

RESEARCH ARTICLE

CORRELATION BETWEEN PHYSICAL ACTIVITY, BODY COMPOSITION, AND MICRONUTRITION INTAKE IN PATIENTS OF KNEE OSTEOARTHRITIS AT THE MEDICAL REHABILITATION CLINIC, FATMAWATI HOSPITAL JAKARTA IN 2021

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ABSTRACT

Background : Osteoarthritis (OA) is a degenerative joint disease associated with joint cartilage damage that usually occurs in the aging process. This study is to analyze the correlation between physical activity, body composition, and the micronutrients intake such as vitamin C, D, E, and Calcium the patients with knee OA at the Medical Rehabilitation Clinic (MRC) at Fatmawati Hospital, Jakarta in 2021.

Methods: This is a cross sectional quantitative research. The samples were 45 patients who have been diagnosed with knee osteoarthritis in outpatient medical rehabilitation clinic at Fatmawati General Hospital Jakarta who met the inclusion criteria.

Results : the results of statistical tests showed that there was a significant difference in the average percentage of body fat with the gradation of OA patients, p value = 0.004. However, there was no significant difference between the average physical activity score, and intake of macronutrients (energy, protein, fat and carbohydrates), BCAAs (arginine and histidine), and intake of micronutrients (vitamin C, vitamin D, vitamin E and Calcium)

Conclusion: Percent body fat is the variable with the highest correlation among other factors.

Keywords: genu osteoarthritis, physical activity, body composition, micronutrient intake

INTRODUCTION

The percentage of the elderly population in Indonesia has approximately doubled (1971-2020), to 9.92% (26 million). There is an increase in life expectancy followed by an increase in the number of elderly people, as Indonesia is starting to enter the aging population period. An important aspect that will have an impact on the quality of life of the elderly is health.¹ Osteoarthritis (OA) is a degenerative joint disease associated with joint cartilage damage that usually occurs in the aging process. The spine, pelvis, knees, and ankles are most commonly affected by OA. The prevalence of OA increases with age and generally affects women more often than men. Osteoarthritis is estimated to be the fourth most common cause of disability in the world. It is estimated that 80% of all cases of OA will experience limitations in movement, and 25% are unable to carry out daily activities. The economic, psychological and social impacts of OA are enormous, not only for sufferers, but also for families and the environment.²

Data from the Arthritis Research Campaign in 2000

showed that 2 million patients with knee OA went to a general practitioner or hospital, 550 thousand of whom suffered from severe knee OA (grade IV).³ The prevalence of radiological knee OA is quite high in Indonesia, reaching 15.5% for men and 12.4% for women. Osteoarthritis patients generally report of pain when doing activities or if there is a load on the affected joint. In more severe degrees, pain can be felt continuously so that it greatly interferes with the patient's mobility. The high prevalence of OA, which is chronically progressive and causes joint pain, causes OA to have a large socio-economic impact, both in developed and developing countries. It is estimated that 1-2 million elderly people in Indonesia suffer from disabilities due to OA.⁴ This joint disease has occurred in the community in the age range of 15-24 years with prevalence rate is around 1.3%, the prevalence rate continues to increase in age range 24-35 years (3.1%) and age range 35-44 years (6.3%). Prevalence of OA at the age of 40-60 years becoming 30% and even 65% at the age > 61 years.⁵

The prevalence of OA has increased over the past 20 years, and increased life expectancy and obesity are also risk

factors for OA. Potential risk factors for joint OA include age, gender, genetic predisposition, ethnicity, anatomical malalignments (hyper-lordosis, scoliosis, etc.), body composition (obesity), occupation (repeated flexion/extension, prolonged sitting, lifting objects), weight, and nutritional and lifestyle factors.² Osteoarthritis of the knee radiographically increases 4-fold on average in obese women, with an odds ratio (OR) between 2 and 9 (Kertia, 2012). The Chingford study showed that for every 2 unit increase in BMI (approximately 5 kg body weight) radiographically, knee OA increased with an odds ratio of 1.36 points. Increasing body weight will increase the risk of suffering from knee OA.⁶

Abbate Lauren M, showed that,⁷ show BMI (Body Mass Index) and body weight are strongly associated with knee OA in women (OR 5.27; 95% CI 3.05-9 and OR 5.28; 95% CI 3.05-9.16). The association of body composition and body fat distribution with knee OA in women is not clear yet. Obesity is caused by excessive fat accumulation which can increase body fat mass which is part of the components of body composition.⁶

Normal activity and exercise do not cause OA, but when these activities are carried out in very strenuous, repetitive or physically demanding jobs, it can increase the risk of OA. Strenuous work and exercise can increase the risk of knee OA.⁸ Strenuous physical activity such as long standing (2 hours or more per day), long distance walking (2 hours or more daily), lifting heavy objects (10 kg–50 kg for 10 or more times per week), pushing heavy objects (10 kg–50 kg for 10 or more times per week), going up and down stairs every day are a risk factors for knee OA.⁹ Excess fat accumulation can be caused by micronutrient intake that is not in accordance with needs or due to low physical activity.⁶ Nutritional factors influence the course of OA. Intake of foods that contain many micronutrients, such as vitamin E, vitamin C, and fruits which contains carotene can prevent the onset of OA. Several other studies have shown that there is an antioxidant effect of vitamin C and vitamin E. Vitamin C is required for collagen metabolism and vitamin E has an impact on mild inflammation or synovitis that occurs in OA. Excess consumption of vitamin E obtained from soybean, palm, and other oils were found to be twice as likely to experience knee OA. Vitamin D deficiency is also associated with an increased risk of joint space narrowing and the progression of OA.⁸

Antioxidants are micronutrients that provide defence against tissue injury, therefore intake of high antioxidant nutrients from food can protect joints against OA. In the Longitudinal Framingham Knee OA Cohort Study, a threefold reduced risk of developing OA was observed in people with high vitamin C intakes compared with those with low vitamin C intakes. Vitamin D deficiency also plays a role in the occurrence of OA.¹⁰

Many researchers have linked OA with the metabolic

syndrome. The ratio of BCAAs to histidine has potential for clinical use as a biomarker of OA. Branched-chain amino acids (BCAAs) such as valine, leucine and isoleucine are essential amino acids that make up about one-third of skeletal muscle protein, and are important fuels for energy metabolism. Lawrence first reported that diastolic blood pressure was associated with knee OA in women. Kellgren reported that OA was significantly associated with above-average serum cholesterol levels in women. Hart et al. found that metabolic factors such as glucose, (insulin resistance) hypercholesterolemia, and even hypertension treatment were associated with the development of OA.¹¹

Based on the description above, researchers are interested in examining the relationship between physical activity, body composition and intake of micronutrients in knee OA patients at the MRC at Fatmawati Hospital, Jakarta in 2021.

METHODS

This study used an observational research design with cross sectional method. The study was conducted in November 2021–April 2022 at the Medical Rehabilitation Clinic Fatmawati Hospital Jakarta. The population of this study were all patients who had been diagnosed with genu osteoarthritis who were outpatients at the Medical Rehabilitation Clinic Fatmawati Hospital Jakarta Fatmawati Hospital Jakarta. Sampling used purposive sampling with inclusion criteria, namely patients diagnosed with genu osteoarthritis who were outpatients at Medical Rehabilitation Clinic Fatmawati Hospital Jakarta Fatmawati Hospital Jakarta, aged 36-65 years. The research variables consisted of independent or independent variables are physical activity, body composition, and micronutrient intake and dependent variable is genu osteoarthritis gradation.

Data on the characteristics of respondents was obtained by direct interviews with respondents using identity questionnaires which included data on age, education, and occupation. Anthropometric data include weight, height and percent body fat. Measurement of body weight using a digital stamping scale with a capacity of 100 kg and an accuracy of 0.1 kg. Height was measured using a microtoice with a capacity of 200 cm and an accuracy of 0.1 cm. This percent body fat measurement uses Bioimpedance Analysis (BIA). Food intake data including vitamin C, vitamin D, vitamin E, and calcium were obtained using the 3 x 24 hour food recall method. The intake data obtained were analyzed using nutrisurvey and then compared with the nutritional adequacy rate (RDA). The instrument for measuring physical activity is the International Physical Activity Questionnaire – Short Form (IPAQ-SF) which is designed to

measure the respondent's physical activity based on the Metabolic Equivalent Task (MET) used for the last 7 days. Data analysis used SPSS 22.0 with Chi-Square.

ETHICAL APPROVAL

Ethical Approval: this research has obtained approval from The Research Ethics Committee of Dr. Hasan Sadikin General Hospital Bandung with registration number LB.02.01/X.6.5/58/2022.

RESULTS

Respondent characteristics

Data was collected by filling out a questionnaire with the interview method. The total number of respondents who met the inclusion and exclusion criteria was 45 people.

The description of the characteristics of these respondents includes gender, age, last education, and occupation. Based on the data in table 1. it can be explained that from 45 respondents 35 people (77.8%) were female and 10 people (22.2%) were male. Most respondents were in the late elderly age category or the age ranged from 56-65 years as many as 34 people (75.6%). Most of the respondents' last education who suffered from OA Genu was high school or the equivalent as many as 25 people (55.6%). The occupation of the respondent can be seen from table 4.1 is a housewife as many as 31 people (68.9%). This number is higher than the other categories, namely 3 civil servants/TNI/Polri, 2 entrepreneurs, 1 private employee and 8 people retired or not working (17.8%).

Table 1. Characteristics of patients with knee osteoarthritis at the medical rehabilitation clinic Fatmawati Hospital Jakarta in 2021

No.	Variable	Frequency (n)	Percentage (%)
1.	Gender		
	Man	10	22.2
	Woman	35	77.8
2.	Age		
	36-45	5	11.1
	46-55	6	13.3
	56-65	34	75.6
3.	Last education		
	Elementary school or equivalent	1	2.2
	Middle school or equivalent	3	6.7
	High school or equivalent	25	55.6
	College	16	35.6
	No school	0	0
4.	Work		
	PNS/TNI/Polri	3	6.7
	Self-employed	2	4.4
	Private sector	1	2.2
	Housewife	31	68.9
	Retired or not working	8	17.8

Correlation of physical activity with the degree of severity of Knee osteoarthritis

Table 2. Analysis of average physical activity (METs-min/week) calculation results of the IPAQ.

Variable	Frequency (n)	Min	Max	Mean	Std. Deviation
Score METs-min/week	45	466.50	1173.00	751.67	257.39

Based on table 2. Score METs-min/week Calculation results of the IPAQ Questionnaire Form (International Physical Activity Questionnaire) obtained the average value of physical activity is 751.67 ± 257.39 METs-min/week. Based on the category of physical activity, it is divided into 3 (three) namely light (<600 MET -min/week), moderate

(600–3000 MET–min/week), and severe >3000 MET –min/week). The following is the distribution of samples by category of physical activity. Based on the results of the study, the category of light physical activity was 26 respondents (57.8%) and the category of moderate activity was 19 respondents (42.2%).

Table 3. Analysis of differences in mean physical activity score (METs-min/week) based on OA Gradation

Variabel	Total				P-value
	Total (45)	Grade 2 (n=6)	Grade 3 (n=30)	Grade 4 (n=9)	
Physical Activity Score (METs-min/week)	751.67 ± 257.39	906.50 ± 247.87	719.15 ± 254.32	756.83 ± 263.73	0.271

The results showed that there was no significant difference in the score of physical activity in male and female respondents based on OA gradations, p value = 0.271.

Correlation of body fat percentage with the degree of severity of knee osteoarthritis

The results showed that from 45 respondents the average percent body fat was $30.19\% \pm 4.0\%$, which was

included in the obesity category. Respondents with grade 2 had a body fat percentage of $25.47\% \pm 6.23\%$ as many as 6 people and increased in grade 3 as many as 30 respondents with an average value of $30.56\% \pm 3.27\%$ and higher in grade 4, namely $32.13\% \pm 2.72\%$ in 9 respondents.

Table 4. Analysis of the difference in the average body fat percentage based on OA gradations.

Variabel	Total				P-value
	Total (n=45)	Grade 2 (n=6)	Grade 3 (n = 30)	Grade 4 (n=9)	
Persentase lemak tubuh (%)	30.19 ± 4.09	25.47 ± 6.23	30.56 ± 3.27	32.13 ± 2.72	0.004

The results obtained p value = $0.004 < 0.05$, it is concluded that there is a significant difference in the average body fat percentage based on the gradation of osteoarthritis genu.

Correlation of micronutrient intake with the degree of severity of knee osteoarthritis

The results of the analysis of differences in the average intake of micronutrients (vitamin C, vitamin D, vitamin E, calcium) based on OA gradations can be seen in table 5. The results of the Anova statistical test, from the table it can be

concluded that there is no significant difference in the average intake of micronutrients (vitamin C, vitamin D, vitamin E, and calcium based on OA grade, seen from p value > 0.05 . Average intake of vitamin C in respondents who have grade 2 OA is higher than grade 4 The average difference the intake of vitamin C was 2.71 ± 13.26 mg. The difference in the mean of vitamin D in grade 4 and grade 2 was 1.7 ± 0.79 g, the average difference of vitamin E in grade 2 and grade 4 was 0.08 ± 0.29 mg.

Table 5. Analysis of differences in average Intake of micronutrients based on OA gradations

Variabel	Total					P-value
	Total (n = 35)	Total (n=45)	Grade 2 (n=6)	Grade 3 (n = 30)	Grade 4 (n=9)	
Asupan Vitamin C (mg)	49.83 ± 42.3	46.64 ± 39.03	52.61 ± 53.53	44.31 ± 36.78	50.44 ± 40.27	0.853
Asupan Vitamin D (µg)	2.68 ± 3.15	2.52 ± 3.13	2.89 ± 3.68	1.82 ± 2.26	4.59 ± 4.47	0.059
Asupan Vitamin E (mg)	3.00 ± 0.9	2.99 ± 0.87	3.11 ± 0.58	2.95 ± 0.93	3.03 ± 0.87	0.914
Asupan Kalsium (mg)	212.45 ± 72.06	210.96 ± 69.72	205.56 ± 60.70	204.46 ± 69.22	236.22 ± 78.55	0.488

DISCUSSION

Correlation of physical activity with the degree of severity of knee osteoarthritis

Physical activity is any physical movement as a result of skeletal muscle contraction and is measured as energy expenditure. The results of the study using the Chi-square

test found that there was no significant relationship between physical activity and degree of severity of knee OA. In line with the research of Azlar et al., (2020) normal activities and exercises do not cause OA, but if these activities are carried out very strenuously, repetitively or physically demanding work, a person can increase the risk of OA.¹² Strenuous work and exercise can increase the risk of knee OA. Light physical

activity was mostly found in patients with grade 3 knee OA, while the moderate physical activity was mostly found in knee OA with grade 3. Based on the results of the study, the average value of physical activity was 751.67 ± 257.39 METs-min/week. The category of physical activity, was divided into light (<600 MET-min/week), moderate ($600-3000$ MET-min/week), and severe (>3000 MET-min/week). The light physical activity category was majority with 26 respondents (57.8%). This is in line with the results of the study of Yovita & Enesthesia (2015) with 57.8% respondents with knee OA had light physical activity with PAL values between 1.40 to 1.6.¹³

Correlation of body fat percentage with the degree of severity of knee osteoarthritis

Body fat percentage is an illustration of the amount of fat in the body. Body fat percentage can also determine a person's nutritional status in addition to BMI. Body fat percentage, can have a negative impact on health, as hypertension and coronary heart disease. Although the distribution of subcutaneous fat is the same for each individual, men and women tend to have different distributions. Women's body fat percentage tends to be higher than men's, due to various things such as anatomical and hormonal differences. The percentage of body fat is divided into, very good, good, moderate, overweight and obese.¹⁴ In this study, overweight and obesity categories were grouped based on the American Council on Exercise (2020), overweight categorized if the body fat percentage is 26-29% and obese if the body fat percentage is 30%, while men can be categorized as overweight if the body fat percentage is 19-24% and obese if the percent body fat 25%. Based on the results of the mean difference in respondents with normal nutritional status, overweight, and obesity, the results of the ANOVA test show, a significant difference in the percentage of fat body between groups of normal nutritional status, overweight and obese (p 0.000). The average value of body fat percentage in women and men are $30.34 \pm 3.54\%$ and $29.67 \pm 5.84\%$ respectively. The value of body percentage more than 30% in women and 25% in men categorized as obesity. Based on the results of this statistical test, it can be seen that the percentage of body fat of respondents with obese nutritional status has a higher mean value than respondents with normal nutritional status or overweight. The category of percent body fat for respondents who are overweight is in the overweight category and obese respondents are in the obesity category. The higher the BMI, the higher the percent body fat. This is in line with the research of Wannamethee et al., (2005), who found the fact that percent body fat has a correlation with BMI. The correlation between the results of the research states that the higher a person's BMI, the higher the percent body fat of that person.

Correlation of micronutrient intake with the degree of severity of knee osteoarthritis

Nutritional factors influence the course of osteoarthritis. Intake of foods that contain lots of micronutrients, such as vitamin E, vitamin C, and fruits that contain carotenoids can prevent the onset of osteoarthritis. Several other studies have shown that there is an antioxidant effect of vitamin C and vitamin E. Vitamin C is required for collagen metabolism and vitamin E has an impact on mild inflammation or synovitis that occurs in osteoarthritis. While delta and gamma, which are found in soybean, palm and other oils, were found to be twice as likely to experience knee osteoarthritis. Vitamin D deficiency is also associated with an increased risk of joint space narrowing and the progression of osteoarthritis.⁸ According to the Institute of Medicine, defining vitamin D is a nutrient that is needed in people with osteoarthritis, if vitamin D is not sufficient then the bones become thin, brittle and deformed. In the Framingham study, low and moderate levels of vitamin D can lead to three times the risk of developing knee osteoarthritis.¹⁵

Analysis of the most related factors

The variables studied in this study included physical activity, body fat percentage, and micronutrients intake (vitamin C, vitamin D, vitamin E, calcium). In the results of the study using multiples regression analysis test (multiple) to test the influential variables. It can be said that the body fat percentage variable is an influential variable than the other variables with a significant value of 0.006.

CONCLUSION

There is a significant difference in the average percentage of body fat based on the gradation of osteoarthritis genu. The higher the respondent's OA grade, the greater the average body fat percentage owned by the respondent, p -value= 0.004.

There is no difference in the average intake of physical activity, and micronutrients (intake of vitamin C, vitamin D, vitamin E, and calcium) with OA grades. The categorical variable of body fat percentage is the variable with the highest correlation.

CONFLICT OF INTEREST

None declared

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None

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