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Body Mass Index and Knee Osteoarthritis: A Retrospective Cross-Sectional Study in Baptis Hospital, Batu City

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Abstract

Osteoarthritis is a chronic global and musculoskeletal disorder. This disease is associated with reduced articular cartilage integrity. The most commonly affected joint is the knee, followed by the hand and the hip. Knee osteoarthritis is associated with aging, obesity, articular cartilage, fatigue, trauma, and congenital joint deformities. Excess body weight is a factor that will exacerbate osteoarthritis. There are still meta-analysis studies involving cohort and case-control studies on osteoarthritis and body mass index (BMI) available, but the relationship between the two variables is still not assessed quantitatively. In addition, research on knee osteoarthritis and BMI is still limited, particularly at Baptis Hospital, where it has never been done. As a result, this study was carried out to determine the relationship between BMI and the degree of knee osteoarthritis. This retrospective cross-sectional study involved 33 patients who suffered from knee osteoarthritis. Data were collected from medical records, and the Kellgren-Lawrence system to assess the degree of knee osteoarthritis based on radiology findings. A total of 7 patients (21.2%) suffered from osteoarthritis grade 1, 10 patients (30.3%) had degree 2, 15 patients (45.5%) had degree 3, and one patient had degree 4. The Spearman correlation test showed that there was no significant relationship ($p > 0.05$). So, it can be concluded from this study that there was no correlation between BMI and the degree of knee osteoarthritis patients at Baptis Hospital, Batu City.

Keyword: body mass index, Kellgren-Lawrence, obesity, osteoarthritis, overweight.

Case Report

Indeks Masa Tubuh (IMT) and Osteoarthritis Lutut: Sebuah Studi Cross-Sectional Retrospektif di Rumah Sakit Baptis, Kota Batu

Abstrak

Osteoarthritis merupakan salah kecacatan kronis global dan gangguan muskuloskeletal. Penyakit ini dikaitkan dengan berkurangnya integritas tulang rawan articular. Sendi yang sering terdampak adalah lutut yang diikuti tangan dan pinggul.

Osteoarthritis lutut dikaitkan dengan penuaan, obesitas, tulang rawan articular, kelelahan, trauma, dan kelainan bentuk sendi bawaan. Kelebihan berat badan merupakan faktor yang dapat memperparah osteoarthritis. Studi meta-analisis yang melibatkan studi kohort dan kasus-kontrol mengenai osteoarthritis dan index masa tubuh (IMT) masih ditemukan akan tetapi hubungan antara kedua variabel masih belum dinilai secara kuantitatif. Selain itu, penelitian mengenai osteoarthritis lutut dengan IMT masih terbatas, terutama di Rumah Sakit Baptis, Batu, belum pernah dilakukan. Oleh karena itu penelitian ini dilakukan untuk mengetahui

hubungan antara IMT dengan osteoarthritis lutut. Studi cross-sectional retrospektif ini melibatkan 33 pasien yang menderita osteoarthritis lutut. Data dikumpulkan dari rekam medis, dan sistem Kellgren-Lawrence digunakan untuk menentukan grade osteoarthritis lutut berdasarkan hasil radiologi. Sebanyak 7 pasien (21,2%) menderita osteoarthritis derajat 1, 10 (30,3%) pasien derajat 2, 15 pasien (45,5%) derajat 3, dan satu pasien derajat 4. Uji korelasi Spearman menunjukkan

tidak ada hubungan bermakna ($p > 0,05$). Sehingga, dapat disimpulkan bahwa pada penelitian ini tidak terdapat hubungan yang signifikan antara IMT dan derajat osteoarthritis lutut baik pada pasien di Rumah Sakit Baptis, Kota Batu.

Kata Kunci: indeks masa tubuh, kegemukan, Kellgren-Lawrence, obesitas, osteoarthritis.

INTRODUCTION

Osteoarthritis is one of the musculoskeletal conditions with the highest prevalence leading causes of chronic disability globally and musculoskeletal disorders (Rachmat et al., 2021). Osteoarthritis is a heterogeneous condition, causing signs and symptoms in the joints associated with reduced articular cartilage integrity. In addition, this disease also involves changes in the bones and tissues around the joints (Kloppenborg & Berenbaum, 2020). The prevalence of osteoarthritis varies according to the joints involved. The most commonly affected joint is the knee, followed by the hand and the hip (Long et al., 2022). A person with knee osteoarthritis finds it difficult to do daily activities due to damage to the knee's structure and its manifestations, which may affect their quality of life (Rachmat et al., 2021).

The prevalence of knee osteoarthritis in the world in 2020 is still high at 654.1 million people (aged >40 years) (Budiman & Widjaja, 2020). According to the prevalence of osteoarthritis cases, the type of osteoarthritis in Indonesia affects 5% of people under the age of 40, 30% of people between the ages of 40 and 60, and 65% of people over the age of 61. It is predicted that in 2025, this number will rise by as much as 40% due to an aging and obese population (Rachmat et al., 2021). Aging, obesity, articular cartilage, fatigue, trauma, congenital joint deformities, and joint deformities caused by a variety of factors such as injury degradation and reactive hyperplasia of the subchondral bone all contribute to knee osteoarthritis (Zheng & Chen, 2015).

When bearing large loads, the joints between the bones have to work harder, which can be thought to be a factor in osteoarthritis. Men and overweight women have a higher risk of developing osteoarthritis. Being overweight is a

factor that will make osteoarthritis worse (Munthe et al., 2021).

According to Departemen Kesehatan Republik Indonesia (2016), 26.3% of the population aged >18 years in Indonesia is overweight, and 14.8% is obese. Body mass index (BMI) is calculated by dividing the weight in kilograms by the square of the height in meters (kg/m^2) and is classified into four groups based on the Asia-Pacific cut-off point: underweight, normal weight, overweight, and obese (Lim et al., 2017).

In a cohort study of 1420 patients, Felson discovered that obese people had 1.5 to 2 times the risk of developing knee osteoarthritis as those who were thinner. Obesity was found to be associated with knee osteoarthritis (OR=2.63, 95%CL2.28 to 3.05) in a meta-analysis of risk factors for knee osteoarthritis (Zheng & Chen, 2015). Although meta-analyses involving cohort studies and case-control studies were discovered, the relationship between the two variables is still not assessed quantitatively. There has been little research on knee osteoarthritis and BMI, particularly in Indonesia. According to the explanation above, there is a clear correlation between osteoarthritis and BMI. However, there is no definitive data on the relationship between the degree of osteoarthritis, particularly knee osteoarthritis, and BMI. Researchers can use it to evaluate the relationship between the degree of knee osteoarthritis and BMI in osteoarthritis patients. As a result, this study was carried out at one of secondary hospitals, Baptis Hospital, to determine the relationship between BMI and the degree of knee osteoarthritis.

This study used a retrospective cross-sectional study method. The Kellgren-Lawrence system was used to determine the degree of knee osteoarthritis into four grades (0-4), with grade 0 indicating no osteoarthritis and grade 4 indicating

severe osteoarthritis (Sukhikh et al., 2020) based on radiological findings. This study hypothesizes that there is a correlation between BMI and the degree of knee osteoarthritis in patients at Baptis Hospital.

MATERIAL AND METHODS

Patients and study design

This research was conducted to determine the correlation between BMI and the degree of knee osteoarthritis using a retrospective cross-sectional study. The population in this study was all outpatients who had knee osteoarthritis at Baptis Hospital in April–July 2020. Furthermore, sampling was carried out using the consecutive sampling technique, where research subjects were selected based on the researcher's decision. The decision of the researcher was made based on the inclusion and exclusion criteria of the sample used.

The number of samples used in this study was calculated using the following formula:

$$n = \left(\frac{Z\alpha + Z\beta}{0.5 \ln \left(\frac{1+r}{1-r} \right)} \right)^2 + 3$$

n = minimum sample size
 Zα = standard normal distribution values (Table Z) at a certain α
 Zβ = standard normal distribution values (Table Z) at a certain β

(Rosenbaum, 2021)

So, the calculation of the minimum number of samples is as follows:

$$n = \left(\frac{2.326 + 2.576}{0.5 \ln \left(\frac{1 + 0.73753}{1 - 0.73753} \right)} \right)^2 + 3$$

n = 29.91, rounded up to 30 people

The number of samples was increased so that the research results could be more representative of the population being observed. The addition of the number of samples is done by adding 10% of the minimum required sample so that the minimum sample size is 32.89 or rounded up to 33 people.

Through the use of medical records for secondary data collection and the consecutive sampling approach, 49 respondents were acquired. A total sample of 33 patients was collected based on predetermined inclusion and

exclusion criteria. The inclusion criteria in this study were: patients who suffer from knee osteoarthritis, confirmed by radiological examination, aged between 36 and over 65 years, having a physical activity level (inactive, intermediately inactive, intermediately active, and active), presence or absence of involvement in comorbid diseases such as diabetes mellitus and hypertension, and a poor or good quality of life. The ethical committee from the Faculty of Medicine, Universitas Brawijaya, reviewed and approved this study proposal, as stated in the ethical clearance certificate No. 73/EC/KEPK/03/2020.

Height and weight measurements were taken from the patients. The grade of osteoarthritis is determined using Kellgren-Lawrence based on radiological findings gained from medical records. Each imaging modality's radiographic findings and imaging features are grouped into an ordinal scale to form an osteoarthritis-specific scoring system. The development of a scoring system has enabled the assessment of disease severity, which contributes to the basis of knee osteoarthritis diagnosis. The Kellgren-Lawrence scoring scheme, which is based on X-ray imaging, is commonly used to assess the severity grading of knee osteoarthritis (Teoh et al., 2022). According to the Kellgren-Lawrence system, there are four grades: grade 1 or possible osteoarthritis (doubtful narrowing of the joint space with possible osteophyte formation), grade 2 (possible narrowing of the joint space with definite osteophyte formation), grade 3 (definite narrowing of the joint space, moderate osteophyte formation, some sclerosis, and possible deformity of bone ends), and grade 4 (large osteophyte formation, severe narrowing of the joint space with marked sclerosis and definite deformity of the ends) (Kohn et al., 2016). For BMI there are 4 criteria: underweight range (if BMI is less than 18.5 kg/m²), healthy weight range (if BMI is 18.5-22.9 kg/m²), overweight range (if BMI is 23-24.9 kg/m²), and obesity range (if BMI is >25 kg/m²) (Lim et al., 2017).

Statistical analysis

The Spearman correlation test was used in this study to determine the correlation between two variables based on the Kallgren-Lawrence system with a p<0.05 significance level.

RESULTS

Among 33 patients with knee osteoarthritis, one patient had a thin BMI category (Table 1), 14 patients (42.4%) had a normal BMI, 6 patients (18.2%) were overweight, and 12 patients (36.4%) were obese. Based on the degree of osteoarthritis, there were 7 patients (21.2%) who had degree 1 osteoarthritis, 10 patients (30.3%) had degree 2, 15 patients (45.5%) had degree 3, and one patient with degree 4.

Table 1. General characteristic of respondents.

Characteristics	n	%
BMI category		
Thin	1	3%
Normal	14	42.4%
Overweight	6	18.2%
Obesity	12	36.4%
Total	33	100%
Degree of osteoarthritis		
1	7	21.2%
2	10	30.3%
3	15	45.5%
4	1	3%
Total	33	100%

One patient who had a degree of 1 osteoarthritis had a thin BMI category. Among 14 patients with normal BMI, six patients (18.2%) had degree 1, three patients (9.1%) had degree 2, four patients (12.1%) had degree 3, and one patient had degree 4. Among six patients with overweight

BMI, one had degrees 1 and 2, respectively, and four (12.1%) had degree 3. Among 12 patients with obesity, five patients (15.2%) had a degree 2, and seven patients (21.2%) had a degree 3 (Table 2). Correlation between the variables analysed by Spearman (Table 3).

The data (Table 3) above show that the correlation value (0.076) is greater than the significance level (0.05) and the coefficient correlation was 0.313. So, it can be concluded that there is no significant correlation between BMI and the degree of knee osteoarthritis patients at Baptis Hospital, Batu.

DISCUSSION

The sample criteria in this study were; patients with knee osteoarthritis aged between 36 and over 65 years (Sananta, Firladi, et al., 2022); patients must meet the criteria for having a physical activity level (inactive, intermediate inactive, intermediate active, and active) (Sananta, Ariyanti, et al., 2022); presence or absence of involvement in comorbid diseases such as diabetes mellitus and hypertension (Sananta, Zahrah, et al., 2022); and based on the patient's quality of life (poor or good) (Sananta, Qurotu'ain, et al., 2022). The risk factors that can lead to knee osteoarthritis are divided into three categories: systemic factors (such as age and gender), intrinsic joint factors (such as trauma and deformity), and joint extrinsic factors (such as high BMI) (Zheng & Chen, 2015).

Table 2. Relation between BMI category and degree of knee osteoarthritis

BMI category	Degree of knee osteoarthritis								Total	
	1		2		3		4			
	n	%	n	%	n	%	n	%	n	%
Thin	0	0	1	3%	0	0	0	0	1	3%
Normal	6	18.2%	3	9.1%	4	12.1%	1	3%	14	42.4%
Overweight	1	3%	1	3%	4	12.1%	0	0	6	18.2%
Obesity	0	0	5	15.2%	7	21.2%	0	0	12	36.4%
Total	7	21.2%	10	30.3%	15	45.5%	1	3%	33	100%

Table 3. Correlation test between BMI and degree of osteoarthritis

Spearman's rho	BMI			Degree of osteoarthritis		
	Correlation coefficient	Sig (2-tailed)	n	Correlation coefficient	Sig (2-tailed)	n
BMI	1.000		33	0.313	0.076	33
Degree of osteoarthritis	0.313	0.076	33	1.00		33

A high BMI can put a great load on bones and joints, especially the knee joint, which is the foundation for activities such as standing and walking (Felson et al., 2013). In the thin BMI category, there were patients with osteoarthritis degree 2. Furthermore, in the normal BMI category, it was found that one patient had osteoarthritis grade 4. The number of patients with osteoarthritis in the normal BMI category (14 patients) was higher than in the obesity BMI category (12 patients). This shows that it is not only BMI that can affect the occurrence of osteoarthritis. Several other factors aside from those previously mentioned can exacerbate the occurrence of osteoarthritis, such as physical activity, age, quality of life and the presence of comorbid illnesses or trauma. The degree of knee osteoarthritis is determined by observing X-ray photos of the knee. Furthermore, the degree of osteoarthritis was determined using the Kellgren-Lawrence grading system (Teoh et al., 2022).

This study found that more patients were suffering from knee osteoarthritis in the normal category, followed by obese patients. A high BMI can load bones and joints, especially the knee joint, which is the foundation for activities (Felson et al., 2013). Obesity is widely recognized as a risk factor for osteoarthritis; each 5 kg increase in weight increases the risk of knee osteoarthritis by 36% (Bliddal et al., 2014). The same was stated by King et al. (2013), a high BMI ($>27.5 \text{ kg/m}^2$) was linked to the development of knee osteoarthritis (OR 3.2; 95% CI: 1.1–9.7), as measured by reduced joint space width on radiographs, but not hip osteoarthritis. Similar to Zheng's study (2015), overweight and obesity were significantly associated with knee osteoarthritis with $p < 0.001$.

The results of the Spearman correlation test showed that there was no correlation between BMI and the degree of knee osteoarthritis (Table 3). However, if examined per sample, the trend or distribution of the data obtained tends to be determined by existing theories; the higher the respondent's BMI, the more severe the osteoarthritis will be (Vasilic-Brasnjevic et al., 2016).

Several studies have different results from the results of this study, such as the research conducted by Jordi et al. (2019) at Prof. dr. W. Z. Johannes Hospital in Kupang. The study found a significant difference in values, which indicated that there was a significant relationship between the BMI category and the severity of knee osteoarthritis and also showed the trend of the

data, leading to the higher the patient's BMI category, the more severe the severity of knee osteoarthritis suffered. Another study conducted by Theodora et al. (2019) at the Royal Taruma Hospital in Jakarta also showed significant results. Forty-three of the 59 patients in the obese category had severe knee osteoarthritis. Research conducted in Serbia, Europe, by Vasilic-Brasnjevic et al. (2016) showed similar results. Of the 150 patients involved, patients with high grades of osteoarthritis (grades 3 and 4) were found in patients with a high BMI category.

However, several other studies are consistent with the results of this study, such as the research conducted by Kusuma et al. (2019) at RSUP dr. Kariadi and Diponegoro Hospital Semarang. Of the 30 patients, 14 (46.7%) were found to be obese but did not have severe osteoarthritis. Similar results were also obtained by the study of Sari et al. (2019). Of 35 patients, there was no significant relationship between BMI and the severity of knee osteoarthritis. Another study by Widhiyanto et al. (2019) at Soetomo Hospital, Surabaya, using 30 samples revealed that there was no relationship between BMI and the degree of knee osteoarthritis. This result indicates that the occurrence of knee osteoarthritis was determined by factors other than BMI, such as knee injuries, physical activity, and leg arrangement.

The study above did not get significant results, perhaps due to several factors. Such as the demographic characteristics of patients that are unique in each place, such as socio-economic conditions, gender, age, anatomical tendencies, and physical activity. According to Lee et al. (2021), education was the only component of socioeconomic status that did not change based on disease status among the three components (education level, income level, and occupation). Meanwhile, when a person is diagnosed with a disease, his or her job and income may change. As a result, among the three components, a lower education level may be a good marker of lower socioeconomic status, indicating a more stable association with risk factors for osteoarthritis and knee pain. Research by Sananta, Firladi, et al. (2022); Sananta, Ariyanti, et al. (2022); and Sananta, Rahmanda, et al. (2022) shows that there is no significant relationship between knee osteoarthritis and age, gender, or physical activity. This might be one reason why there is no significant relationship between BMI and knee osteoarthritis. Because, as we know, the factors

that cause osteoarthritis may influence one another. In addition, because this study uses the retrospective cross-sectional study methodology used in this research, it is not possible to determine which disorders interact with one another.

This study also has limitations. Even though it met the minimum number of samples, this study had a small number of samples. This happened because this research was conducted during the COVID-19 pandemic, so researchers had limitations on research time and the number of samples. It would be even better if the number of samples was larger. In addition, this study only uses one factor to study. For further research, it can be done by combining two or more factors in the same sample that are interconnected, such as knee osteoarthritis with age, socioeconomic, trauma, and physical activity. So that researchers can find out whether these factors are significantly related to each other or not. Only patients from the Orthopaedic and Traumatology outpatient polyclinic at Baptis Hospital in Batu were studied. It is hoped that future studies will include samples from the Department of Internal Medicine's Rheumatology Polyclinic and the Medical Rehabilitation Polyclinic at Baptis Hospital, Batu. Despite its limitations, this study can be used as a foundation for future research to assess the relationship between the degree of knee osteoarthritis and BMI. In addition, this research can also be used as a guideline for the treatment of knee osteoarthritis, whether in the form of medication or surgery.

CONCLUSION

In conclusion, there was no relationship between BMI and the degree of knee osteoarthritis.

CONFLICT OF INTEREST

The authors declare no competing interests.

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