarthritis (KL grades 1–2)
- Severe osteoarthritis (KL grades 3–4)

Age was measured in years and analyzed both as a continuous variable and as a categorical variable (<60 years and ≥60 years). Sex was classified as male or female. Obesity status was determined using body

mass index (BMI), calculated as weight in kilograms divided by height in meters squared (kg/m^2). According to the Asia-Pacific classification, BMI $\geq 25 \text{ kg/m}^2$ was categorized as obese, while BMI $< 25 \text{ kg/m}^2$ was categorized as non-obese.

5. Study Instruments

Data were collected from patients' medical records using a structured data extraction form. The collected variables included age, sex, body weight, height, BMI, obesity status, and Kellgren–Lawrence grading results. Data on age, sex, body weight, and height were obtained from medical records. Body mass index was calculated from recorded weight and height measurements. Data on osteoarthritis severity were obtained from radiographic examination reports using the Kellgren–Lawrence classification system, which had been assessed by clinicians according to standard radiological criteria.

6. Data analysis

Descriptive analysis was conducted to summarize participant characteristics. Categorical variables were presented as frequencies and percentages, whereas continuous variables were presented as means and standard deviations. Differences in mean age between patients with severe and mild osteoarthritis were analyzed using the independent t-test. Associations between categorical variables, including sex and obesity status, and osteoarthritis severity were analyzed using the Chi-square test. Odds ratios (OR) and 95% confidence intervals (95% CI) were calculated to estimate the strength of association in bivariate analysis.

To adjust for potential confounding effects, multivariable logistic regression analysis was performed. Severe knee osteoarthritis was used as the dependent variable, categorized as mild osteoarthritis for Kellgren–Lawrence grades 1–2 and

severe osteoarthritis for Kellgren–Lawrence grades 3–4. Obesity status, age category, and sex were included as independent variables in the initial model. Variables retained in the final model were reported as adjusted odds ratios (AOR) with 95% confidence intervals. A p-value of less than 0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS Statistics version 26.

7. Research Ethics

Research ethical issues including confidentiality, anonymity, and privacy protection were carefully addressed throughout the study. Since the study utilized anonymized secondary medical record data, no direct patient contact was involved. Ethical approval was obtained from the Research Ethics Committee of Universitas Ahmad Dahlan, Yogyakarta, Indonesia, with ethical clearance number REC-UAD/01/01/11-2025/436.

RESULTS

1. Sample Characteristics

A total of 104 patients with knee osteoarthritis who met the inclusion criteria were included in this study. The demographic and clinical characteristics of the participants are presented in Table 1. The mean age of the participants was 58.59 ± 11.03 years, ranging from 29 to 87 years. Most participants were younger than 60 years (56.7%), while 43.3% were aged 60 years or older. Female patients constituted the majority of the study population (75.0%). Regarding obesity status, 72.1% of participants were classified as obese, whereas 27.9% were non-obese. Based on the Kellgren–Lawrence classification, 66.3% of participants had mild knee osteoarthritis (KL grades 1–2), while 33.7% had severe knee osteoarthritis (KL grades 3–4) (Table 1).

Table 1. Characteristics of Study Participants (N= 104)

Characteristic	Value
Age (years), mean ± SD	58.59 ± 11.03
Age group, n (%)	
<60 years	59 (56.7)
≥60 years	45 (43.3)
Sex, n (%)	
Female	78 (75.0)
Male	26 (25.0)
Obesity status, n (%)	
Obese	75 (72.1)
Non-obese	29 (27.9)
Knee osteoarthritis severity (KL grade), n (%)	
Mild (Grade 1–2)	69 (66.3)
Severe (Grade 3–4)	35 (33.7)

KL = Kellgren–Lawrence classification

The study population was predominantly female and obese, reflecting the demographic profile commonly observed among

patients with knee osteoarthritis. The average age of approximately 59 years indicates that knee osteoarthritis primarily

affected middle-aged and older adults in this cohort. Furthermore, nearly one-third of the participants were classified as having severe knee osteoarthritis according to the Kellgren–Lawrence grading system, suggesting a considerable burden of advanced structural joint degeneration within the study population. These findings highlight the importance of evaluating demographic and anthropometric factors,

particularly age and obesity, in relation to the severity of knee osteoarthritis.

2. Bivariate Analysis

Bivariate analyses assessed factors associated with knee osteoarthritis severity by comparing demographic and clinical characteristics. Age was evaluated using the independent t-test, and sex and obesity status using the Chi-square test. Table 2 presents the results.

Table 2. Bivariate Analysis of Factors Associated with Severe Knee Osteoarthritis

Variable	Severe OA		Mild OA		OR (95% CI)	p-value
	n	%	n	%		
Age (years)	61.69 ± 9.25		57.01 ± 11.58		-	0.041*
Sex						
Female	24	30.8	54	69.2	0.61 (0.24-1.51)	0.281
Male	11	42.3	15	57.7		
Obesity Status						
Obese	30	40	45	60	3.20 (1.10–9.32)	0.028*
Non-obese	5	17.2	24	82.8		

*Significant at $p < 0.05$.

As shown in Table 2, patients with severe knee osteoarthritis were significantly older than those with mild disease (61.69 ± 9.25 vs. 57.01 ± 11.58 years, $p = 0.041$). This finding suggests that increasing age may contribute to the progression of structural joint degeneration in knee osteoarthritis. No significant association was observed between sex and osteoarthritis severity ($p = 0.281$). Although female patients constituted the majority of the study population, the proportion of severe osteoarthritis did not differ significantly between males and females. The odds ratio also showed no statistically significant association between female sex and severe knee osteoarthritis (OR = 0.61; 95% CI: 0.24–1.51).

In contrast, obesity was significantly associated with severe knee osteoarthritis ($p = 0.028$). The proportion of severe osteoarthritis was higher among obese patients than among non-obese patients (40.0% vs. 17.2%). Obese individuals had 3.20 times higher odds of having severe knee osteoarthritis compared with non-obese individuals (OR = 3.20; 95% CI: 1.10 to 9.32). This finding highlights the potential role of obesity as an important factor associated with increased structural severity of knee osteoarthritis. Overall, the findings indicate that older age and obesity were significantly associated with severe knee osteoarthritis, whereas sex was not significantly associated with disease severity in this study population.

3. Multivariable Analysis

Multivariable logistic regression analysis was conducted to determine independent factors associated with severe knee osteoarthritis after adjustment for potential

confounders. Obesity status, age category, and sex were entered into the initial model. Table 3 shows the final model of factors associated with severe knee osteoarthritis.

Table 3. Multivariable logistic regression analysis of factors associated with severe knee osteoarthritis

Variable	aOR	95% CI	p-value
Obesity Status			
Obese	4.423	1.417–13.802	0.010*
Non-obese	Ref.	Ref.	Ref.
Age			
≥60 years	0.362	0.147–0.888	0.026*
<60 years	Ref.	Ref.	Ref.

*Significant at $p < 0.05$.

Multivariable logistic regression analysis showed that obesity and age category were independently associated with severe knee osteoarthritis. Patients with obesity had significantly higher odds of severe knee osteoarthritis than non-obese patients after adjustment for age category (aOR = 4.42; 95% CI = 1.42 to 13.80; $p = 0.010$). Patients aged ≥ 60 years had lower odds of severe knee osteoarthritis compared with those aged < 60 years (aOR = 0.36; 95% CI = 0.15 to 0.89; $p = 0.026$).

DISCUSSION

Knee osteoarthritis (OA) is a degenerative joint disease that is one of the leading causes of chronic pain, functional limitations, disability, and reduced quality of life in the adult and elderly populations (Elmajee et al., 2025; Kolasinski et al., 2020). In addition to imposing a significant clinical burden, OA also contributes to increased health care demand and reduced productivity in the population (Hunter & Bierma-Zeinstra, 2019; Steinmetz et al., 2023). The severity of OA is influenced by various factors, both modifiable and non-modifiable. This study found that age and

obesity were significantly associated with severe knee OA according to the Kellgren–Lawrence classification, whereas gender was not.

The study found that the mean age in the severe OA group was higher than in the mild OA group (61.69 ± 9.25 years vs. 57.01 ± 11.58 years; $p = 0.041$). These findings indicate that advancing age is associated with an increased severity of knee osteoarthritis. With advancing age, various biological changes occur in the joints, including decreased chondrocyte regenerative capacity, reduced extracellular matrix synthesis, increased oxidative stress, and changes in subchondral bone that contribute to the progressive nature of joint damage (Elmajee et al., 2025).

These findings are consistent with previous studies indicating that age is a major risk factor for knee osteoarthritis. A systematic review by Cui et al. (2023) reported that advancing age is consistently associated with the incidence and progression of knee osteoarthritis (Hao et al., 2024). In addition, epidemiological studies show that both the prevalence and severity of OA increase significantly in the

elderly due to the accumulation of long-term degenerative processes (Elmajee et al., 2025).

In addition to biological changes in cartilage, aging also leads to a decline in periarticular muscle function and biomechanical changes in the joint, which can accelerate the progression of knee osteoarthritis (OA). Aging is associated with a decrease in muscle mass and strength, particularly in the quadriceps femoris muscle, which plays a crucial role in maintaining knee joint stability. This muscle weakness can increase the load on the articular cartilage, thereby accelerating structural joint damage.

Research by Sharma et al. indicates that reduced muscle strength and impaired physical function in the elderly contribute to the progression of knee osteoarthritis and worsening radiographic damage. Additionally, Loeser (2017) explains that the aging process affects not only the cartilage but also other joint tissues, including the synovial membrane, ligaments, and subchondral bone, which collectively contribute to the development of knee osteoarthritis (OA) (Leena, 2021; Loeser, 2009).

The findings of this study are also consistent with recent observational studies and meta-analyses, which indicate that advanced age is associated with an increased risk of severe knee osteoarthritis (OA) according to the Kellgren–Lawrence classification. A study by Kohn et al. (2016) reported that the prevalence of knee OA increases significantly after age 50 and continues to rise with advancing age (Kohn et al., 2016).

Similar findings were reported in a study by Vina and Kwoh (2018), which stated that aging is the most important non-modifiable risk factor in the development of OA because it is associated

with the accumulation of joint tissue damage over a lifetime (Vina & Kwoh, 2018). Thus, the findings of this study further strengthen the evidence that age is a key factor in the progression of knee osteoarthritis and should be taken into account in efforts to detect the condition early and prevent its progression in the elderly population.

In this study, obesity was found to be significantly associated with severe knee osteoarthritis ($p=0.028$). Obese patients were approximately 3.2 times more likely to develop severe knee osteoarthritis than non-obese patients (OR=3.20; 95% CI=1.10–9.32). These results indicate that obesity is a key factor in the increased severity of knee OA in the study population. The association between obesity and knee OA can be explained through biomechanical mechanisms (Shumnalieva et al., 2023). Weight gain increases compressive stress on the knee joints during daily activities such as walking, standing, and going up and down stairs (Chen et al., 2020). Excessive mechanical stress over the long term can accelerate the degradation of articular cartilage, increase subchondral bone remodeling, and promote the formation of osteophytes, ultimately increasing the severity of OA according to the Kellgren–Lawrence radiographic classification.

In addition to biomechanical factors, recent research indicates that obesity also plays a role through metabolic and systemic inflammatory mechanisms (Wei et al., 2023). Adipose tissue produces various adipokines, such as leptin, resistin, and adiponectin, which can affect cartilage metabolism and exacerbate joint inflammation. Leptin, in particular, has been linked to increased cartilage degradation and the progression of knee osteoarthritis (OA). Therefore, obesity is no longer viewed

merely as a factor that increases mechanical stress, but also as a chronic inflammatory condition that contributes to OA development (Altowijri et al., 2023; Hao et al., 2024).

The findings of this study are consistent with various international studies reporting that obesity is one of the strongest risk factors for knee osteoarthritis. A systematic review by Cui et al. (2023) identified obesity as a risk factor consistently associated with the incidence and progression of knee osteoarthritis across various populations (Cui et al., 2020). In addition, Shumnalieva et al. (2023) explain that obesity contributes to the increased severity of knee osteoarthritis through a combination of biomechanical and systemic inflammatory mechanisms (Shumnalieva et al., 2023). Similar findings were also reported by Hao et al. (2024), who demonstrated that obesity is associated with more severe knee osteoarthritis based on radiological evaluation (Hao et al., 2024).

The findings of this study are also consistent with those of Mutiwara et al., who demonstrated a significant association between body mass index and the degree of joint damage in patients with knee osteoarthritis ($p=0.003$). In that study, 88.9% of patients classified as obese had severe osteoarthritis according to the Kellgren–Lawrence classification. These results indicate that weight gain is associated with worsening structural damage to the knee joint, as indicated by an increase in the radiographic severity score (Mutiwara et al., 2016). In addition, a cohort study by Zheng et al. (2021) found that higher body mass index was significantly associated with faster joint space narrowing and progression of radiographic changes in patients with knee osteoarthritis. These findings further

reinforce the role of obesity in the deterioration of knee joint structure over time (Zheng & Chen, 2015).

From a clinical perspective, this study's results indicate that weight control is a key strategy for preventing the progression of knee osteoarthritis (OA). The latest recommendations from the European League Against Rheumatism (EULAR) identify weight management as a core component of non-pharmacological treatment for knee OA, particularly in patients who are overweight or obese.

Weight loss has been shown to reduce mechanical stress on the knee joint, improve physical function, and alleviate pain in OA patients. Therefore, interventions such as lifestyle modifications, increased physical activity, and education on weight management should be an integral part of the management of patients with knee OA to prevent progression to more severe stages (Lim et al., 2022; Moseng et al., 2024).

Unlike age and obesity, this study found no significant association between gender and the severity of knee osteoarthritis ($p=0.281$). Although the majority of study participants were women (75%), the proportion of severe knee osteoarthritis did not differ significantly between men and women. These results suggest that gender may not play a direct role in the severity of knee osteoarthritis in this study population.

These findings differ slightly from some studies that report a higher prevalence of knee osteoarthritis (OA) in women, particularly after menopause (Lee, 2024). Declining estrogen levels are known to affect cartilage metabolism and increase the risk of joint degeneration. However, some recent studies suggest that, after accounting for other factors such as age and obesity, the association between gender and

the severity of OA becomes less consistent (Szilagyi et al., 2023). Thus, age and obesity likely have a greater impact on the progression of knee osteoarthritis than gender alone.

This study has several limitations. The cross-sectional design does not allow researchers to determine a causal relationship between obesity and severe knee osteoarthritis. Furthermore, this study did not evaluate other factors known to be associated with OA, such as physical activity, history of knee injury, occupation, or other metabolic diseases. Nevertheless, using the Kellgren–Lawrence classification as the basis for determining OA severity provides an objective radiological assessment, thereby supporting the validity of the study results.

Overall, this study indicates that older age and obesity are associated with increased severity of knee osteoarthritis, whereas gender is not significantly associated with the degree of osteoarthritis. These findings underscore the importance of weight management as a key strategy in efforts to prevent the progression of knee osteoarthritis and reduce the disease burden in the adult and elderly populations (Lawford et al., 2024; Lim et al., 2022; Moseng et al., 2024).

AUTHORS CONTRIBUTION:

EP contributed to the formulation of the research concept, development of the background, preparation of the research methodology, data collection, data analysis, and manuscript drafting. **SCR** contributed to the preparation of the research methodology, data collection, and manuscript writing. **RAP** contributed the preparation of the research methodology and data collection. **AWO** contributed to data analysis, finalization of the manuscript, and translation of the manuscript

draft into English. All authors have read and approved the final version of the manuscript.

FINANCIAL SUPPORT AND SPONSORSHIP

None.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to Universitas Ahmad Dahlan and PKU Muhammadiyah Bantul Hospital for granting permission and providing support during the data collection process for this study.

CONFLICT OF INTEREST

There are no conflict of interest.

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