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Original Research Paper

The correlation between body mass index and the incidence of osteoarthritis in menopausal women

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Abstract
Osteoarthritis is more common in menopausal women due to decreased estrogen levels, which impacts joint health. Due to the high prevalence of OA in menopausal women with a high BMI, this study was conducted to determine the correlation between BMI and the incidence of OA in this group. The purpose of this study is to identify the correlation between Body Mass Index (BMI) and the incidence of osteoarthritis in menopausal women at Sinjai District Hospital during July-September 2024 period. This study applied an observational analytical design with a cross-sectional approach. The sample consisted of 50 menopausal women selected through consecutive sampling techniques. Data were collected through interviews, direct BMI measurements, and medical record reviews. Analysis was performed univariately and bivariately using the Chi-Square test. Based on the univariate analysis involving 50 respondents, it showed that most OA patients had an obese BMI (46%), while the normal category was only found in 26% of patients. Bivariate analysis using the Chi-Square test showed a significant relationship between BMI and OA (p-value = 0.007, $p < 0.05$). These results indicate that post-menopausal women with a BMI > 25 (obese category) have a higher risk of developing OA compared to those with a normal BMI. Conclusion: The conclusion of this study is that there is a significant relationship between BMI and OA in postmenopausal women, in which obesity is an important risk factor. This study recommends public education about the importance of maintaining ideal body weight as an effort to prevent OA in postmenopausal women, as well as the need for further research to explore the role of estrogen hormone levels in the pathogenesis of osteoarthritis.

Keywords: body mass index; menopausal women; osteoarthritis

1. Introduction

Osteoarthritis (OA) is a disease that involves several anatomical and physiological changes in joint tissue, including cartilage degradation, bone remodeling and osteophyte formation that cause clinical problems such as pain, stiffness, swelling and limited joint function. There are 2 groups of osteoarthritis, namely primary osteoarthritis and secondary osteoarthritis (ISTY et al., 2023; Paerunan c & Gessal J, 2019). The incidence of OA in America at the age of 18-24 years shows that 7% of men and 2% of women has OA in the hands. At the age of 55-64 years, 28% are affected by OA genu and 23% are affected by OA hip. At the age of 65-74 years, 39% describe OA knee and 23% OA hip. At age 70 and above, 100% of both men and women experience symptoms of osteoarthritis (Mutmainah, 2019).

According to the Indonesian Ministry of Health, the elderly population in 2019 was approximately 25.9 million and continues to increase annually. The prevalence of osteoarthritis in Indonesia is 55 million (24.7%). According to the Basic Health Research (*RISKESDAS*), the age-adjusted prevalence of osteoarthritis is 5% at age 61. The incidence of osteoarthritis in West Sulawesi is approximately 3.2%. A study conducted at the Jakarta Islamic Hospital in Sukapura in 2019 found 217 patients with

genu osteoarthritis and 42 patients aged 60 and over receiving medical rehabilitation therapy (Mokhtar S et al., 2024).

The relationship between OA and menopause was first described by Drs. Cecil and Harper in 1925, and in 1952 it was termed "menopausal arthritis." Since then, several research studies have investigated the influence of changing sex hormone profiles during the menopausal transition on the onset and progression of OA. The higher prevalence of OA in older women is partly due to estrogen deficiency. The most common sites of OA with increasing age are the hands, knees, and hips. It is important to recognize that these different OA locations may have different risk associations with menopause due to their different etiologies. In particular, knee or hip OA, or weight-bearing OA, has a higher incidence in postmenopausal women (Mei et al., 2022).

One of the risk factors for osteoarthritis genu is obesity or being overweight and people who are obese are susceptible to osteoarthritis genu if there is an injury to the knee due to supporting excess body weight. Obesity is a condition when the body is in a state of excess nutrition of macronutrients (carbohydrates, proteins, and fats). The prevalence of osteoarthritis increases with age and generally women are affected more often than men (Anggraini N.E & Hendrati L.Y, 2019). The higher prevalence of OA in women over 50 years is partly due to the absence of the musculoskeletal protective effect of estrogen. In addition to the overlap of biomedical and physiological factors, it is important to consider the effects of environmental and societal contributors to the disease. Very few studies have examined the intersection of OA, requiring further consolidation of the current literature (Mei et al., 2022; Mutmainah, 2019).

Although osteoarthritis (OA) has been extensively studied, particularly in relation to age, menopause, and obesity, there are still limitations in the research specifically highlighting the relationship between body mass index (BMI) and OA incidence in postmenopausal women as a specific population group. Some studies tend to discuss OA and menopause or OA and obesity separately, without integrating all three into a holistic analysis. Furthermore, local (Indonesian) data is still limited, particularly on the postmenopausal female population in certain regions, such as West Sulawesi, in which the OA incidence is around 3.2% (Mutmainah, 2019). In fact, the burden of OA in Indonesia is quite high, reaching 24.7% of the population (Ministry of Health of the Republic of Indonesia, 2019), and is expected to increase with the increasing number of elderly people. Furthermore, most of the literature is still limited to describing the prevalence and clinical management of OA, while BMI-based preventive measures have not been studied in depth, particularly in postmenopausal women. This highlights the need for research specifically exploring the relationship between BMI and OA incidence in this group.

The novelty of this study lies in its specific focus on the relationship between body mass index (BMI) and the incidence of osteoarthritis (OA) in postmenopausal women, a highly vulnerable group that has received little attention in previous research, particularly in Indonesia. Although numerous studies have addressed OA in general, research specifically examining the role of BMI in the context of postmenopausal hormonal changes is still very limited. This study combines two major risk factors, menopause and obesity, in a single focused analysis, considering both hormonal aspects and mechanical loading as interrelated mechanisms in exacerbating joint degeneration. Furthermore, local data on the incidence of OA in postmenopausal women in Indonesia, particularly those that consider anthropometric indicators such as BMI, are still very limited. Therefore, this study not only contributes to filling the gap in the literature but also has the potential to serve as a basis for community-based promotive and preventive efforts in OA control in the postmenopausal women population. Based on the above description, it is necessary to conduct research on "The Relationship Between Body Mass Index and Osteoarthritis in Menopausal Women".

2. Research Method

This study employed a quantitative approach with an observational analytical method and a cross-sectional design. Data were obtained from direct measurements of respondents (primary) and medical records of osteoarthritis patients (secondary). The study took place at the Sinjai District Hospital from July to September 2024. A sample of 50 menopausal women was taken using a consecutive sampling method with inclusion criteria, such as age ≥50 years, having or not having osteoarthritis, recorded in the medical record based on a clinical diagnosis that met the diagnostic criteria for knee OA. Exclusion criteria included a history of joint trauma, certain medical conditions, use of certain medications, a history of knee cancer, or having undergone arthroplasty. Data were analyzed using SPSS with univariate analysis for variable description and bivariate analysis to examine the relationship between osteoarthritis (independent variable) with menopause and body mass index (dependent variable) using the Chi-Square test.

3. Results and Discussion

3.1. Results

This research was conducted at the Sinjai District Hospital. This research was conducted by collecting primary data from interviews and secondary data from patient medical records from the internal department of the Sinjai District Hospital during the period of July - September 2024. From the data collected during the research, there were 50 medical record data obtained. The research results are presented in the following table.

3.1.1. Univariate Analysis Results

3.1.1.1. Age

Table 1. Distribution of OA Patients by Age at Sinjai District Hospital

Age	Frequency (n)	Percentage (%)
45-55 years old	6	24
56-65 years old	19	76
Total	**25**	**100**

Source: Primary Data, 2024

Based on Table 1, data shows that there were 25 total osteoarthritis patients in this study. Subject data based on age was dominated by 19 (76%) aged 56–65 years, while 6 (24%) were aged 45–55 years.

3.1.1.2. Distribution of Oa and Non-Oa Patients

Table 2. Distribution of OA and Non-OA patients in Sinjai District Hospital

OA/Non OA	Frequency	Percentage (%)
OA	25	50
Non OA	25	50
Total	**50**	**100**

Source: Primary Data, 2024

Table 2 shows that there were 50 total samples in this study. Of these, 25 patients (50%) had osteoarthritis and 25 (50%) had non-osteoarthritis.

3.1.1.3. BMI

Table 3. Distribution of OA and Non-OA patients based on Body Mass Index (BMI) at Sinjai District Hospital

BMI	Frequency (n)	Percentage (%)
Underweight	3	6

BMI	Frequency (n)	Percentage (%)
Normal	13	26
Overweight	10	20
Obese I	23	46
Obese II	1	2
Total	**50**	**100**

Source: Primary Data, 2024

Based on the table above, body mass index can be divided into five categories: underweight (<18.5 kg/m2), normal (18.5–22.9 kg/m2), overweight (23–24.9 kg/m2), obesity I (25–29.9 kg/m2), and obesity II (>30 kg/m2). The table above shows that 3 patients (6%) were underweight, 13 (26%) were normal, 10 (20%) were overweight, 23 (46%) were obese I, and 1 (2%) were obese II.

3.1.2. Bivariate Analysis

Table 4. Table of Relationship between Body Mass Index (BMI) and Osteoarthritis in Menopausal Women

		OA		Total		P Value
		Yes	No	n	%	
BMI	**Underweight**	**0**	**3**	**3**	**6**	
	Normal	2	11	13	26	
	Overweight	7	3	10	20	0.007*
	Obese 1	15	8	23	46	
	Obese 2	1	0	1	2	
Total		**25**	**25**	**50**	**100**	

*chi-square test

The relationship between body mass index and osteoarthritis in menopausal women can be seen based on table 4. Bivariate analysis using the Chi Square method showed that out of 50 subjects, 25 patients were diagnosed with OA, of which 2 patients had normal BMI, 7 overweight patients, 15 obesity I patients, and 1 obesity II patient. Meanwhile, there were 25 patients who were not diagnosed with OA, with 3 patients having underweight BMI, 11 normal patients, 3 overweight patients, and 8 obesity I patients. Based on the results of the Chi Square test, the p value was obtained = 0.007, which means the p value is <0.05. Because the p value obtained 0.007 (<0.05), it means H0 is rejected. This shows that there is a significant relationship between body mass index and osteoarthritis in menopausal women at the Sinjai District Hospital.

3.2. Discussion

3.2.1. Body Mass Index

Obesity is a disorder or disease characterized by excessive accumulation of fat tissue in the body. Obesity occurs due to an imbalance between energy intake and energy expenditure. Obesity/overweight has become a global pandemic and is recognized by the World Health Organization (WHO) as a major chronic health problem. With increasing age, the risk of developing osteoarthritis increases. Obesity is a strong risk factor for bilateral and unilateral osteoarthritis in both sexes. Therefore, being overweight at age 60-65 is a risk factor for osteoarthritis in later life (Justiyulfah Syah et al., 2021).

In recent years, obesity has become a worldwide epidemic, characterized by an increase in the body's adipose tissue composition. The link between obesity and OA has long been recognized. Patients with obesity develop OA earlier and have more severe symptoms, a higher risk of infection, and more technical difficulties with total joint replacement surgery. In addition to increased biomechanical loading on the knee joint, obesity is thought to contribute to low-grade systemic inflammation through

the secretion of adipose tissue-derived cytokines, called adipokines. Specifically, levels of pro-inflammatory cytokines, including interleukin (IL)-1α, IL-6, IL-8, and tumor necrosis factor alpha (TNF-α), are increased in a high-fat diet-induced mouse obesity model and in obese patients. These inflammatory factors may trigger the nuclear factor-κB (NF-κB) signaling pathway, stimulating articular chondrocyte catabolism and causing ECM degradation through upregulation of MMPs (Chen et al., 2017).

Based on the results of this study, it can be seen that the BMI of OA and non-OA samples at the Sinjai District Hospital in the obesity group 1 was 23 (46%), 15 (65%) of whom were OA patients, while the number of underweight and normal weight patients was smaller. This is in accordance with research conducted by Justiyulfah (2020) at the Batu Aji Community Health Center in Batam City which stated that there is a relationship between obesity and the incidence of osteoarthritis with a p value of 0.001 <0.05 totaling 67 samples and processed using the chi square test (Justiyulfah Syah et al., 2021). In another study, Nur Fajriah (2021) also stated that every 1 kg increase in body weight, the risk of osteoarthritis increases by 10%. Meanwhile for obese people, every weight loss of even 5 kg will reduce the risk factor for osteoarthritis in the future by 50% (Fajriya & Masruri, 2021) Another study conducted by Sofyan Z (2020) in Aceh also showed that most respondents with obesity experienced more osteoarthritis and statistically showed a significant relationship between the two (Sofyan & Rizal, 2020).

3.2.2. Osteoarthtritis

Osteoarthritis (OA) is the most common degenerative joint disease, with a higher prevalence among the elderly population. The knee is the primary peripheral joint affected, resulting in progressive loss of function, pain, and stiffness. OA is characterized by joint degeneration involving the articular cartilage and surrounding connective tissue. The joints most commonly affected by OA are the hands, feet, facet joints, and large weight-bearing joints, such as the knees and hips. Joint degeneration in OA causes pain, which in turn leads to stiffness and limited joint movement.

The study involved 50 postmenopausal women, 25 of whom were diagnosed with OA. In her research, Arintika (2022) found that the prevalence of osteoarthritis genu was higher in women, with 87 samples (84.5%). Furthermore, the incidence of OA in Arintika's (2022) study also supported the results of this study, showing that OA patients were most commonly found in women aged 56-65 (21 cases), and 4 in women aged 45-55 (4 cases). Another study conducted by Arintika (2022) also found that the highest prevalence of OA patients was in the 61-65 age group (56%) (Arintika et al., 2022).

Age and weight, along with BMI, have long been considered primary factors, but other contributing factors also exist. According to Nursyarifah, (2013) in Surakarta revealed that elderly people who have a BMI value > 25 (obese) and have a 4.9 times greater vulnerability to osteoarthritis than those with a BMI of 18.5-25.0, this is in line with the results obtained in this study, in which 23 people from 25 positive OA samples had a high BMI. In another study, Anggraini N (2019) also found that the results of the chi square analysis showed a p value = 0.001 indicating that the obesity variable has a p value less than the significance level α = 0.05, so H0 is rejected and it is concluded that there is a relationship between obesity and the incidence of Osteoarthritis (Anggraini N.E & Hendrati L.Y, 2019; Arintika et al., 2022; Husnah et al., 2019).

3.2.3. The Relationship Between Body Mass Index and Osteoarthritis in Menopausal Women

Women are at greater risk of developing osteoarthritis than men. This is due to hormonal factors. Estrogen and bone formation play a role in the development and progression of OA. Estrogen influences the formation of osteoblasts and endothelial cells. A decrease in estrogen levels also decreases the production of transforming growth factor β (TGFβ) by osteoblasts and nitric oxide by endothelial cells,

resulting in increased osteoclast differentiation and maturation. In menopausal women, estrogen decreases, and therefore, women are at greater risk of osteoarthritis.

In this study, using a sample of all menopausal women (Table 4.4), osteoarthritis was more common in patients with a high BMI compared to those with a normal BMI. After statistical analysis using the chi-square method, a p-value of 0.007 was obtained. This indicates a significant association between body mass index and osteoarthritis in menopausal women. This is in line with research conducted by Purwati, et al. (2021), who found the highest incidence of osteoarthritis in menopausal women (82.1%). Furthermore, other research suggests a link between estradiol levels and OA. A decline in functional capacity in women occurs on average at age 50. The study also reports a relationship between functional capacity and the age of menopause in women, based on measurements of activity of daily living and instrumental activity of daily living.

Decreased estrogen causes a decrease in the collagen matrix, causing cartilage damage and pain. Estrogen has also been shown to reduce the rate of bone loss and the risk of fractures in women. Hormonally, estrogen can inhibit osteoblast activity and increase osteoclast activity, leading to degenerative factors in the formation of synovial fluid, which protects bones. Synovial fluid is formed from serum ultrafiltration by cells that form the synovial membrane. Synovial cells also produce hyaluronic acid (HA), a glycosaminoglycan. Glycosaminoglycans are the main component of synovial fluid. This is all regulated by hormonal processes, lifestyle, and physical activity (Fatmawati, 2021; Gede et al., n.d.).

Data obtained from 50 patients showed that the respondents were over 45 years old and all patients were female. The correlation between BMI and osteoarthritis showed that the majority of patients had high BMI measurements (34 patients). A cross-sectional analysis of BMI and OA showed that the majority of OA patients had high BMI measurements (23 patients), while the remaining 11 did not suffer from OA. Statistical data also showed a significant relationship between BMI and OA in this study. This is in line with research conducted by Anggraini (2019); the calculations showed a relationship between obesity and the incidence of osteoarthritis. This means that obesity is a risk factor for genu OA and the risk of genu osteoarthritis in obese individuals is higher than in individuals with a normal BMI. 6 The chi-square analysis showed a p-value of 0.027, indicating a significant influence of obesity on the incidence of osteoarthritis (Anggraini N.E & Hendrati L.Y, 2019; Gustina E et al., 2020a).

This study shows a significant association between Body Mass Index (BMI) and the incidence of osteoarthritis in postmenopausal women ($p = 0.007$). Postmenopausal women with a BMI > 25 kg/m² (overweight and obese) have a higher risk of developing osteoarthritis than those with a normal BMI.

Most cases of osteoarthritis are found in women with obesity category I (BMI 25–29.9 kg/m²). Excess weight increases the mechanical load on joints and triggers chronic inflammation through pro-inflammatory substances from adipose tissue, thus accelerating joint damage.

Interestingly, although most patients demonstrated adherence to pain medication, recurrence of the disorder persisted, indicating that lifestyle management and nutritional status play a greater role than pharmacological therapy alone. This distinguishes this study from previous studies that focused on symptomatic treatment. This research emphasizes the importance of a preventive approach with weight control as a protective factor.

Obesity is strongly associated with an increased risk and progression of knee OA, as well as the role of adipokines in accelerating cartilage degradation. Furthermore, obesity not only increases the mechanical load on joints but also worsens the biochemical environment of the joints.

Thus, this study argues that obesity is not only a structural but also a biological risk factor, making BMI an important indicator in screening for OA risk in menopausal women. Further researches with a

broader scope and considering other factors such as physical activity and hormonal status are highly recommended.

Excess weight is associated with an increased risk of developing osteoarthritis in both women and men. Obesity is not only associated with osteoarthritis in weight-bearing joints. The greater the body fat load, the greater the trauma to the joints over time. The risk of developing knee osteoarthritis in obese individuals ranges from 5 to 12 times, and obese patients with knee osteoarthritis experience increased pain in the knee joint area compared to less obese patients. Based on these two factors, it can be concluded that obesity is a factor that increases the intensity of pain felt in the knees of osteoarthritis patients. Based on the results of these studies, it can be concluded that there is a significant relationship between body mass index and osteoarthritis in postmenopausal women.

4. Conclusion

This study shows a significant association between Body Mass Index (BMI) and the incidence of osteoarthritis in postmenopausal women ($p = 0.007$). Menopausal women with a BMI > 25 kg/m² (overweight and obese) have a higher risk of developing osteoarthritis than those with a normal BMI.

Most cases of osteoarthritis are found in women with obesity category I (BMI 25–29.9 kg/m²). Excess weight increases the mechanical load on joints and triggers chronic inflammation through pro-inflammatory substances from fat tissue, thus accelerating joint damage.

These results emphasize the importance of weight management as a preventive measure for osteoarthritis, especially in postmenopausal women who experience hormonal changes. It is expected that these findings will serve as a basis for education and preventive efforts for at-risk groups.

Further researches with a broader scope and considering other factors such as physical activity and nutritional intake are highly recommended to deepen the understanding of the risk factors for osteoarthritis in postmenopausal women.

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