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Original Research

Association Between Body Mass Index, Knee Pain, and Physical Function in Older Adults

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ABSTRACT

Background: *Excess body weight, particularly a high body mass index (BMI), is an important risk factor for knee pain and functional limitations among older adults due to increased mechanical loading and inflammatory processes.These conditions can impair daily activities,reduce functional independence, and negatively affect the quality of life of the elderly. Therefore, investigating the association between BMI, knee pain, and functional ability is essential to provide evidence for developing effective physiotherapy strategies to maintain mobility and independence in older adults.*

Methods: *This study employed an observational analytical design with a cross-sectional approach involving 114 older adults aged 60 years and above who experienced knee pain. Participants were selected using simple random sampling. Body mass index (BMI) was calculated from measured body weight and height, while knee pain, joint stiffness, and physical function were assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Data were analyzed using descriptive statistics with Spearman correlation analysis, as appropriate.*

Results: *The findings indicated a positive association between BMI and WOMAC scores, suggesting that higher BMI was associated with greater knee pain and functional limitations among older adults. The mean BMI was 25.87 ± 3.04 kg/m², and the mean total WOMAC score was 49.76 ± 5.98. However, $\rho = 0.923$, $p < 0.001$ to establish the strength and statistical significance of this association.*

Conclusions: *Higher BMI was associated with greater knee pain and functional limitations among older adults in this study. These findings highlight the importance of BMI assessment and weight management as components of physiotherapy care for older adults with knee pain. Further studies using longitudinal designs and controlling for potential confounding factors are recommended to clarify the relationship between BMI, knee pain, and functional ability.*

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INTRODUCTION

The aging process is an inevitable biological phenomenon characterized by the gradual decline in the physiological function of various body organs, including the musculoskeletal system. In the elderly population, tissue aging manifests as a loss of muscle mass and strength (sarcopenia), reduced elasticity of ligaments and tendons, and the degeneration of articular cartilage in weight-bearing joints (Li et al., 2024). The knee joint is particularly susceptible to degenerative disorders resulting from heavy mechanical loads sustained over a lifetime. These knee joint disorders most frequently manifest as knee pain and knee osteoarthritis (OA), which are leading causes of disability and reduced physical mobility among the elderly worldwide (Perdana et al., 2020).

One independent, dynamic, and modifiable risk factor for the onset of knee pain is weight gain, clinically measured via Body Mass Index (BMI) (Adouni, 2024). An increase in BMI to the overweight or obese category adversely affects knee joint biomechanics. From a pathomechanical perspective, during walking, the compressive force exerted on the knee joint can reach three to six times the total body weight. Consequently, every one-kilogram increase in weight amplifies the compressive force on the knee's articular structures, particularly within the medial compartment (Zhao et al., 2025). This constant and chronic excessive compressive pressure accelerates the erosion of and microtrauma to the articular cartilage (hyaline cartilage), ultimately triggering pain, bone-on-bone friction, and local inflammation (Ahsan, 2022).

In addition to biomechanical mechanisms, the interaction between excess body weight and knee joint damage is also mediated by biochemical pathways and systemic inflammation. Excess adipose tissue in obese individuals does not merely serve as a fat storage site; rather, it acts as an active endocrine organ that secretes various pro-inflammatory cytokines—such as Interleukin-6 (IL-6) and Tumor Necrosis Factor-alpha (TNF-α)—and adipokines, such as leptin (Zhao et al., 2025). These systemic inflammatory mediators circulate in the blood, accelerating the degradation of the extracellular matrix in knee cartilage and exacerbating synovitis (inflammation of the synovial membrane). It is the combination of compressive mechanical stress and the systemic inflammatory response associated with obesity that renders the elderly highly susceptible to persistent knee pain (Ito et al., 2020).

The impact of weight gain and the onset of knee pain extends beyond structural joint damage; it directly leads to a decline in the daily functional activities of the elderly (Solanki et al., 2023). Functional activity refers to an individual's capacity and independence in performing essential daily movements—such as walking on level ground, rising from a seated position, climbing or descending stairs, bending, and attending to personal care. When elderly individuals experience knee pain due to excess body weight, they reflexively reduce their physical mobility to avoid pain (kinesiophobia) (Tong et al., 2025). This decline in physical activity creates a vicious cycle: immobilization leads to a loss of muscle mass and quadriceps weakness; muscle weakness reduces knee joint stability; reduced calorie burning triggers further weight gain; and this weight gain further exacerbates pressure and pain in the knee (Yang, 2019).

Severe functional limitations in the elderly can compromise quality of life, increase the risk of falls, and lead to total dependence on family members or caregivers. In the fields of physiotherapy and primary healthcare, understanding the extent to which body weight influences functional limitations in the elderly is crucial for designing

preventive programs, weight management education, and precise therapeutic exercise interventions (Amlak et al., 2025). Therefore, this observational analytic study was conducted on 114 elderly individuals to quantitatively examine and analyze the association of body weight and BMI on functional activity, as measured by the standardized Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) instrument (Xie et al., 2018).

MATERIALS AND METHOD

This study employed an observational analytic design with a cross-sectional approach to analyze the influence of body weight on functional activity and the incidence of knee pain among the elderly population. The study population consisted of elderly individuals experiencing knee pain. A total of 114 older adults with knee pain participated in this cross sectional study.

Participants mere selected using sample random sampling based on the established inclusion and exclusion criteria, were selected as the study sample using simple random sampling. Inclusion criteria comprised elderly individuals aged 60 years or older who were experiencing knee pain, were able to communicate effectively and cooperate, and were willing to participate as respondents. Exclusion criteria included individuals under the age of 60, those with a history of acute lower-extremity injury within the past three months, and those with severe cognitive impairment.

Data collection began with a preparatory phase that included obtaining permits and ethical clearance, applying inclusion and exclusion criteria, and securing informed consent from prospective respondents. Anthropometric measurements involved recording the respondents' weight (in kilograms) and height (in meters) to calculate their Body Mass Index (BMI) using the formula: weight divided by the square of height (kg/m^2). The resulting BMI values were then classified into five categories based on Asia-Pacific standards: underweight, normal, overweight, obesity I, and obesity II.

The independent variable in this study is body weight, represented by BMI values, while the dependent variables are functional activity and the incidence of knee pain. The The Indonesian version of the WOMAC has demonstrated good validity (correlation coefficients: 0.809–0.964) and excellent internal consistency (Cronbach’s alpha = 0.992) in patients with knee osteoarthritis (Made et al., 2024). The collected data were subsequently processed and analyzed statistically using both descriptive and analytical methods. Descriptive analysis was performed to characterize the sample, covering age, gender, height, weight, BMI category, as well as WOMAC subscale and total scores. Prior to analyzing the relationships between variables, a normality test was conducted using the Shapiro–Wilk test, given the sample size of 114 respondents.

If the measurement data followed a normal distribution ($p > 0.005$), the Pearson correlation test was used to analyze the relationship between BMI and WOMAC scores. Conversely, if the data were not normally distributed ($p < 0.005$), the statistical analysis proceeded using the Spearman Rank correlation test. The level of statistical significance for this study was set at $p < 0.005$, with correlation coefficient (r) values categorized from This study was conducted in accordance with ethical principles for research involving human participants. Ethical approval was obtained from the Aisyah University of Surakarta (Approval No. 878/II/AUEC/2026, dated 20 Februari 2026). The study followed the principles of respect for persons, beneficence, non-maleficence, and justice. Informed consent was obtained from all participants before data collection, and confidentiality and privacy were maintained throughout the study

RESULTS

The research data were analyzed using descriptive and analytical statistics to determine the relationship between Body Mass Index (BMI) and functional activity as well as the incidence of knee pain among the elderly. Descriptive analysis was conducted to characterize the respondents based on age, gender, weight, height, BMI category, and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores—including the subscales for pain, stiffness, and physical function, as well as the total WOMAC score.

Prior to the correlation analysis, the data were tested for normality using the Shapiro–Wilk test, given the sample size of 114 respondents. The normality test results served as the basis for selecting the appropriate statistical test. If the data followed a normal distribution ($p > 0.05$), the Pearson correlation test was used for the analysis. Conversely, if any variable did not follow a normal distribution ($p < 0.05$), the Spearman Rank correlation test was employed.

Correlation analysis aims to determine the direction and strength of the relationship between BMI and WOMAC scores. The correlation coefficient (r) ranges from -1 to +1, where a positive value indicates a direct relationship, while a negative value indicates an inverse relationship. The strength of the relationship is interpreted as very weak (0.00–0.19), weak (0.20–0.39), moderate (0.40–0.59), strong (0.60–0.79), and very strong (0.80–1.00).

The analysis revealed a positive association between BMI and WOMAC scores. This indicates that an increase in BMI tends to be accompanied by an increase in WOMAC scores, signifying greater impairment in functional activity and increased knee pain among the elderly. The descriptive results based on the complete dataset are presented below:

Table 1. Distribution of BMI Categories

BMI Category	BMI Range (Kg/m^2)	n	precentage (%)
Normal	18,5 – 22,9	19	16,7 %
Overweight	23,0 – 24,9	36	31,6 %
Obesity I	25,0 – 29,9	42	36,8 %
Obesity II	> 30,0	17	14,9 %
Total		114	100 %

Table 2. Descriptive Statistics of Research Variables (n = 114)

Variable	Mean	Std. deviation	Minimum	Maksimum
Age (year)	69,27 ± 5,72	5,724	60	79
Body Weight (Kg)	64,73 ± 8,96	8,9585	49,7	90,9
Body Height (Cm)	158,04 ± 5,13	5,133	150	170
BMI (kg/m^2)	25,87 ± 3,04	3,0424	21,2	32,2
WOMAC Score	49,76	5,975	40	60

Based on the study results involving 114 respondents, the distribution of BMI categories in Table G.1 shows that the largest group fell into the Obesity I category (BMI 25,0 – 29,9 kg/m^2), comprising 42 respondents (36,8%). This was followed by the Overweight category with 36 respondents (31,6%), normal with 19 respondents

(16,7%), and Obesity Class II with 17 respondents (14.9%). There were no respondents in the underweight category. Table G.2 shows a mean respondent age of 69.27 ± 5.72 years (range: 60–79 years), a mean body weight of 64.73 ± 8.96 kg, and a mean height of 158.04 ± 5.13 cm. Overall, the mean Body Mass Index (BMI) was 25.87 ± 3.04 kg/m², with minimum and maximum values of 21.20 kg/m² and 32.20 kg/m², respectively. This mean value indicates that, in general, the respondents' anthropometric profile falls within the overweight category according to Asia-Pacific classification standards.

Table 3. Correlation Between BMI and WOMAC Scores (n = 114)

Variable Pair	Spearman's ρ	p-value
BMI – Total WOMAC	0.923	< 0.001
BMI – Pain subscale	0.889	< 0.001
BMI – Stiffness subscale	0.817	< 0.001
BMI – Physical function subscale	0.920	< 0.001

Spearman's rank correlation was used because the data were not normally distributed (Shapiro-Wilk, $p < 0.05$). Significance level was set at $p < 0.05$.

Table 4. Comparison of WOMAC Scores Across BMI Categories (n = 114)

BMI category	n	Pain (mean ± SD)	Stiffness (Mean ± SD)	Physical Function (Mean ± SD)	Total WOMAC (Mean ± SD)
Normal	19	8.21 ± 0.42	3.00 ± 0.00	30.37 ± 0.76	41.58 ± 1.02
Overweight	36	9.31 ± 0.52	3.94 ± 0.23	33.08 ± 1.54	46.33 ± 2.06
Obesity I	42	10.60 ± 0.80	4.14 ± 0.35	38.26 ± 2.53	53.00 ± 3.49
Obesity II	17	11.65 ± 0.49	4.88 ± 0.33	41.65 ± 0.79	58.18 ± 1.33
P-Value		< 0.001	< 0.001	< 0.001	< 0.001

Bivariate analysis showed a very strong positive correlation between BMI and total WOMAC score ($\rho = 0.923$, $p < 0.001$). Total WOMAC scores differed significantly across BMI categories (Kruskal-Wallis $H = 94.11$, $p < 0.001$), with the highest scores in the Obesity II group (58.18 ± 1.33) and the lowest in the Normal group (41.58 ± 1.02)

DISCUSSION

The study results involving 114 elderly respondents showed a mean age of 69.27 ± 5.72 years and a mean Body Mass Index (BMI) of 25.87 ± 3.04 kg/m². This mean BMI value places the majority of respondents in the overweight category according to Asia-Pacific classification criteria. Based on the BMI category distribution in Table G.1.no respondents were found to be obesity 1. This prevalence of excess body weight (overweight and obesity 1) among the elderly population is closely linked to the aging process, which triggers a decline in basal metabolic rate and a loss of muscle mass (sarcopenia), accompanied by increased fat mass accumulation. These changes in body composition directly increase the risk of musculoskeletal disorders, particularly in weight-bearing joints such as the knee.

The evaluation of functional activity and knee pain levels among the elderly, measured using the WOMAC questionnaire (Table G.2), yielded a mean total score of

49.76 ± 5.98, with scores ranging from 40 to 60. This high mean total score reflects that the elderly subjects in the study experienced moderate impairments in functional activity and knee pain. Regarding the individual subscales, the physical function subscale contributed the most, with a mean score of 35.82 ± 4.24, followed by the pain subscale (9.95 ± 1.27) and the joint stiffness subscale (4.00 ± 0.82). The high level of physical function limitation indicates that the moderate of respondents faced significant obstacles in performing essential daily movements—such as rising from a seated position, ascending and descending stairs, walking long distances, or bending over. These physical limitations often trigger kinesiophobia—a fear of movement intended to avoid pain—which ultimately leads to prolonged immobilization and a decline in the elderly individuals' independence (Brown, 2026).

Analytically, the study findings reveal a trend wherein increases in body weight or BMI are directly proportional to increases in WOMAC scores, signifying more severe pain and functional limitations. This phenomenon can be explained by compressive biomechanical mechanisms: during walking or weight-bearing activities, the knee joint is subjected to compressive forces three to six times the total body weight; consequently, any increase in body weight multiplies the mechanical load on the knee's articular cartilage and accelerates the deterioration of joint tissues (Wirasatya & Putra, 1924). Furthermore, the accumulation of adipose tissue in individuals with high BMI acts as an endocrine organ, secreting pro-inflammatory cytokines—such as Interleukin-6 (IL-6), Tumor Necrosis Factor-alpha (TNF-α), and leptin—that exacerbate synovial membrane inflammation (synovitis).

These findings reinforce research by Tong et al. (2024/2025) and Zhao et al. (2025), which indicates that high BMI and fat mass are significantly associated with poor WOMAC scores resulting from the combined effects of compressive mechanical stress and systemic inflammatory reactions. These findings align with the study titled "Association of body composition and physical activity with pain and function in knee osteoarthritis patients: a cross-sectional study" (2024), which found that individuals with higher body mass index and fat mass exhibited worse WOMAC scores compared to those with a normal BMI. Weight gain increases mechanical load on the knee joint and heightens inflammatory activity, leading to pain, joint stiffness, and a decline in physical function. The significance level was set at $p < 0.05$

The clinical implications of these findings underscore the importance of integrating weight management programs into physiotherapy management for elderly individuals with knee joint disorders. Physiotherapy interventions should not focus solely on symptomatic pain relief but must also encompass weight management education, modification of daily activities, and the prescription of precise therapeutic exercises (Olson & Eccleston, 2024). Quadriceps strengthening and low-impact aerobic exercises—such as stationary cycling or aquatic exercises—are highly recommended to enhance knee joint stability without imposing excessive compressive loads. Consequently, this comprehensive approach is expected to reduce pressure on the knee joint, alleviate pain, break the vicious cycle of immobilization, and optimally improve the elderly's quality of life and functional independence (Liu et al., 2025).

In accordance with the research by Tong et al., (2025) which states that individuals with higher body fat composition and body mass index (BMI) have worse WOMAC scores compared to individuals with a normal BMI. The study demonstrates that an increase in fat mass is significantly associated with higher scores for pain, stiffness, and physical functional limitation in patients with knee osteoarthritis.

These research findings are also supported by studies Zhao et al., (2025) which states that increasing body weight is one of the main risk factors for knee osteoarthritis through biomechanical and inflammatory mechanisms. This research explains that any increase in body weight will increase pressure on the medial compartment of the knee, thereby **Strengths and Limitations.**

Strengths and Limitations. The strengths of this study include the use of the WOMAC, a widely validated instrument, and the analysis of both total and subscale scores in an elderly population aged 60–79 years. Appropriate non-parametric tests were chosen after normality testing. Several limitations should be noted. First, the [cross-sectional] design permits only associations, not causal inference. Second, the sample was relatively small (n = 114) and [non-probability / from a limited number of sites], which limits generalizability. Third, total WOMAC scores ranged only from 40 to 60, so participants with mild symptoms were not represented, and this restricted range may influence the strength of the association. Fourth, only bivariate analyses were performed, without adjustment for confounders such as age, sex, physical activity, comorbidities, and duration of osteoarthritis. Finally, BMI does not distinguish fat from muscle mass, inflammatory markers were not measured, and WOMAC is self-reported and may be subject to reporting bias.

Recommendations. Future studies should use longitudinal or interventional designs, larger multi-site samples covering the full range of symptom severity, and multivariate analyses to adjust for confounders. Body composition measures (e.g., waist circumference, body fat percentage), inflammatory biomarkers (e.g., IL-6, TNF-α, CRP), and radiographic grading (Kellgren-Lawrence) are also recommended to better support the proposed mechanisms.

CONCLUSION AND SUGGESTIONS

Based on the analysis and discussion, limitations in respondents' understanding of the WOMAC questionnaire—stemming from age and education factors—were successfully minimized through neutral guidance provided by the researchers. However, limitations regarding the control of confounding factors (such as physical activity, medical history, medication use, nutrition, and muscle strength) and the use of a cross-sectional design mean that the study's findings merely confirm an association between Body Mass Index (BMI) and both functional activity and knee pain, without definitively establishing a causal relationship. Therefore, future research is advised to employ a longitudinal design and more comprehensively control for confounding factors to gain a deeper understanding of the mechanisms underlying the relationships between these variables.

Declaration of Generative AI Use. The authors used Claude (Anthropic) to assist with statistical analysis checks, table formatting, translation, and language editing. All outputs were reviewed and verified by the authors, who take full responsibility for the content of this publication. AI was not used to generate or alter research data.

REFERENCES

Adouni, M. (2024). The effect of body weight on the knee joint biomechanics based on subject - specific finite element - musculoskeletal approach. *Scientific Reports*, 1–15. https://doi.org/10.1038/s41598-024-63745-x

Ahsan, M. (2022). *Determine the kinematics and kinetics parameters associated with*

bilateral gait patterns among healthy , overweight , and obese adults. *93*(3). https://doi.org/10.23750/abm.v93i5.13060

Alexaki, V. I. (2024). ScienceDirect Adipose tissue-derived mediators of systemic inflammation and metabolic control. *Current Opinion in Endocrine and Metabolic Research*, *37*, 100560. https://doi.org/10.1016/j.coemr.2024.100560

Amlak, B. T., Getinet, M., Getie, A., Kebede, W. M., & Tarekegn, T. T. (2025). *Functional disability in basic and instrumental activities of daily living among older adults globally : a systematic review and meta- analysis*.

Brown, R. (2026). *BMC Public Health Article in Press Self-reported functional and mobility limitations in mid-life : a systematic review of prevalence and association with chronic health conditions IN IN*.

Ito, A., Hayashi, K., Suzuki, S., Ideno, Y., Kurabayashi, T., Ogata, T., Seichi, A., & Akai, M. (2020). *Association of trajectory of body mass index with knee pain risk in Japanese aged women in a prospective cohort study : the Japan Nurses ' Health Study*. 1–8. https://doi.org/10.1136/bmjopen-2019-033853

Li, Y., Tian, X., Luo, J., Bao, T., Wang, S., & Wu, X. (2024). Molecular mechanisms of aging and anti - aging strategies. *Cell Communication and Signaling*, 1–24. https://doi.org/10.1186/s12964-024-01663-1

Liu, H., Qin, L., Liu, Y., Meng, X., Li, C., & He, M. (2025). *Knee osteoarthritis rehabilitation : an integrated framework of exercise , nutrition , biomechanics , and physical therapist guidance — a narrative review*.

Made, P., Hartana, Y., Luh, N., Gita, P., & Saraswati, K. (2024). *Validation of the Indonesian version of Western Ontario and McMaster Universities osteoarthritis index in pre-elderly and elderly with osteoarthritis*. *5*(2), 164–170. https://doi.org/10.51559/ptji.v5i2.215

Olson, K. L., & Eccleston, C. (2024). Reconsidering the Role of Weight Loss in Treatment for Chronic Pain_ Knee Osteoarthritis as an Exemplar. *The Journal of Pain*, *25*(12), 104647. https://doi.org/10.1016/j.jpain.2024.104647

Perdana, S. S., Safitri, A. H., Nabila, & Martopo, N. A. (2020). Uji Inter-RaterReliabilityWestern Ontario and Mcmaster University (WOMAC) Osteoarthritis Index pada Pasien Osteoarthritis Knee. *Jurnal Kesehatan 13*, *2*(2), 131–135.

Solanki, P., Hussain, S. M., Abidi, J., Cheng, J., Fairley, J. L., Page, M. J., Cicuttini, F. M., & Wluka, A. E. (2023). Association between weight gain and knee osteoarthritis : a systematic review. *Osteoarthritis and Cartilage*, *31*(3), 300–316. https://doi.org/10.1016/j.joca.2022.10.023

Tong, B., Liang, Y., Liu, P., Wang, M., Li, D., Zeng, W., Zhu, D., Liu, T., & Chen, H. (2025). *Relationship of total and regional lean body mass with knee pain and*

function in patients with knee osteoarthritis : a cross-sectional study.

Wirasatya, I. P., & Putra, E. (1924). *Impact of BMI on Knee Osteoarthritis WOMAC Severity in Adults : A Cross-Sectional Study*. 665–674.

Xie, Y., Zhang, C., Jiang, W., Huang, J., Xu, L., Pang, G., Tang, H., Chen, R., Yu, J., Guo, S., Xu, F., & Wang, J. (2018). Quadriceps combined with hip abductor strengthening versus quadriceps strengthening in treating knee osteoarthritis: A study protocol for a randomized controlled trial. *BMC Musculoskeletal Disorders*, *19*(1), 1–7. https://doi.org/10.1186/s12891-018-2041-7

Yang, Y. J. (2019). *An Overview of Current Physical Activity Recommendations in Primary Care*. 135–142.

Zhao, Y., Wang, J., & Zhao, B. (2025). *The impact of high BMI on the global burden of osteoarthritis from 1990 to 2021 and future projections*. *June*, 1–13. https://doi.org/10.3389/fmed.2025.1561750