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HOW MUCH BMI AND PHYSICAL ACTIVITY LEVEL INDUCE ELEVATED URIC ACID?

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ABSTRACT
Gout is a disease by elevated uric acid that is categorized as a degenerative disease by process of decreasing organ function which generally occurs in old age but can also occur in adulthood due to decreased health status. The epidemiological studies showed that a high BMI triggers risk factors for lifestyle-related diseases such as type 2 diabetes, cardiovascular disease, cancer, and high uric acid. The other finding stated that regular exercise produces an immunomodulatory effect, which may contribute to health benefits. Despite the high prevalence of gout and evidence that underscores the benefits of physical activity in rheumatic diseases, there has been no discussion about the link between Body Mass Index (BMI), physical activity and elevated uric acid. The main objective is to analyze the body mass index and level of activity on uric acid levels, and the first specific objective is to describe the characteristics of the responden. The study conducted in Martapura 1 Public Health Center by an observational cross sectional design using linear regression models. Sixty-one respondents were collected using simple random sampling and questionnaire containing the result of BMI, physical activity level and uric acid was used to measure the data. Results: There is a significant effect between BMI and physical activity together on uric acid levels. There is a significant effect between BMI and activity together on uric acid levels. BMI variable = 6.102 (t count> t table = 2.00172) and the activity level variable = 2.234 (t count> t table = 1.67155) means that H0 is rejected Conclusions: Research showed that an increase in BMI can increase uric acid levels by controlling variabel of physical activity (B=0,31, P<0.001 in BMI; B=-0.002, P=0.029 in physical activity).

Keywords: BMI; physical activity; uric acid

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INTRODUCTION

Hyperuricemia is increased serum acid that is the cause of gout disease (Hinkle *et al.*,2022). Gout is a disease by elevated uric acid that is categorized as a degenerative diseaseby process of decreasing organ function which generally occurs in old age but can also occur in adulthood due to decreased health status (Kemenkes, 2013). Excess uric acid levels in the blood is called hyperuricemia. The prevalence and incidence of hyperuricemia differ substantially across geographic areas. According to data from the 2007-2016 National Health and Nutrition Examination Survey in America, the prevalence rate of hyperuricemia was 20.2% in men and 20.0% in women from 2015 to 2016. Reduction of the hormone estrogen production in postmenopausal women can reduce removal of uric acid from the body results in increased uric acid levels and an increased risk of developing hyperuricemia (Zhang et al, 2020).

Hyperuricemia is said to occur frequently in developed countries, but the fact is that hyperuricemia does not only occur in developed countries, but also in developing countries. Several studies were conducted in urban areas in Indonesia, namely Depok City, West Java, the prevalence of hyperuricemia was 18.6%, while in Denpasar, Bali the prevalence was 18.2% (Usman et al, 2019). Gout is a cause of arthritis which is characterized by inflammation induced by monosodium urate crystals in the joints, tendons and surrounding tissues. Excessive consumption of foods/drinks rich in purines and various health factors such as obesity can cause an increase in serum uric acid and form crystal deposits in the body. (Jeblonski et al, 2020).

The World Health Organization (WHO) announced BMI as the best epidemiological measure to use for overall obesity assessment, but is not suitable for explaining body fat distribution (Kashyap, 2012). BMI is a useful measurement of body fat based on measurements of weight and height (Soori et al, 2022). Body mass index (BMI) has been identified as a potential risk factor for major metabolic problems (Kuriyama et al, 2014). Other epidemiological studies show that a high BMI triggers risk factors for lifestyle-related diseases such as type 2 diabetes, cardiovascular disease, cancer, and high uric acid level (Ezzati et al, 2002; Wiseman, 2008).

Other epidemiological research related to uric acid is that regular exercise produces an immunomodulatory effect, which may contribute to health benefits. Exercise has been shown to improve anti-inflammation and overall health by reducing the incidence of co-morbidities (Benatti & Pedersen, 2015). Despite the high prevalence of gout and evidence that underscores the benefits of physical activity in rheumatic diseases (Holla et al, 2009), there has been no discussion about the link between BMI, physical activity and gout. This study has several objectives, the first is to determine the level of BMI in respondents, the second is to determine the level of physical activity in respondents, the third is to determine uric acid levels in respondents, the fourth is to analyze the effect of BMI on uric acid levels in respondents, the fifth is to analyze the effect of physical activity on levels gout and finally analyzed the effect of BMI and physical activity on gout using a linear regression test.

METHOD

This research took place at the Martapura 1 Public Health Center. Research conducted by quantitative research with an a cross sectional design. The independent variable in this study is physical activity. The dependent variables in this study were Body Mass Index (BMI) and Uric Acid Levels. Sixty-one respondents involved with criteria there are 18 years old or older, able to communicate, fast for 8 hours, willing to be respondents. The respondents with diabetes mellitus, stroke, heart disease, seriously ill condition, and who was not in place at the time of the study are exclused. Sampling was carried out by probability simple random sampling.

The instrument used was a questionnaire that containing the results of BMI examinations, uric acid levels, and the characteristics of the respondents including age, level of education, marital status. Measurement of the BMI variable uses digital weight scales and TB measurements. The Uric Acid Level variable uses the Easy Touched Uric Acid tool by taking blood samples using tools such as handscoon, alcohol cotton, lancet, and safety box. The B questionnaire contains the level of physical activity. The questionnaire used to measure the level of physical activity is the International Physical Activity Questionnaire (IPAQ) which has been tested for validity and reliability in Indonesia with a validity value above 0.8 and cornbach alpha 0.884 so that the questionnaire is valid and reliable to be used in Indonesia.

Each question from the questionnaire is easy to understand, the respondent only takes 2-5 minutes to complete the question (Dharmansyah & Budiana, 2021).

The IPAQ questionnaire consists of 7 questions based on physical activity. the results of the questionnaire assessment used were as follows: walking = 3.3 MET (Metabolic equivalents of task), moderate activity = 4.0 MET, and high activity = 8.0 MET; which is multiplied by the intensity in minutes and days, then summed to give a final score for activity. Data was collected by giving respondents using a questionnaire. The questionnaire used in this study was to determine physical activity, then BMI was measured using a digital scale to measure body weight and height which was measured using a stature meter brand OneMed, and the respondents' uric acid levels were measured using a digital measuring instrument brand Easy Touch. The research was analyzed by computer software program with pearson correlation to bivariate data, and multivariate data was used regressions linear models. The research was approved by the Departement of Ethic, Sekolah Tinggi Ilmu Kesehatan Intan Martapura.

RESULTS

Table 1.
Frequency distribution of respondents' characteristics (education, marital status, pain history, pain examination, last time uric acid level was checked) (n=30)

Education Level	f	%
Elementary school equivalent	18	24,3
Junior high school equivalent	12	16,2
High school equivalent	15	20,3
Higher Education	16	21,6
Total	61	100
Marital status		
Mating	36	59
Death divorce	25	41
Total	61	100
History of pain		
Yes	61	100
Total	61	100
Uric acid level check		
Ever	61	100
Total	61	100
Last time uric acid level waschecked		
1-3 months	34	55,7
4-6 months	27	44,3
Total	61	100

Based on the table above, it was found that the majority of respondents' education level was elementary school equivalent by 24,3%, marital status was married by 59%, had felt pain by 100%, had checked uric acid levels by 100%, and the last time to check uric acid levels was 1-3 months by 55.7%.

Table 2.
Statistical distribution of respondents (age, height, weight, BMI, physical activity level) (n=30).

Variable	Mean	Median	min-max	SD	95% CI
Age	62,69	63	43-81	9,568	60,17-65,12
Height	154,98	154.00	143-165	6,012	153,44-156,52
Weight	57,79	58,00	39-95	11,390	54,87-60,70

Based on the table 2, the mean age was 62.69, median 63, lowest value 43 and highest value 81, standard deviation 9.568 and 95% confidence level 60,17-65,12, mean height 154.98, median 154,00, lowest value 143 and highest value 165, standard deviation 6.012 and 95% confidence level 153,44-156,52, mean weight 57.79, median 58,00, lowest value 39 and highest value 93, standard deviation 11.390 and 95% confidence level 54,87-60,70.

Table 3.
Statistical distribution of respondents (body mass index, activity level anduric acid level) (n=30)

Characteristics	mean	median	min-max	SD	95% CI
Body mass index	23,25	23	16-31	3,78	22,28 - 24,21
Activity level	407,74	346	115-766	245,53	344,85 - 470,62
Uric acid levels	6,58	7	3-9	1,93	6,09-7,08

Based on the table 3, the mean body mass index is 23.258, median 23, lowest value 16 and highest value 31, standard deviation 3,78 and 95% confidence level 22,28-24,21, mean activity level is 407,74, median 346, lowest value 115 and highest value 766, standard deviation 245,53 and 95% confidence level 344,85-470,62, mean uric acid level of 57.83, median 57.50, lowest value 3 and highest value 9, standard deviation 1,93 and 95% confidence level 6,09-7,08.

Table 4.
Pearson correlations test analysis results between body mass index andactivity level with uric acid levels in Martapura 1 Health Center Working Area (n=61)

Variable	*ρ value*	*Pearson correlations*
Body mass index	<0,001	0,701
Activity level	<0,001	-0,481

Based on the table 4, the *ρ value of* body mass index is <0.001 (*ρ value <0*.05), meaning that H_0 is rejected, which means that there is a relationship between body mass index and uric acid levels, with *Pearson correlations* of 0.701. *ρ value of* activity level is <0.001 (*ρ value <0*.05) that means H_0 is rejected, which means there is a relationship between activity level and uric acid levels, with *Pearson correlations* of -0.481.

Table 5.
Results of multiple linear regression test analysis between body mass indexand activity level with uric acid levels in Martapura 1 Health Center Working Area (n=61)

Variables	Regression Coefficient	T count	Sig.
Constant	0,080		
IMT	0,311	6,102	<0,001
Activities	-0,002	-2,234	0,029
F count	32,984		0,000
R Square	0,532		

Based on the table 5, it is obtained that the constant is 0,080, meaning that if IMT and activity, the value is 0, then the value of uric acid levels is 0,080. The IMT regression constant of 0,311 means that if the other independent variables are fixed and IMT increases by 1%, then uric acid levels will increase by 0.311. The coefficient is positive, meaning that there is a positive relationship between BMI and uric acid levels, so the more BMI increases, the more uric acid levels increase. The activity regression constant of -0.002 means that if the other independent variables are constant and BMI increases by 1%, then

uric acid levels will increase by -0.002. The coefficient is negative, meaning that there is a negative relationship between activity and uric acid levels, so the higher the activity, the lower the uric acid levels.

Multiple correlation analysis obtained an R number of 0.729. This shows a strong relationship between BMI, activity and uric acid levels. The results of the determination analysis obtained the number R^2 (R Square) of 0.532 or 53,2%. This shows that the percentage of BMI and physical activity on uric acid levels is 53,2%. Or the variation of the independent variables used in the model (BMI and activity) is able to explain 53,2% while the remaining 46,8% is influenced by other variables notexamined.

The p value of BMI variable has <0.001 (ρ value <0.05), meaning that H_0 is rejected, in other words the Body Mass Index variable partially has a significant effect on uric acid levels, this is in line with the calculated t value of the BMI variable = 6.102 (t count> t table = 2.00172) which also means that H_0 is rejected, in other words the Body Mass Index variable partially has a significant effect on uric acid levels. (t table from df = 58, on a 2-sided test because t count is positive). The activity level variable has a ρ value = 0.029 (ρ value <0.05), meaning that H_0 is rejected, in other words the activity variable partially has a significant effect on uric acid levels, this is in line with the t value of the activity level variable = 2.234 (t count> t table = 1.67155) which also means that H_0 is rejected, in other words the activity variable partially has a significant effect on uric acid levels. (t table from df = 58, on a 1-sided test because t count is negative)

DISCUSSION

Hyperuricemia is an increase in uric acid levels in the blood. The upper limit of normal is 6.8 mg/dL, and more saturation point of crystal formation (Honan, 2019) The results of the research that has been done show that the average uric acid value of the respondents is 6.23 mg/dl with a maximum value of 9 mg/dl. This proves the uric acid examination results for all respondents tend to be high. High uric acid levels are the result of increased production, decreased uric acid excretion, or a combination of these two processes (George et al., 2023).

Increased uric acid can also be seen in accelerated purine degradation under conditions of high cell turnover such as conditions of hemolysis, rhabdomyolysis, and tumor lysis and decreased excretion due to conditions of renal insufficiency and metabolic acidosis. Hyperuricemia can cause gout and nephrolithiasis and their association as an indication of metabolic syndrome, diabetes mellitus, cardiovascular disease, and chronic kidney disease (Gherghina et al., 2022). High uric acid levels can cause complaints such as pain. The study conducted by Jonsson et al. (2019) stated that hyperuricemia can be a cause of joint pain, especially joint pain in the hands in elderly women. In the study, the results showed that the majority of respondents had experienced joint pain. Although joint pain does not only occur with elevated uric acid levels, this finding can be a predictor in the treatment of hyperuricemia.

According to the study of Lin et al. (2019), hyperuricemia is more prone to occur in men because the hormone estrogen in women increases uric acid clearance in the kidneys and decreases post-tubular secretion reabsorption but as aging occurs sex hormones in women also decrease with the onset of menopause so that the positive effect of these hormones on uric acid also decreased. This study is in line with the results of this study with the majority of respondents being women but with an average age of 62.37 years.

According to Santos et al. (2021), the level of knowledge about arthritis caused by increased uric acid is still low. The cause of the low level of knowledge can be caused by a low level of education because basically, a high level of education is easier to receive and understand the information

provided (Aupia, 2021). In this study, it was found that the majority of respondents' education level was an elementary school (24,3%).

The results showed that an increase in BMI of 1kg/m2 could increase uric acid levels by 0.3 mg/dl after controlling for physical activity variables with a p-value = <0.001. This means that variables can significantly predict uric acid levels. The results of the study are in line with the findings of Klongthalay et al. (2020) who stated that there is a relationship between the level of obesity on the body mass index and an increase in uric acid because it is alleged that the impact of visceral obesity and adipose tissue is the site of activity of xanthine oxidoreductase which will produce a by-product in the form of uric acid.

As for the physical activity variable in this study, the results obtained were p <0.01, meaning that the uric acid value was significantly predictable by the physical activity variable. In table 3 shows maximal value of activity level is 799 METs-minute/week which means a moderate level of activity. This is in line with the research of Prasetyawan and Hidayati (2018) which states that excessive physical activity will have an impact on the accumulation of uric acid levels because high physical activity will result in the production and assembly of lactic acid in the body which causes muscle pain, and as a result of an accumulation of lactic acid can reduce the secretion of uric acid. The results of this study can be essential findings in the self-management of patients with hyperuricemia to maintain health by controlling BMI and doing physical activity according to the portion needed by the body. The uric acid level may be elevated by the intensity of Physical activity because vigorous exercise induces excessive oxidative stress that may induce an increase in the serum uric acid level (Hadano 1988; Nishida, 2011). Apart from this, other factors such as diet and medication are also important things that can affect uric acid levels in a person's body. Low purin diet and yoga exercise 60 minutes three times a week can reduce uric acid (Kusmayanti & Dewantari, 2017).

CONCLUSION

The average BMI was 23,25 kg/m^2 with a median of 23 kg/m^2, the lowest was 16 kg/m2 and the highest was 31 kg/m^2. The activity level obtained an average of 407,74 METs-minutes/week, the median was 346 METs-minutes/week, the lowest value was 115 METs-minutes/week and the highest value was 766 METs-minutes/week. There is a significant effect between BMI and activity together on uric acid levels. BMI variable = 6.102 (t count> t table = 2.00172) and the activity level variable = 2.234 (t count> t table = 1.67155) means that H_0 is rejected.

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