

The Relationship Between Body Mass Index and the Level of Functional Disability in Knee Osteoarthritis Patients at the Korbafo Community Health Center UPTD - Rote Ndao Regency

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Abstract. Osteoarthritis (OA) of the knee is a degenerative disease of the joints that often causes pain and functional disorders. High Body Mass Index (BMI) is known to be one of the main risk factors for knee OA, but its relationship with the rate of functional disability in knee OA patients in archipelagic regions such as Rote Ndao is still limited. This study aims to analyze the relationship between Body Mass Index (BMI) and the level of functional disability in knee osteoarthritis patients at UPTD Korbafo Health Center, Rote Ndao Regency, in 2026. This study used a cross-sectional design. The study sample was knee OA patients who received treatment at the Korbafo Health Center for the period January-March 2026, selected using purposive sampling techniques (n=78). BMI was measured based on body weight and height (kg/m^2), while functional disability rates were measured using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Data were analyzed using Spearman's rank correlation between continuous BMI and continuous WOMAC scores. Most of the patients were aged 56–70 years (71.8%) and female (83.3%). The BMI distribution showed that 44.9% of patients were classified as obese ($\text{BMI} \geq 25$). The rates of mild, moderate, and severe functional disabilities were 23.1%, 56.4%, and 20.5%, respectively. The Spearman test showed a correlation coefficient of $r = 0.487$ (95% CI 0.28–0.65; $p = 0.002$), indicating a positive association of moderate strength between BMI and functional disability. Higher BMI was moderately associated with more severe functional disability in knee osteoarthritis patients at the Korbafo Health Center UPTD. Because this association was not adjusted for potential confounders, it should be interpreted with caution.

Keywords: Body Mass Index, Functional Disability, Knee Osteoarthritis, WOMAC

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INTRODUCTION

Osteoarthritis (OA) is the most common degenerative joint disease found in the elderly population and is a leading cause of functional disability worldwide (Tong et al., 2024; Scheuing et al., 2023; Hawker & King, 2022; Long et al., 2022). This disease is characterized by articular cartilage damage, subchondral bone hypertrophy, and chronic joint inflammation, which progressively results in pain, stiffness, and decreased functional ability (Fatmawati, 2021; Grässel et al., 2021; Krakowski et al., 2024; Yunus et al., 2020; Wei & Bai, 2016; Goldring & Goldring, 2016). The knee is the joint most frequently affected by osteoarthritis (knee OA or genu osteoarthritis), given its role as the primary weight-bearing joint during standing and walking.

With the aging population and the increasing number of elderly people globally, the prevalence of knee OA is expected to continue to increase significantly (Godziuk et al., 2024). In Indonesia, increasing life expectancy also contributes to the increasing burden of this degenerative disease (Godziuk et al., 2026). One of the greatest health challenges in the elderly population is the decline in physical function caused by knee OA, which in advanced stages can lead to functional disability and significantly reduce quality of life (Zhu et al., 2024; Atukorala & Hunter, 2023; Araujo et al., 2016; Prado et al., 2023). Body Mass Index (BMI) has been identified as a major risk factor influencing the onset and progression of knee OA. High BMI places an excessive mechanical load on the knee joint, which, if repeated and prolonged, accelerates cartilage degeneration (Nafisa et al., 2024; Voinier et al., 2020; Chen et al., 2024; Klets et al., 2018; Wang et al., 2026). Furthermore, adipose tissue also plays a role in systemic inflammation through the release of adipokines, which can metabolically exacerbate OA (Zimowska et al., 2024).

Recent scientific evidence suggests that the relationship between BMI and functional disability in knee OA is complex and multidimensional (Shumnalieva et al., 2023; Raud et al., 2020). The Multicenter Osteoarthritis (MOST) Study, a longitudinal cohort study involving 1,211 participants with 7 years of follow-up, found that individuals with obesity (BMI ≥ 30 kg/m²) with metabolic comorbidities or low muscle mass (sarcopenic obesity) had a 2.1 to 2.6 times higher odds ratio of being on the worst functional impairment trajectory compared to obese individuals without these conditions. These findings indicate that the impact of BMI on physical function is not solely mechanical, but is also influenced by metabolic factors and body composition (Godziuk et al., 2024; Godziuk et al., 2026).

A cross-sectional study by Tong et al. (2024) published in *BMJ Open* also confirmed that obese patients with knee OA (n=103) had worse pain scores and functional disability compared to the non-obese group. This study emphasizes the importance of an integrated weight management approach in the management of knee OA (Tong et al., 2024). Meanwhile, an 8-year cohort study of elderly Japanese women showed that BMI was the strongest single predictor of incidental knee OA, with an area under the curve (AUC) of 0.753, even before the appearance of significant radiological changes (Takayama et al., 2025).

At the primary healthcare level, community health centers (Puskesmas) play a strategic role in the early detection and management of knee OA, particularly in island regions such as Rote Ndao Regency, which have limited access to specialist orthopedic and rehabilitation services. The Korbafo Community Health Center (UPTD), as one of the first-level health facilities in the region, faces challenges in providing comprehensive services for patients with knee OA, including addressing modifiable risk factors such as excess weight (Takayama et al., 2025; Zahra et al., 2022).

Although the relationship between BMI and functional disability in knee OA has been extensively studied across various populations, a research gap remains regarding the characteristics of this relationship in coastal or island populations with distinct sociodemographic backgrounds, physical activity patterns, and cultures, such as those in Rote Ndao Regency. Most previous studies were conducted in urban or suburban areas with relatively good access to healthcare. However, population characteristics, BMI distribution, and patterns of functional disability can differ significantly across geographic regions.

Based on this description, researchers are interested in analyzing the relationship between Body Mass Index and the level of functional disability in knee osteoarthritis patients at the UPTD Korbafo Health Center, Rote Ndao Regency, in 2026. This study is expected to provide empirical evidence to support risk factor control programs and improve the quality of life of knee OA patients in the archipelago region.

METHODS

Study Design, Setting, and Period

This study used an analytical cross-sectional design (Lesley, 2023; Figueiredo et al., 2021). The cross-sectional design was chosen because this study aimed to analyze the relationship between the independent variable (Body Mass Index) and the dependent variable (level of functional disability) at a single point in time without intervention or longitudinal follow-up. The study was conducted at the UPTD Korbafo Community Health Center, a primary health care facility in Rote Ndao Regency, East Nusa Tenggara Province, Indonesia. Data were collected from January to March 2026.

Population, Recruitment, and Eligibility Criteria

The source population was all patients with knee OA who visited the UPTD Korbafo Community Health Center during the data collection period. Because a complete list of knee OA patients was not available before data collection and patients attended the health center irregularly, random sampling from a sampling frame was not feasible. Purposive sampling was therefore used: patients with knee OA who visited the health center during the data collection period and met the eligibility criteria were invited consecutively to participate. All eligible patients who were invited agreed to participate, resulting in 78 respondents.

The inclusion criteria were: (1) aged 40 years or older; (2) a diagnosis of knee OA recorded in the patient's medical record; (3) able to stand without assistance for weight and height measurement; (4) able to communicate verbally and answer the questionnaire items read by the interviewer; and (5) willing to participate and provided informed consent. No minimum disease duration was required; disease duration was recorded as a respondent characteristic. The exclusion criteria were: (1) inflammatory or other types of arthritis, such as rheumatoid arthritis or gouty arthritis; (2) a history of knee surgery, including knee replacement; (3) knee trauma or fracture within the previous six months; (4) an intra-articular knee injection within the previous three months; (5) neurological conditions affecting lower-limb function, such as stroke with hemiparesis; and (6) conditions that could distort body weight measurement, such as marked edema or ascites.

The diagnosis of knee OA was confirmed from the medical records, in which it had been established by the health center physician based on the clinical criteria of the American College of Rheumatology: knee pain accompanied by at least three of the following findings: age over 50 years, morning stiffness lasting less than 30 minutes, crepitus on active motion, bony tenderness, bony enlargement, and no palpable warmth of the synovium (Altman et al., 1986). Radiographic examination was not part of the study protocol because it is not available at the health center; therefore, radiographic severity (Kellgren–Lawrence grade) was not assessed.

Sample Size

The adequacy of the sample size was evaluated using the formula for detecting a correlation coefficient: $n = [(Z\alpha + Z\beta) / C]^2 + 3$, where $C = 0.5 \times \ln[(1 + r) / (1 - r)]$ (Hulley et al., 2013). With a two-sided α of 0.05 ($Z\alpha = 1.96$), a power of 80% ($Z\beta = 0.84$), and an expected correlation of $r = 0.35$, which was regarded as the smallest association of moderate strength, the minimum required sample size was 62 respondents. The 78 respondents included in this study exceeded this minimum.

Measurement of Body Mass Index

Body weight was measured using a calibrated digital scale with a precision of 0.1 kg, and height was measured using a wall-mounted microtoise with a precision of 0.1 cm. Measurements were taken with respondents wearing light clothing and no footwear, standing upright with the head in a neutral position. Each measurement was taken twice, and the mean of the two readings was used. BMI was calculated as body weight (kg) divided by the square of height (m²). BMI was analyzed as a continuous variable in the correlation analysis and was also classified, for

descriptive purposes only, according to the Asia-Pacific cut-off values recommended by the WHO Western Pacific Region: underweight (<18.5 kg/m²), normal (18.5–22.9 kg/m²), overweight (23.0–24.9 kg/m²), obesity I (25.0–29.9 kg/m²), and obesity II (≥30.0 kg/m²).

Measurement of Functional Disability

Functional disability was measured using the Indonesian version of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) Likert version 3.1. The WOMAC consists of 24 items in three subscales: pain (5 items), stiffness (2 items), and physical function (17 items). Each item is rated on a five-point Likert scale from 0 (none) to 4 (extreme), giving a raw total score of 0–96. The raw total score was converted to a 0–100 scale using the formula: WOMAC score = (raw total score / 96) × 100, with higher scores indicating more severe symptoms and functional disability. The Indonesian version was developed through translation and cultural adaptation and showed high internal consistency (Cronbach's α = 0.966) in Indonesian patients with knee OA (Karsten et al., 2019).

Because many respondents had low educational attainment, the questionnaire was interviewer-administered. The interviewer read each item and its response options verbatim in Indonesian, using the same standardized wording for all respondents, and recorded each answer without providing additional explanation or suggesting answers, in order to minimize interviewer bias. Each questionnaire was checked for completeness immediately after the interview. Because there are no universally established cut-off points for WOMAC severity, the 0–100 score was divided into three equal intervals for descriptive purposes: mild (0–33), moderate (34–66), and severe (67–100) disability. These categories were used only to describe the distribution of disability; the correlation analysis used the continuous WOMAC score.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics. Respondent characteristics were described using frequencies and percentages for categorical variables and means, standard deviations, and ranges for continuous variables. The relationship between BMI and functional disability was analyzed using Spearman's rank correlation between continuous BMI (kg/m²) and the continuous WOMAC score (0–100), not their categorized forms. Spearman's correlation was chosen rather than Pearson's correlation because the WOMAC score is derived from ordinal Likert items and because Spearman's correlation does not require the variables to be normally distributed or linearly related and is less sensitive to outliers; its assumption of paired observations measured on at least an ordinal scale was met for all respondents. The 95% confidence interval (CI) of the correlation coefficient was calculated using Fisher's z transformation with the standard error proposed by Bonett and Wright [27]. The strength of the correlation was interpreted as weak (0–0.25), moderate (0.26–0.50), strong (0.51–0.75), or very strong (>0.75). Statistical significance was set at a two-sided $p < 0.05$. Because all questionnaires were checked for completeness at the time of the interview, there were no missing data and no imputation was required.

RESULT AND DISCUSSION

Respondent Characteristics

This study involved 78 knee osteoarthritis (OA) patients who received treatment at the Korbafo Community Health Center (UPTD), Rote Ndao Regency, between January and March 2026. All eligible patients who were invited agreed to participate (100% response rate), and all 78 respondents completed both the BMI measurement and the WOMAC interview, so there were no missing data.

Table 1. Distribution of Respondent Sociodemographic Characteristics (n=78)

Characteristics	Frequency (n)	Percentage (%)
Age (years)		
40–55	12	15.4

56–70	56	71.8
>70	10	12.8
Mean $\pm$ SD	62.4 $\pm$ 7.8	
Gender		
Male	13	16.7
Female	65	83.3
Occupation		
Farmer/Fisherman	34	43.6
Homemaker	38	48.7
Retired	4	5.1
Others	2	2.6
Educational Level		
No Schooling / Did Not Complete Elementary School	31	39.7
Completed Elementary School	35	44.9
Completed Junior/Senior High School	10	12.8
Higher Education	2	2.6
Duration of Knee Osteoarthritis (years)		
<1	8	10.3
1–5	46	59.0
>5	24	30.7

Based on Table 1, the majority of respondents were in the 56–70 age group (71.8%), with an average age of 62.4 years (± 7.8). Female respondents dominated this study (83.3%), with a female-to-male ratio of approximately 5:1. Most respondents worked as housewives (48.7%) or farmers/fishermen (43.6%). Respondents' educational level was relatively low, with 84.6% having either not completed or only completed elementary school. The duration of knee OA was most often in the range of 1–5 years (59.0%).

Table 2. Distribution of Respondents' Body Mass Index (n=78)

BMI Category	Frequency (n)	Percentage (%)
Underweight (<18.5)	2	2.6
Normal (18.5–22.9)	26	33.3
Overweight (23.0–24.9)	15	19.2
Obesity I (25.0–29.9)	27	34.6
Obesity II (≥ 30.0)	8	10.3
Total	78	100

The minimum BMI of respondents was 16.2 kg/m² and the maximum was 34.7 kg/m², with an average BMI of 24.9 kg/m² (± 4.6). Based on Table 2, the proportion of obese respondents (BMI ≥ 25) was 44.9% (n=35). The overweight group (BMI 23.0 – 24.9) was 19.2% (n=15), while the normal BMI group was only 33.3% (n=26). These categories follow the Asia-Pacific BMI cut-off values.

Table 3. Distribution of Functional Disability Levels Based on WOMAC Scores (n=78)

Disability Level	Frequency (n)	Percentage (%)
Mild (score 0–33)	18	23.1
Moderate (score 34–66)	44	56.4
Severe (score 67–100)	16	20.5
Total	78	100

On the 0–100 scale, the minimum WOMAC score was 18.5 and the maximum was 82.4, with a mean of 52.7 (± 17.3). The majority of respondents (56.4%) had moderate disability,

followed by mild disability (23.1%) and severe disability (20.5%). There were no respondents with a WOMAC score of 0 (no disability at all).

Table 4. Spearman Correlation Test Results between BMI and WOMAC Score

Variable	Correlation Coefficient (r) and 95% CI	p-value	Interpretation
BMI (continuous, kg/m ²) vs WOMAC total score (continuous, 0–100)	0.487 (0.28–0.65)	0.002	Moderate positive correlation

Based on Table 4, Spearman's rank correlation between continuous BMI and the continuous WOMAC score was $r = 0.487$ (95% CI 0.28–0.65; $p = 0.002$). This result indicates a statistically significant positive correlation between BMI and the level of functional disability in knee OA patients. The positive direction of the coefficient indicates that respondents with higher BMI tended to report higher (more severe) WOMAC scores. The strength of the correlation was moderate (0.26–0.50). The squared coefficient ($r^2 \approx 0.24$) indicates that differences in BMI ranks accounted for approximately 24% of the variation in WOMAC score ranks, meaning that most of the variation in functional disability was related to factors other than BMI. Because this was an unadjusted bivariate analysis, it does not show whether BMI remains associated with functional disability after accounting for age, sex, disease duration, and other potential confounders.

Characteristics of Knee Osteoarthritis Patients in the Indonesian Archipelago

This study provides an overview of the characteristics of knee OA patients in a relatively remote island region, namely Rote Ndao Regency. Key findings indicate that knee OA patients at the Korbafo Community Health Center are predominantly female (83.3%) and elderly (71.8% aged 56–70 years). This female predominance is consistent with previous studies in various populations. A large cohort study using UK Biobank data with 485,977 participants also reported a significantly higher incidence of knee OA in women than men after age 50, which is associated with postmenopausal hormonal changes and anatomical and biomechanical differences.

The high proportion of respondents with low education levels (84.6% had not completed primary school or only completed primary school) reflects challenges in health communication and understanding of knee OA self-management in this region. Research by Atkins & Mukhida (2022), Carneiro et al. (2026), Owoyemi et al. (2025) showed that low education levels are associated with limited knowledge about OA and non-pharmacological pain management strategies, which can ultimately exacerbate functional disability.

Relationship between BMI and Functional Disability

The main result of this study was a moderate positive correlation between BMI and the level of functional disability ($r = 0.487$; 95% CI 0.28–0.65; $p = 0.002$). This finding is in line with existing evidence that excess weight is a modifiable factor associated with disability in knee OA (Tong et al., 2024; Nafisa et al., 2024; Solanki et al., 2023; Webb et al., 2022; Jurado-Castro et al., 2022; Wu et al., 2024). However, the magnitude of this association differs across studies. Tong et al. found that obese patients with knee OA had worse WOMAC pain and function scores than non-obese patients, and that higher body fat mass was associated with worse function, whereas higher skeletal muscle mass and moderate-to-low-intensity physical activity were associated with better function. In contrast, Gorial et al. (2018) who analyzed 150 patients with knee OA using multiple linear regression, found that age, radiographic severity, and educational level were significantly associated with the total WOMAC score, whereas BMI was not. These differences suggest that the crude correlation observed in the present study may be attenuated after adjustment for other patient characteristics (Solanki et al., 2023; Webb et al., 2022; Wu et al., 2024).

Clinically, a correlation of 0.487 indicates a meaningful but incomplete relationship. The squared coefficient suggests that BMI accounted for only about one quarter of the variation in WOMAC scores; the remaining variation is likely related to other determinants of disability in

knee OA, such as pain severity, radiographic severity, age, muscle strength, comorbidities, and physical activity, which were not measured in this study (Jurado-Castro et al., 2022; Webb et al., 2022; Wu et al., 2024). Therefore, BMI alone cannot be used to predict an individual patient's level of disability. Nevertheless, because body weight is modifiable, even a moderate association is relevant for primary care, where weight management can be integrated into routine knee OA management (Solanki et al., 2023; Jurado-Castro et al., 2022; Webb et al., 2022).

The mechanisms discussed below were not measured in the present study. They are presented only as possible explanations drawn from previous research, not as mechanisms demonstrated by the current findings. First, a biomechanical explanation: excess body weight increases the load on the knee joint during weight-bearing activities (Solanki et al., 2023; Wu et al., 2024). Messier et al. (2005) showed that, in overweight and obese older adults with knee OA, each unit of weight loss was associated with an approximately four-unit reduction in knee-joint forces during walking.

Second, a systemic inflammatory explanation: adipose tissue is an active endocrine organ that secretes pro-inflammatory adipokines (Wu et al., 2024). Zimowska et al. (2024) reported significantly higher interleukin-6 (IL-6) and leptin levels in individuals with a BMI above 25 kg/m² than in those with a normal BM. However, that study was not conducted in patients with knee OA, and inflammatory markers were not measured in the present study, so this pathway could not be examined.

Third, differences in body composition: BMI does not distinguish fat mass from muscle mass (Webb et al., 2022; Wu et al., 2024). In the Multicenter Osteoarthritis (MOST) Study, Godziuk et al. (2024) and Godziuk et al. (2026) found that individuals with obesity accompanied by low muscle mass (sarcopenic obesity) or metabolic comorbidities had 2.1 to 2.6 times higher odds of following the worst functional trajectory over 7 years than obese individuals without these conditions. Differences in body composition may therefore partly explain why BMI accounted for only part of the variation in functional disability in this study (Webb et al., 2022; Wu et al., 2024). Because body composition, inflammatory markers, and knee-joint loading were not measured, these explanations should be tested in future studies.

Study Limitations

This study has several limitations. First, the analysis was bivariate and did not adjust for potential confounders. Age, sex, disease duration, occupation, educational level, pain severity, comorbidities, medication use, physical activity, and radiographic severity may influence both BMI and functional status. Because most respondents were female, aged 56–70 years, and had knee OA for 1–5 years, the observed correlation may partly reflect these characteristics rather than BMI alone. Multivariable analysis, such as linear or ordinal regression, is needed in future studies with larger samples to determine whether BMI is independently associated with WOMAC scores. Second, the cross-sectional design does not allow the direction of the relationship to be determined; reduced function may also lead to lower physical activity and weight gain. Third, purposive sampling at a single primary health care facility limits the generalizability of the findings. Fourth, knee OA was diagnosed clinically without radiographic confirmation, so radiographic severity could not be assessed. Fifth, the WOMAC was interviewer-administered, which may introduce interviewer or social desirability bias despite the use of standardized wording, and its internal consistency was not evaluated in the present sample. Finally, the WOMAC severity categories used for description are not standardized cut-off points

CONCLUSION

There was a moderate positive correlation between Body Mass Index and the level of functional disability, measured by the WOMAC, in knee osteoarthritis patients at the UPTD Korbafo Community Health Center: patients with higher BMI tended to have more severe functional disability. Because the analysis was cross-sectional and not adjusted for potential confounders, this finding does not show that BMI independently causes functional disability.

SUGGESTION

Weight management may still be considered as part of knee OA care at the primary health care level, and future studies should use multivariable analysis and include body composition, pain severity, physical activity, and radiographic severity.

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