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Relationship Between Body Mass Index Values and Uric Acid Levels in The Elderly at Jungkat Health Centre Mempawah Regency

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Abstract
The increasing prevalence of obesity among the elderly has been linked to various health complications, including elevated serum uric acid levels. Hyperuricemia, in turn, may contribute to conditions such as gout and cardiovascular disease. This study aims to investigate the relationship between body mass index (BMI) and uric acid levels in the elderly, with the goal of highlighting the importance of weight management in mitigating health risks in this age group. This research employed an observational analytic approach with a cross-sectional design. The study population consisted of elderly individuals residing within the service area of Jungkat Health Center, Mempawah Regency. A total of 46 participants were selected using purposive sampling. Data collection involved direct anthropometric measurements to determine BMI and uric acid analysis using the point-of-care testing (POCT) method. The results indicated that a majority of participants had BMI values within the obese category and elevated serum uric acid levels. Notably, 24 individuals (52.2%) exhibited hyperuricemia. Statistical analysis using the Chi-square test revealed a significant association between BMI and uric acid levels ($p = 0.000$, $p < 0.05$), confirming the hypothesis. In conclusion, there is a statistically significant relationship between BMI and uric acid levels among the elderly at Jungkat Health Center.

Keywords: Body Mass Index, Uric Acid

Introduction
The aging process, which naturally occurs with increasing age, leads to cellular degeneration and a decline in the function of various organ systems. Consequently, older adults become more susceptible to degenerative diseases such as hypertension, cardiovascular disorders, endocrine dysfunctions, and joint diseases, including hyperuricemia. In recent decades, there has been a shift in the disease pattern in developing countries—from infectious diseases to non-communicable diseases—driven by lifestyle changes, urbanization, and globalization.[1]

Hyperuricemia is a condition characterized by elevated serum uric acid levels, which can lead to the formation of urate crystals in the joints. These deposits can trigger intense inflammation and pain, commonly known as gout. Uric acid is the final product of purine metabolism and serves as an antioxidant at normal levels. However, excessive production or impaired excretion can result in its accumulation in the blood.[2]

The normal range for serum uric acid levels is 3.0–7.0 mg/dL in men and 2.4–6.0 mg/dL in women[3] ,Globally, the prevalence of hyperuricemia is on the rise, influenced by high-purine diets, increased sugar and alcohol consumption, and the growing incidence of obesity. In the United States, the prevalence ranges from 20% to 25%, while in Indonesia, the prevalence of joint disorders increased from 11.9% in 2013 to 13.3% in 2018. Gout is more commonly found in men, and about 10% of cases in postmenopausal women are thought to be associated with decreased estrogen levels.[4]

Indonesia ranks fourth globally in gout prevalence, with an estimated 840 cases per 100,000 population. Risk factors contributing to this condition include sex, body mass index (BMI), and dietary intake of carbohydrates and purines.[5]

According to Law No. 13 of 1998, elderly individuals are defined as those aged 60 years and above. At this stage of life, there is a general decline in physical, mental, and social functions. Hyperuricemia in older adults may be linked to reduced activity of the enzyme uricase, which plays a role in breaking down uric acid into more excretable forms.[6] Therefore, maintaining a balance between uric acid production and excretion is crucial for regulating its levels in the body.

Body mass index (BMI) is a simple anthropometric measure to assess nutritional status, calculated by dividing weight by height squared (kg/m^2). BMI has a positive correlation with body fat and is commonly used to classify the risk of overweight and obesity. According to the World Health Organization (WHO), normal BMI ranges from 18.5 to 24.9 kg/m^2, with increased health risks observed in individuals with BMI ≥ 25 kg/m^2.[4]

Previous research conducted in Senggrong Village, Boyolali Regency, demonstrated a significant correlation between BMI and serum uric acid levels among the elderly, with a p-value of 0.000 and a correlation coefficient of 0.655.[6] Jungkat Public Health Center (Puskesmas Jungkat), located in Mempawah Regency, is one of the healthcare facilities with a high number of uric acid examinations, especially among older adults. According to the 2018 Basic Health Research (Riskesdas) data[7], the prevalence of joint disorders in Mempawah Regency was 14.79%, with a significant increase observed in the population aged 55 years and above.

Given this context, the present study aims to analyze the relationship between body mass index (BMI) and serum uric acid levels among elderly individuals at Jungkat Public Health Center, Mempawah Regency

Materials and methods

This study employed a cross-sectional design. A cross-sectional study is used to examine the relationship between independent and dependent variables through a one-time measurement at a single point in time.

Population and Sample

The population of this study consisted of elderly individuals living within the working area of Jungkat Public Health Center (Puskesmas Jungkat), Mempawah Regency. The sample included 46 elderly participants who met the inclusion criteria. Inclusion criteria were: aged 60 years or older, willing to participate as respondents, registered as residents within the working area of Puskesmas Jungkat, and domiciled in Jungkat, Mempawah Regency. The exclusion criteria included participants who were not present at the time of data collection or unable to be contacted.

Sampling Technique

The sampling method used in this study was purposive sampling. This technique was chosen based on the characteristics of the population and the specific criteria required for the research subjects.

Data Collection Instruments

The instruments used for data collection included observation sheets, a digital body weight scale, a microtoise for measuring height, and a point-of-care testing (POCT) device for uric acid testing.

Body Weight Measurement

Body weight was measured using a digital scale placed on a stable, flat surface in a well-lit location. Participants were asked to remove shoes, jackets, hats, and other outerwear. The assessor stood beside or in front of the scale to supervise the process. Participants stood in the center of the scale platform, facing forward in an upright position and remaining still. It was ensured that participants did not touch any objects or other individuals during the process. Once the reading stabilized, the body weight was recorded. Participants were then allowed to step down and put their footwear and clothing back on.

Body Height Measurement.[8]

Height was measured using a microtoise mounted vertically on a wall at a 90° angle to the floor. The device was first checked to ensure it was securely attached and aligned at the zero mark. Participants removed their shoes and any head accessories. They were instructed to stand upright with their heels and calves touching the wall, feet flat on the floor, arms at their sides, and head facing forward. The headpiece was lowered gently to touch the top of the head. Height was recorded to the nearest 0.1 cm. Participants were then permitted to put their shoes and accessories back on.

Body Mass Index (BMI) Calculation

$$BMI = \frac{Weight\ (kg)}{Height^2\ (m^2)}$$

Weight and height values obtained from previous measurements were used in this calculation.

Capillary Blood Sampling.[9,10]

Capillary blood sampling was performed on participants by collecting blood from the fingertip using standardized aseptic techniques. The procedure followed current clinical guidelines, utilizing sterile equipment including a single-use lancet, alcohol swab, sterile gauze, and an adhesive bandage. The healthcare professional conducted hand hygiene and donned disposable gloves prior to sample collection. The chosen fingertip was cleaned with an alcohol swab and allowed to air dry to prevent hemolysis. A sterile lancet was then used to make a swift puncture at the fingertip. The initial drop of blood was discarded to minimize contamination with tissue fluid, and subsequent drops were gently collected for analysis. After sample collection, the puncture site was dressed with an adhesive bandage

Uric Acid Testing Using POCT.[11]

Uric acid levels were measured using a point-of-care testing (POCT) device. A test strip was inserted into the device, which automatically activated and displayed the strip code. A drop of capillary blood was applied to the test area on the strip. The result was displayed on the device screen within approximately 30 seconds.

Data Analysis

Data analysis was performed using Statistical Product and Service Solutions (SPSS) version 16 for Windows. The analysis included both univariate and bivariate approaches. The Chi-square test was used to examine associations between categorical variables in the bivariate analysis.

Results

Univariate analysis was conducted to obtain an overview of each variable individually. This analysis was performed using statistical tests and is presented in the form of tables and narratives. The results of the tests can be seen in the table below:

Table 1. Frequency Distribution of Respondents by Age

Age Range (years)	Frequency	Percentage (%)
60 – 70	38	82.6
71 – 84	8	17.4
Total	46	100.0

Table 1 shows the frequency distribution of respondents by age group. The majority of participants were aged between 60 and 70 years, totaling 38 individuals, which accounts for approximately 82.6% of the total respondents. In contrast, the older age group, ranging from 71 to 84 years, comprised only 8 individuals, or about 17.4%. This indicates that the predominant population in this study was within the 60–70-year age group, while the older age group, although present, was relatively underrepresented.

Table 2. Frequency Distribution of Respondents by Body Mass Index (BMI) Category

BMI Category	BMI Range (kg/m^2)	Frequency	Percentage (%)
Underweight	<18.5	2	4.3
Normal	18.5 – 22.9	13	28.3
Overweight	23 – 24.9	7	15.2
Obese	25 – 29.9	24	52.2
Total		46	100.0

Table 2 shows the frequency distribution based on Body Mass Index (BMI) categories. Most respondents fell into the overweight category (BMI 25.0–29.9), with 24 individuals or about 52.2% of the total population. The normal weight category (BMI < 25.0) included only 13 individuals (28.3%), whereas the obese category (BMI 30.0–34.9) consisted of 6 individuals (13%). These findings highlight a high prevalence of overweight and obesity among the elderly population in this study, which is noteworthy due to its implications for increased health risks.

Table 3. Minimum and Maximum BMI Values of Respondents

N	Minimum (kg/m^2)	Maximum (kg/m^2)	Mean (kg/m^2)
46	18.0	34.0	25.172

Table 3 shows the mean BMI of respondents was approximately 25.172 kg/m^2. The minimum recorded BMI was 18.0 kg/m^2, which falls within the lower range of the normal category, while the maximum BMI was 34.0 kg/m^2, categorized as class I obesity. This range suggests that most respondents were at the upper boundary of the normal range or in the early stages of obesity, indicating that adiposity is a prevailing concern in this population.

Table 4. Frequency Distribution of Uric Acid Levels by Sex

Sex	Uric Acid Level	Frequency (N)	Percentage (%)	Total (N)	Total (%)
Male	Normal	13	28.3	21	45.7
	High	8	17.4		
Female	Normal	7	15.2	25	54.3
	High	18	39.1		
Total		46	100.0		

Table 4 presents the frequency distribution of serum uric acid levels by sex. A greater number of females exhibited hyperuricemia, with 18 women (39.1%) recording elevated uric acid levels compared to 8 men (17.4%). Conversely, a higher proportion of men had normal uric acid levels, with 27 individuals in this category. These data suggest that older women are more susceptible to hyperuricemia, potentially due to hormonal and metabolic changes post-menopause.

Table 5. Minimum and Maximum Uric Acid Levels of Respondents

N	Minimum (mg/dL)	Maximum (mg/dL)	Mean (mg/dL)
46	4.2	11.0	7.233

Table 5 shows the minimum, maximum, and mean values of serum uric acid levels. The average uric acid level among all respondents was approximately 7.233 mg/dL, with a minimum of 4.2 mg/dL and a maximum of 11.0 mg/dL. This indicates that most participants had uric acid levels near or above the upper normal limit of 6.0 mg/dL. A substantial number of respondents exhibited values exceeding 7.0 mg/dL, which is a diagnostic indicator of hyperuricemia and associated with an elevated risk of conditions such as gout and renal dysfunction.

Table 6. Frequency Distribution of Uric Acid Levels by Body Mass Index (BMI)

BMI Category	Uric Acid Level	Frequency (N)	Percentage (%)	Total (N)	Total (%)
Underweight	Normal	2	4.3	2	4.3
	High	0	0.0		
Normal	Normal	13	28.3	13	28.3
	High	0	0.0		
Overweight	Normal	5	10.9	7	15.2
	High	2	4.3		
Obese	Normal	0	0.0	24	52.2
	High	24	52.2		
Total		46	100.0		

Table 6 shows the relationship between BMI categories and serum uric acid levels. Among individuals classified as overweight or obese, 24 (52.2%) had elevated uric acid levels. In contrast, all respondents within the normal BMI range exhibited normal uric acid levels. These results suggest a strong correlation between higher BMI and increased uric acid levels. Respondents with elevated BMI were more likely to experience hyperuricemia, supporting the hypothesis that obesity is a major risk factor for metabolic disturbances related to uric acid.

Table 7. Chi-Square Test of the Relationship Between Body Mass Index and Uric Acid Levels in Elderly Individuals at Jungkat Community Health Center, Mempawah Regency

Test Statistic	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	28.049	1	.000		
Continuity Correction	24.976	1	.000		
Likelihood Ratio	31.821	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	27.439	1	.000		
Number of Valid Cases	46				

Table 7 shows the results of a chi-square statistical test evaluating the association between BMI and uric acid levels. The analysis yielded a p-value of 0.000, which is significantly below the alpha threshold of 0.05. This indicates a statistically significant association between the two variables. In other words, individuals with higher BMI values are more likely to exhibit elevated serum uric acid levels. These findings reinforce the role of obesity as a critical determinant in the development of hyperuricemia among the elderly population studied.

Discussion

This study showed that the majority of respondents fell into the obese category. Obesity in the elderly represents a state of imbalance between energy intake and energy expenditure over an extended period. Energy intake from food consumption exceeds the energy expended for metabolism and daily physical activity. The excess energy is stored as fat in adipose tissue, leading to weight gain. High energy intake is often caused by the consumption of high-fat and high-calorie foods, while low energy expenditure is due to insufficient physical activity.[12]

Physical activity also influences uric acid levels, as inadequate physical activity can increase lactic acid production, which may reduce uric acid excretion. If uric acid is not efficiently excreted by the kidneys, it can accumulate in the body.[13]

In this study, the highest prevalence of obesity was found among elderly women. This trend is consistent with previous research indicating that older women are more susceptible to obesity than men, particularly due to hormonal changes associated with menopause. The decline in estrogen levels after menopause significantly alters body fat distribution, leading to increased central adiposity. Estrogen is known to play a regulatory role in lipid metabolism and fat distribution; thus, its reduction contributes to a shift of fat accumulation from the gluteofemoral region to the abdominal area, increasing the risk of obesity in postmenopausal women.[14,15] Additionally, lower estrogen levels can impair energy balance and fat oxidation, further promoting adiposity in this population.

In contrast, men experience a gradual decline in testosterone with age; however, this decline does not have the same direct effect on fat distribution as estrogen deficiency does in women. Testosterone plays a critical role in maintaining muscle mass and metabolic rate, and its reduction may contribute less significantly to obesity compared to the marked metabolic changes associated with estrogen loss in postmenopausal women.[16,17] Men are more likely to accumulate visceral fat, which is metabolically active and closely linked to metabolic syndrome and cardiovascular risk, potentially explaining sex-based differences in obesity prevalence.[18] Furthermore, muscle mass—being more metabolically active than adipose tissue—is generally higher in men, which contributes to higher basal metabolic rate and greater energy expenditure.[19]

The findings of this study showed that among male respondents, 13 individuals (28.3%) had normal uric acid levels, while 8 individuals (17.4%) had elevated levels. Among female respondents, 7 individuals (15.2%) had normal levels, while 18 individuals (39.1%) had elevated uric acid levels. These results indicate that a greater proportion of women had elevated uric acid levels compared to men within the sample group.

This condition is closely related to the physiological role of estrogen in women. Estrogen, the primary female sex hormone, exerts a protective effect on uric acid metabolism by enhancing renal uric acid excretion. It increases the glomerular filtration rate and modulates the expression of urate transporters in the kidney, facilitating uric acid clearance from the bloodstream.[20] After menopause, the significant decline in estrogen levels impairs this excretory function, leading to elevated serum uric acid concentrations in postmenopausal women.[21]

In contrast, testosterone is the principal androgen in men and is primarily involved in the regulation of metabolism, muscle mass, and body composition. Although testosterone does not directly modulate uric acid excretion, it may have an indirect effect on uric acid metabolism through its influence on muscle turnover and purine metabolism. However, this effect is considerably less pronounced than the influence of estrogen in females.[22]

The results of the study revealed a statistically significant correlation between body mass index (BMI) and uric acid levels among the elderly, as indicated by a p-value of 0.000, which is less than the alpha level of 0.05. This suggests that individuals with obesity tend to have higher uric acid levels.

This finding supports the theory that individuals with excessive body weight generally have excessive dietary intake, including high levels of purine, carbohydrates, proteins, and fats. Excess body weight also places pressure on the joints, impairs uric acid excretion, and contributes to insulin resistance.[23]

High uric acid levels in overweight and obese individuals are often attributed to increased adiposity, which is strongly associated with insulin resistance—a central component of metabolic syndrome that also includes hypertension, dyslipidemia, and hyperinsulinemia. These metabolic disturbances have all been linked to elevated serum uric acid concentrations.[24,25]

In addition, women are more likely to experience obesity due in part to lower basal metabolic rates compared to men, a difference primarily driven by reduced lean muscle mass.[26,27] Since skeletal muscle is more metabolically active than adipose tissue, lower muscle mass results in fewer calories burned at rest, increasing the risk of weight gain when energy intake exceeds expenditure. In women, obesity may also enhance purine turnover and subsequently increase uric acid production.[28] Furthermore, excessive adipose tissue may impair renal function and uric acid clearance. Increased body weight imposes a higher glomerular filtration load, potentially leading to decreased renal excretion of uric acid.[29]

Conclusion

This study found that the majority of elderly individuals at Jungkat Public Health Center were classified as obese, with a higher prevalence of elevated uric acid levels observed among women. A statistically significant relationship was identified between body mass index (BMI) and uric acid levels, indicating that increased BMI is associated with higher uric acid concentrations in the elderly population.

Conflict of interest

Authors state no conflict of interest.

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