



Physical Activity Associated With Knee Osteoarthritis Severity

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ABSTRACT

Background: Knee osteoarthritis (OA) is a chronic degenerative disease causing articular cartilage damage and potentially leading to long-term disability. Physical Activity Level (PAL) is a modifiable risk factor; however, previous studies have shown inconsistent results regarding the relationship between PAL and the severity of knee OA. **Objective:** To determine the relationship between Physical Activity Level (PAL) and the severity of knee OA at RST Wijayakusuma Purwokerto. **Methods:** An analytic observational study with a cross-sectional design was conducted at RST Wijayakusuma Purwokerto involving 32 respondents selected via consecutive sampling. Physical activity levels were measured using the

IPAQ-LF questionnaire, while knee OA severity was assessed based on the Kellgren-Lawrence classification. **Results:** Bivariate analysis revealed a significant relationship between PAL and knee OA severity ($p = 0.016$). Logistic regression analysis showed that PAL was significantly associated with knee OA severity ($p = 0.015$); respondents with physical activity levels classified as "at-risk" had 9.334 times higher odds of developing severe knee OA compared to those with non-risk activity levels (OR = 9.334; 95% CI: 1.537–56.674). **Conclusion:** There is a relationship between PAL and the severity of knee OA. Respondents with at-risk physical activity levels have higher odds of experiencing severe knee osteoarthritis.

1. INTRODUCTION

Osteoarthritis (OA) is a chronic inflammatory joint disease that has a significant impact on health. OA can affect any joint in the body, but it most commonly affects weight-bearing joints such as the hip and knee. The knee joint is the site most frequently affected by osteoarthritis. In OA, there is degradation of articular cartilage, the formation of osteophytes on joint surfaces, sclerosis of the subchondral bone, and inflammation of the synovial fluid (Charlier *et al.*, 2019). As a result of these structural changes in the joints, people with OA experience pain, limited range of motion, and reduced functional ability, which disrupts daily activities and can lead to long-term disability. In addition to affecting physical function, OA also has a negative impact on psychological health, thereby reducing patients' quality of life (Roemer *et al.*, 2022). The higher the severity of knee OA, the greater the decline in joint function and quality of life for patients; therefore, identifying factors associated with the severity of OA is crucial for efforts to prevent disease progression.

Among the various types of arthritis, osteoarthritis is one of the most common and significant diseases worldwide. According to 2020 data from the Institute for Health Metrics and Evaluation (IHME), approximately 595 million people suffer from osteoarthritis, or about 7.6% of the world's total population (Global Burden of Disease Study, 2021). In Indonesia, the prevalence of OA reaches 24.7% of the total population. Data from the 2018 Riskesdas survey also show an OA prevalence of 7.3%, which is projected to continue rising with increasing age. Aceh Province ranks first with an OA prevalence of 13.3%, followed by Bengkulu at 12.11% and Bali at 10.46%. Meanwhile, in Central Java, where RST Wijayakusuma is located, the prevalence of OA stands at

5.1% (Kemenkes RI, 2019). Although the prevalence is lower than in some other provinces, OA remains a health issue because it impacts patients' function, activities, and quality of life.

Osteoarthritis is a multifactorial disease. Some risk factors associated with osteoarthritis include age, gender, body mass index (BMI), history of knee injury, and physical activity (Duha, 2019). Age is one of the strongest risk factors for knee osteoarthritis (OA) because the degenerative processes that occur with aging lead to a decline in the cartilage's ability to maintain its structure (Putri, Ilmiawan, & Darmawan, 2022). OA is also more common in women, particularly after menopause due to decreased estrogen levels (Utomo *et al.*, 2022). In addition, obesity increases the mechanical load on the knee joint (Mutiwara *et al.*, 2016), while a history of knee injury can accelerate joint damage due to post-traumatic inflammatory processes (Rahmanto & Aisyiah, 2019). Among these various risk factors, physical activity is a modifiable factor and thus has the potential to serve as one strategy for slowing the progression of knee osteoarthritis.

In addition, one of the factors contributing to the development of OA is physical activity. Physical Activity Level (PAL) reflects an individual's level of physical activity, which in this study was measured using the International Physical Activity Questionnaire Long Form (IPAQ-LF) (Huffman *et al.*, 2024). The IPAQ-LF is a widely used questionnaire for measuring physical activity; it has been validated in Indonesian and is capable of comprehensively assessing physical activity across four domains: work, transportation, household chores, and recreational activities. Consequently, the use of this questionnaire is considered relevant to the respondents' daily activities. Physical activity plays a crucial role in the development of OA. Excessive or repetitive activities, such as kneeling, squatting, climbing stairs, standing for long periods, and lifting heavy loads, can increase mechanical stress on the knee joints, thereby accelerating cartilage damage and increasing the progression of OA. Conversely, physical activity at an appropriate intensity can help maintain joint function, strengthen periarticular muscles, and reduce symptoms in people with OA. Therefore, physical activity is not only associated with the incidence of OA but is also thought to be related to the severity of knee OA (Putri, Ilmiawan, & Darmawan, 2022).

Physical activity is bodily movement that results in energy expenditure, whereas exercise is a type of physical activity performed in a planned manner to achieve specific goals (Huffman *et al.*, 2024). Several studies, such as one by Ma *et al.*, indicate that high-intensity physical activity is associated with an increased risk of knee osteoarthritis progression, whereas moderate-intensity activity provides a protective effect on the joints. Similar results were also reported by Cui *et al.*, who demonstrated a dose-dependent relationship: physical activity exceeding physiological capacity increases the risk of osteoarthritis, whereas activity at an appropriate intensity continues to provide benefits for joint function. On the other hand, a study by Mustaqim *et al.* reported a different direction of association, namely that high levels of physical activity are associated with lower severity of knee osteoarthritis. These differing results indicate that the relationship between Physical Activity Level (PAL) and the severity of knee osteoarthritis (OA) remains inconsistent and thus warrants further investigation. These differences are thought to be influenced by variations in respondent characteristics, methods of measuring physical activity, and the study outcomes used; therefore, the relationship between Physical Activity Level (PAL) and the severity of knee osteoarthritis (OA) requires further investigation (Gates *et al.*, 2017).

The limited research on the relationship between Physical Activity Level (PAL) and the severity of knee osteoarthritis (OA) in the Banyumas population, as well as the varying results of previous studies, formed the basis for this study. The study was conducted at Wijayakusuma General Hospital in Purwokerto because the hospital treats patients with knee osteoarthritis in the Banyumas region, and to date, there has been little data available on the relationship between PAL and the severity of knee OA in this population. The results of this study are expected to serve as a basis for developing recommendations regarding physical activity, medical rehabilitation, and efforts to prevent the progression of knee osteoarthritis. Based on the above, this study aims to analyze the relationship between Physical Activity Level (PAL) and the severity of knee osteoarthritis in patients at RST Wijayakusuma Purwokerto.

2. METHOD

This study is an analytical observational study with a cross-sectional design conducted at Wijayakusuma General Hospital in Purwokerto. The study population consisted of all patients clinically and radiologically diagnosed with knee osteoarthritis (OA) according to the study's inclusion and exclusion criteria. Sampling was performed using consecutive sampling. The sample size was calculated using the association test formula, resulting in a minimum requirement of 29 respondents. With a 10% dropout correction, the sample size used in this study was 32 respondents. The independent variable was Physical Activity Level (PAL), while the dependent variable was the severity of knee OA. The confounding variables analyzed included age, sex, and body mass index (BMI), as these three variables are known to be associated with knee osteoarthritis. This study did not analyze other factors that could potentially influence the severity of knee osteoarthritis, such as the duration of the condition, occupation, history of knee injury, comorbidities, or treatments the patients had undergone.

Physical activity levels were measured using the Indonesian version of the International Physical Activity Questionnaire Long Form (IPAQ-LF), which has been validated and demonstrates good validity and reliability (Cronbach's Alpha = 0.884; KMO = 0.910; Bartlett's Test of Sphericity $X^2 = 573.434$; $p < 0.000$). The IPAQ-LF was selected because it comprehensively assesses physical activity across various domains of daily life. Physical activity scores were calculated in MET-minutes/week and categorized as high-risk (≥ 600 MET-minutes/week) and low-risk (< 600 MET-minutes/week). The severity of knee OA was assessed based on the Kellgren–Lawrence radiographic classification and then grouped into mild OA (grades 1–2) and severe OA (grades 3–4). Radiographic assessment was performed independently by two observers using the Kellgren–Lawrence classification. Prior to primary data collection, inter-observer reliability was tested using Cohen's Kappa to ensure consistency in the interpretation of knee OA grades, yielding a value of 0.845.

Data analysis was conducted in stages, including univariate, bivariate, and multivariate analyses. Bivariate analysis used the chi-square test after first ensuring that the test's assumptions—specifically, the expected cell count—were met. If these assumptions were not met, Fisher's exact test was used as an alternative. Multivariate analysis was performed using backward logistic regression. Variables with a p-value < 0.25 in the bivariate analysis were included in the logistic regression model to identify the factors most strongly associated with the severity of knee osteoarthritis. This study received ethical approval from the Research Ethics Committee under number 003/KEPK/PE/I/2026. All participants provided written informed consent before participating in the study.

3. RESULT AND DISCUSSION

Result

The analysis was conducted on 32 respondents who met the inclusion and exclusion criteria and were willing to participate in the study. The research data included primary data on demographic characteristics (age and sex), anthropometric measurements (BMI), and physical activity levels, which were assessed using the International Physical Activity Questionnaire-Long Form (IPAQ-LF). Secondary data consisted of records of the respondents' knee radiographic examination results. The severity of knee osteoarthritis in each respondent was objectively assessed based on the Kellgren-Lawrence radiographic classification system. To ensure data consistency and reliability, an inter-observer agreement test was conducted using Cohen's Kappa, which yielded a value of 0.845 ($p < 0.001$). These results indicate a very strong level of agreement (reliability), thereby validating the data on the severity of knee OA for use in subsequent statistical analysis.

Table 1. Respondent Characteristics

Variable	Category	Frequency	Percentage(%)
Age	> 50 years	18	56,3

	≤ 50 years	14	43,8
Gender	Female	26	81,3
	Male	6	18,8
IMT	Obesity	17	53,1
	Not obese	15	46,9

The analysis was conducted on 32 respondents who met the inclusion and exclusion criteria at Wijayakusuma Hospital in Purwokerto. The characteristics of the respondents in this study were dominated by women, totaling 26 people (81.3%), while men numbered 6 (18.8%). Based on age distribution, the majority of respondents were in the older age group, with 18 people (56.3%) aged over 50 years and 14 people (43.8%) aged 50 years or younger. Furthermore, based on body mass index (BMI), the majority of respondents fell into the obese category (BMI > 25) 17 people (53.1%)—while the remaining 15 people (46.9%) were classified as non-obese.

Table 2. Severity of Osteoarthritis Based on Physical Activity Level (PAL)

Variable	Category	Frequency	Percentage (%)
Physical Activity Level (PAL)	Risky activities	14	43,8
	Low-risk activity	18	56,3
Severity of OA Genu	Grade 3-4	13	40,6
	Grade 1-2	19	59,4

Total of 32 patients studied, the distribution of osteoarthritis severity showed that the majority of respondents fell into the “non-risky activities” category, totaling 18 people (56.3%), while those with “risky activities” numbered 14 people (43.8%). The severity of knee osteoarthritis, assessed based on the Kellgren-Lawrence classification and grouped into two categories, showed that the majority of respondents were in the mild stage (stages 1–2), totaling 19 people (59.4%), while those in the severe stage (stages 3–4) numbered 13 people (40.6%). These data describe the baseline profile of the study subjects, in which the majority of respondents still had a safe activity load and were in the early stages of joint damage.

Table 3. The Relationship between PAL and the Severity of Osteoarthritis Genu

Physical Activity Level (PAL)	Severity of knee osteoarthritis (OA)		Total	p-value
	3-4	1-2		
Risk activities	9	5	14	0,016*
Low risk activities	4	14	18	

Table 3 shows the results of the bivariate analysis between Physical Activity Level (PAL) and the severity of knee osteoarthritis (OA) among 32 respondents. In the group of respondents with high-risk physical activity, the majority were in severity grades 3–4 (severe) 9 out of 14 people while the other 5 were in grades 1–2. Conversely, in the group with non-risky physical activity, the majority of respondents were in severity grades 1–2 (mild) 14 out of 18 people and only 4 respondents were in grades 3–4. The results of the chi-square test yielded a p-value of 0.016

($p < 0.05$), indicating a significant association between the level of physical activity and the severity of knee osteoarthritis. This suggests that respondents with high-risk physical activity tend to have more severe joint damage compared to those with low-risk physical activity.

Table 4. Logistic Regression Analysis Results

Step	Variable	<i>p</i> -value	Exp (B)	95% CI for EXP (B)
Step 1 ^a	Physical Activity			
	Level (PAL)	0,015*	9,334	1,537 – 56,674
	Age	0,112	4,442	0,707 – 27,922

Multivariate analysis was conducted to identify the variables with the most dominant influence on the severity of knee osteoarthritis using the backward method of logistic regression. The initial bivariate screening phase identified variables with p -values < 0.25 , namely Physical Activity Level (PAL) ($p = 0.016$), age ($p = 0.221$), and BMI ($p = 0.026$). Based on the focus of this study, the multivariate analysis was designed to test the effect of the primary variable, PAL, on the severity of knee OA while controlling for age. The analysis results in Table 4 show that the age variable does not have a statistically significant effect on the severity of knee OA ($p = 0.112$), but it was retained in the model as a control variable. Conversely, the PAL variable has a statistically significant effect ($p = 0.015$) and is the most dominant factor influencing the severity of the disease. The Exp(B) value of 9.334 indicates that respondents with high levels of physical activity are 9.3 times more likely to have severe knee OA (grades 3–4) compared to respondents with low levels of physical activity.

Discussion

Osteoarthritis (OA) is a chronic degenerative joint disease characterized by damage to articular cartilage, the formation of osteophytes, and subchondral bone sclerosis (Nuswantoro et al., 2024). Clinically, knee OA causes primary symptoms such as knee pain that worsens with activity, joint stiffness, and limited range of motion, all of which reduce the patient's quality of life. In this study, the majority of respondents were women (81.3%), indicating an association with the menopausal phase, during which a decrease in estrogen levels causes an imbalance in cartilage metabolism (Utomo *et al.*, 2022). In addition to hormonal factors, women are physiologically more likely to have less cartilage volume and weaker joint-supporting muscles than men, making them more susceptible to the progression of knee osteoarthritis (Di Martino *et al.*, 2024).

Age is a major intrinsic risk factor for the progression of knee osteoarthritis (OA) (Pelletier et al., 2023) and the participants in this study were predominantly aged over 50 years (56.3%). With advancing age, there is a decline in chondrocyte activity in repairing the cartilage matrix, causing the cartilage tissue to become thinner and lose its elasticity (Putri *et al.*, 2022). At the molecular level, the aging process is associated with chondrocyte senescence mechanisms through the excessive activation of the Piezo1 protein, which triggers an increase in intracellular calcium flux and cellular DNA damage (Jiang *et al.*, 2023). Aging factors also trigger the release of inflammatory mediators through the senescence-associated secretory phenotype (SASP), which accelerates the degradation of the cartilage matrix and worsens the progression of knee osteoarthritis (Diekman & Loeser, 2024).

Based on the results of the diagnostic evaluation, the majority of respondents had mild knee osteoarthritis (grade 1–2), while the remaining 40.6% had severe knee osteoarthritis (grade 3–4). Most respondents engaged in low-risk physical activity, but nearly half engaged in high-risk physical activity (≥ 600 MET-minutes/week). These findings indicate that although the majority of respondents were still in the mild stage, the proportion engaging in high-risk physical activity remained quite high, potentially contributing to the progression of knee OA. This radiographic severity reflects the accumulation of structural joint damage, as assessed using the Kellgren-Lawrence classification (Jameson & Fauci, 2017).

The association between physical activity levels and the severity of knee osteoarthritis (OA) in this study was likely influenced by the respondents' occupational characteristics, as they were predominantly farmers and manual laborers. These types of work involve repetitive movements such as hoeing, prolonged squatting, prolonged standing, and lifting heavy loads, which cause the quadriceps muscles to fatigue, thereby shifting the load distribution directly to the articular cartilage (Soeryadi *et al.*, 2017; Amarseto *et al.*, 2024). These conditions increase mechanical stress on the knee joint and, in the long term, accelerate structural damage to the joint (Lo *et al.*, 2022). However, occupation was not analyzed as a variable in this study; therefore, its influence on the severity of knee osteoarthritis cannot yet be directly concluded.

The results of the multivariate analysis further confirm that Physical Activity Level (PAL) is the most dominant factor associated with the severity of knee osteoarthritis (OA) after controlling for age. The Exp(B) value of 9.334 indicates that respondents with high physical activity levels have approximately 9.3 times the risk of developing severe knee OA (grade 3–4) compared to respondents with low physical activity levels. The magnitude of this odds ratio indicates that high-risk physical activity has significant clinical implications for the progression of knee OA in this study population. Nevertheless, the study results must still be interpreted with caution because there are other factors that could potentially influence the severity of knee OA such as duration of OA, occupation, history of knee injury, obesity, comorbidities, and treatments received by patients—which were not analyzed in this study. Therefore, the results of this study can serve as a basis for developing recommendations for safe physical activity, patient education, and medical rehabilitation programs to slow the progression of knee OA (Ma *et al.*, 2024).

4. CONCLUSION

This study shows that Physical Activity Level (PAL) is associated with the severity of knee osteoarthritis (OA) in patients at Wijayakusuma General Hospital in Purwokerto. Respondents with high physical activity levels were more likely to have knee OA with a higher severity than respondents with low physical activity levels. These findings indicate that physical activity level is one of the factors associated with the severity of knee OA. This study provides evidence regarding the relationship between Physical Activity Level (PAL) and the severity of knee OA in the local population of Banyumas, thereby complementing the scientific evidence, which to date has yielded mixed results. The results of this study are expected to serve as a basis for developing appropriate physical activity recommendations, patient education, and medical rehabilitation programs as efforts to slow the progression of knee OA and maintain joint function.

Future research is recommended to use a prospective cohort design with a larger sample size and to consider other factors that may influence the severity of knee osteoarthritis (OA), such as duration of OA, occupation, history of injury, comorbidities, and treatments received by patients, so that the relationship between physical activity levels and the severity of knee OA can be explained more comprehensively. Physical activity management tailored to each patient's condition is expected to be a key component in strategies to prevent the progression of knee osteoarthritis and to support more optimal rehabilitation practices and clinical care.

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