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Correlation Between Body Mass Index, Blood Pressure, Uric Acid, Total Cholesterol Levels and Age

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Abstract
Obesity increases blood pressure, thereby increasing the risk of heart disease and is recognized as a major factor in the development of hypercholesterolemia and increased uric acid levels. This study aimed to evaluate the relationship between Body Mass Index (BMI), serum uric acid levels, total cholesterol, systolic and diastolic blood pressure, and age. Using a purposive sampling method, 49 respondents participated in a descriptive correlation study. Blood sample analysis was performed to determine total cholesterol and uric acid levels, as well as blood pressure and body mass index (BMI) measurements. Univariate and bivariate analyses based on correlation tests were part of the analytical strategy. A significant relationship of 0.014 < 0.05 between gender and cholesterol was observed. Age and systolic blood pressure variables were statistically significant (p < 0.05). The statistical significance of systolic and diastolic blood pressure was determined at 0.000 < 0.05. With a significance value of 0.006 < 0.05, there was a statistically significant relationship between diastolic blood pressure and body mass index. The statistical significance of uric acid and age was found to be 0.040 < 0.05. Managing lifestyle and maintaining a healthy weight are crucial in preventing hyperuricemia, high blood pressure, and lipid abnormalities.

***Keywords**: BMI, Hypertension, Total cholesterol, Uric acid.*

Abstrak
Obesitas meningkatkan tekanan darah sehingga meningkatkan risiko penyakit jantung dan diakui sebagai faktor utama dalam perkembangan hiperkolesterolemia dan peningkatan kadar asam urat. Penelitian ini bertujuan untuk mengevaluasi hubungan antara Indeks Massa Tubuh (IMT), kadar asam urat serum, kolesterol total, tekanan darah sistolik dan diastolik, serta usia. Dengan menggunakan metode sampling purposif, 49 responden berpartisipasi dalam studi korelasi deskriptif. Analisis sampel darah dilakukan untuk menentukan kadar kolesterol total dan asam urat, serta pengukuran tekanan darah dan indeks massa tubuh (IMT). Analisis univariat dan bivariat berdasarkan uji korelasi menjadi bagian dari strategi analitis. Hubungan yang signifikan sebesar 0,014 < 0,05 antara jenis kelamin dan kolesterol diamati. Variabel usia dan tekanan darah sistolik terbukti secara statistik signifikan (p < 0,05). Signifikansi statistik tekanan darah sistolik dan diastolik ditentukan sebesar 0,000 < 0,05. Dengan nilai signifikansi 0,006 < 0,05, terdapat hubungan yang signifikan secara statistik antara tekanan darah diastolik dan indeks massa tubuh. Signifikansi statistik asam urat dan usia ditemukan sebesar 0,040 < 0,05. Mengelola gaya hidup dan menjaga berat badan yang sehat sangat penting dalam mencegah hiperurisemia, tekanan darah tinggi, dan kelainan lipid.

Kata Kunci: Asam Urat , BMI, Hipertensi, Kolesterol Total

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Introduction

One way to measure nutritional status and body fat percentage is by looking at the body mass index (BMI) (Nuttall, 2015). Hypertension and other CVDs are more likely in those with a high body mass index (BMI) (Chen et al., 2018). According to Sacco et al. (2016), the leading cause of death worldwide is cardiovascular disease (CVD). According to Kemenkes (2018), cardiovascular disease accounts for 26.4% of all fatalities in Indonesia. A quarter of all fatalities in Indonesia are attributed to cardiovascular disease. Similarly, obesity is still a huge problem for global public health. The global obesity epidemic is showing no signs of abating, with over one billion individuals now considered obese as of 2022 (Phelps et al., 2024). A number of metabolic illnesses have been linked to obesity, including type 2 diabetes, cardiovascular disease, and hypertension (Macmohan et al., 1987; Maggio & Pi-Sunyer, 2003; Ortega et al., 2016). Weight also increases the likelihood of developing these conditions. Health services in Indonesia are therefore focused on reducing obesity and hypertension.

Changes in body weight significantly affect the risk of hypertension and blood pressure levels, according to many research (Vallée et al., 2019). Over a five-year follow-up period, the health research located a positive association between a one-kilogram weight shift and a 0.45-mm Hg change in systolic blood pressure (SBP) and a 0.32-mm Hg change in diastolic blood pressure (DBP) (Li et al., 2014). Hypertension was more common and blood pressure was higher in those who gained weight (J. Stevens et al., 2002). Additionally, weight reduction successfully lowers blood pressure, according to clinical research (V. J. Stevens et al., 2001).

The accumulation of fat cells in the body due to obesity raises blood pressure because the heart has to work harder to pump blood. This, in turn, activates the sympathetic nervous system, which causes arterial vasoconstriction and peripheral resistance (Li et al., 2014). An increased risk of hypertension, high blood pressure, or obesity-related hypertension is connected with an increase in body mass index (BMI) (H. Chen et al., 2018). There is a positive correlation between body mass index (BMI) and blood pressure; specifically, systolic blood pressure (SBP) rises with increasing BMI, and obesity increases the risk of SBP elevation (H. Chen et al., 2018). The risk of hypertension increases with increasing body mass index (BMI) in both adults and children (Li et al., 2014).

Because people with extra body fat tend to have abnormalities of lipid metabolism, the research found that those with a high body mass index (BMI) also tend to have elevated total cholesterol levels (Sowers et al., 2001). Elevated blood cholesterol levels are associated with elevated free fat levels, which in turn are associated with an elevated body mass index (BMI) (Al Rahmad, 2021). A worsening of the blood lipid profile may occur physiologically when there is an excess of adipose tissue, since it can lead to an increase in cholesterol and triglyceride production in the liver and a decrease in insulin sensitivity (Bray et al., 2016). There is a statistically significant correlation ($p < 0.05$) between uric acid and cholesterol in the adult population of Wiyono and Taman Sari Villages, Gedung Tataan District, Pesawaran Regency, Lampung. Cholesterol and blood sugar were shown to have a correlation value of $0.019 < 0.05$ (Siagian et al., n.d.). Between body mass index and total cholesterol levels, a favourable association is shown in urban populations (Rahmawati, 2021).

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As a result of their increasing prevalence, obesity, hyperuricemia, and associated health problems have recently emerged as major public health concerns. Previous pathophysiological and metabolic studies have shown that increases in obesity and UA content may interact, even though these changes have been found to occur independently. According to previous research by Ali et al. (2020), Zeng et al. (2021), and M. Y. Chen et al. (2017), there is a strong correlation between UA and obesity in adult populations of China, Japan, India, Pakistan, and Iraq. Many pathways may account for the correlation between UA and excess body fat. Hyperuricemia and poor UA metabolism may be caused by insulin resistance, which is associated with obesity and excess body fat (Matsuura et al., 1998). Another factor is a sedentary lifestyle and poor eating habits. Andi Makbul Aman (2019) found that people with a high body mass index (BMI) tend to have unhealthy lifestyles, which in turn affect blood lipid profiles. Hence, this research set out to connect people' body mass index (BMI) to their systolic blood pressure (SBP), diastolic blood pressure (DBP), and total cholesterol..

Methods

Using a purposive sampling strategy, this study employed a descriptive correlation multivariate methodology. Beringin Jaya Village in Bandar Lampung City, Kemiling District, was selected for investigation into this area of study. Using a selection process in which participants fasted for 10 hours and met the predetermined blood test (cholesterol and uric acid) criteria, there were 49 adults who met our inclusion criteria; while other participants who did not meet these criteria only underwent BMI, blood pressure, and random blood sugar checks. Participants were at least 19 years old, willing to participate, and not currently taking medication for chronic conditions that could affect their cholesterol or uric acid levels. Ethical permission number 517/KEPK-FIK.UNAI/EC/VII/25 was obtained for this investigation.

Using a digital Accu Check meter and capillary blood samples, the levels of total cholesterol and uric acid were determined. Whereas in the past, participants were told to fast for 10 hours the night before to their blood sample collection the following morning. Weight in kilograms divided by height in square meters is the formula for body mass index (BMI), which was employed in this research (Consultation, 2000). After that, three groups were used to classify the BMI. In order to define hypertension, blood pressure measures were taken with either the mean diastolic blood pressure (DBP) or systolic blood pressure (SBP) being equal to or more than 140 mm Hg. In addition, according to Chobanian et al. (2003), blood pressure may be categorized as pre-hypertension if the systolic blood pressure (SBP) is 120–139 or diastolic blood pressure (DBP) is 80–89 mm Hg, as stage 1 hypertensive if the systolic blood pressure (SBP) is 140–159 mm Hg or DBP is 90–99 mm Hg, and stage 2 hypertensive if the diastolic blood pressure (SBP) is 160 mm Hg or above, or if diastolic blood pressure (DBP) is 100 mm Hg or more.

BMI was defined as the person's weight in kilograms divided by the square of the person's height in meters (kg/m²). The World Health Organization (WHO) categorizes BMI for adults over the age of 20 years as follows: underweight, < 18.5 kg/m²; normal weight, 18.5-24.9 kg/m²; pre-obesity, 25-29.9 kg/m²; stage 1 obesity kg/m², 30-34.9 kg/m²; stage 2 obesity, 35-39 kg/m²; and stage 3 obesity, > 40 kg/m². Normal levels are < 200 mg/dL. Levels that have begun to increase and require monitoring and control (borderline high) are 200-239 mg/dL. Dangerously high levels are > 240 mg/dL (P2PTM Kemenkes RI, 2019). Normal uric acid levels in men are < 7.00 mg/dL, while in women < 6.0 mg/dL (Saito et al., 2021). The

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demographic information gathered from the survey allowed us to calculate the average age of the participants.

The Pearson correlation test was used to analyze the data and look for a connection between age, uric acid levels, cholesterol. The SPSS version 25 was used for the statistical analysis. Upon completion of the examination, a health worker counselled each respondent on the NEWSTART lifestyle factors, which include proper nutrition, regular exercise, adequate water intake, exposure to natural light, adequate sleep, and a strong belief in God.

Results

Table 1. Distribution of Characteristics (n=49)

Variables	Category	Frequency	Percentage (%)
Gender	Man	17	34.7
	Woman	32	65.3
Age	Young Adult	7	14.3
	Middle Adulthood	26	53.1
	Older Adult	16	32.7
BMI	Underweight	2	4.1
	Normal Weight	17	34.7
	Overweight	24	49.0
	Obesity Class type 1	5	10.2
	Obesity Class type 2	1	2.0
Systolic Blood Pressure	Normal	21	42.9
	Pre-Hypertensive	12	24.5
	Stage 1 Hypertensive	10	20.4
	Stage 2 Hypertensive	6	12.2
Dyastolic Blood Pressure	Normal	42	85.7
	Stage 1 Hypertensive	7	14.3
Total Cholesterol	Normal	15	30.6
	High	34	69.4
Uric Acid	Normal	29	59.2
	High	20	40.8

The majority of respondents were middle-aged adults (53.1%), and 65.3% of the respondents were female. Among those with a body mass index (BMI), 49% were found to be overweight. According to the data in the table, 24.5% of people had pre-hypertension systolic blood pressure and 14.3% had stage 1 hypertensive diastolic blood pressure. Uric acid was also in the high range at 40.8%, while cholesterol was at 69.34%.

A significant link between gender and cholesterol is seen in Table 2, with a sig value of 0.014 < 0.05. The sig value for systolic and age is 0.009, which is less than 0.05, indicating statistical significance. A sig value of 0.000 < 0.05 indicates that both Systolic and Diastolic are statistically significant. A sig score of 0.006 < 0.05 indicates that diastolic and BMI are statistically significant. Statistical significance is shown by a sig value of 0.040 < 0.05 for both uric acid and age.

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Table 2. Correlation Between Cholesterol and Age Group, Uric Acid, Systole and Diastole

Variables		BMI	Systole	Diastole	Cholesterol	Uric Acid	Gender	Age
BMI	Correlation Coeff.	1	.278	.387	.139	.233	.245	.364
	Sig. (2-tailed)		.053	.006	.340	.107	.090	.010
	N	49	49	49	49	49	49	49
Systole	Correlation Coeff.	.278	1	.725	.109	.034	.021	.370
	Sig. (2-tailed)	.053		.000	.457	.819	.884	.009
	N	49	49	49	49	49	49	49
Diastole	Correlation Coeff.	.387	.725	1	.010	.094	.031	.248
	Sig. (2-tailed)	.006	.000		.944	.520	.831	.086
	N	49	49	49	49	49	49	49
Cholesterol	Correlation Coeff.	.139	.109	.010	1	.177	.348	.072
	Sig. (2-tailed)	.340	.457	.944		.222	.014	.0642
	N	49	49	49	49	49	49	49
Uric Acid	Correlation Coeff.	.233	.034	.094	.177	1	.315	.294
	Sig. (2-tailed)	.107	.819	.520	.222		.028	.040
	N	49	49	49	49	49	49	49
Gender	Correlation Coeff.	.245	.021	.031	.348	.315	1	.187
	Sig. (2-tailed)	.090	.844	.831	.104	.028		.198
	N	49	49	49	49	49	49	49
Age	Correlation Coeff.	.364	.370	.248	.072	.294	.187	1
	Sig. (2-tailed)	.010	.009	.086	.642	.040	.198	
	N	49	49	49	49	49	49	49

Discussions

People with a higher BMI had a higher diastolic blood pressure (p=0.006, r=0.387). Diastolic blood pressure increased by 0.612 mmHg and systolic blood pressure increased by 1.143 mmHg for every 1 kg/m2 rise in body mass index. A person's body mass index (BMI) changes in relation to their percentage of fat in the body. According to Devisprés (2012), changes in insulin and leptin activity, the shape and function of blood arteries, the SANS system, renal function, and other factors are affected by variations in body fat. Kurniawan et al. (2021) demonstrated a statistically significant (p 0.001) and positively correlated (r 0.297) relationship between diastolic blood pressure and body mass index (BMI) in a sample of adults (20–61 years old). Researchers in the Framingham Heart Study found that the risk of hypertension increased by 20-30% for every 5% rise in body weight. Hypertension is common among those who weigh 11.2%, 20.7%, and about 36.9% more than the average, according to previous research conducted in China (Wang Xiaohui et al., 2018). Numerous studies have looked at the link between body mass index and the likelihood of hypertension; for instance, Forman et al. (2009), Kotchen (2010), and Landi et al. (2018) showed that hypertension is more common in those with a higher body mass index (BMI). A study by Ng et al. (2020) found that several variables can influence body mass index (BMI) and blood pressure, including dietary choices, physical activity levels, smoking status, and alcohol consumption.

More and more evidence linking obesity to hypertension has emerged in the last several decades (Elmaleh-Sachs et al., 2023). Elevated blood pressure and changes in body weight between middle age and early adulthood were associated with hypertension. Chronic obesity was associated with a much higher risk of systolic blood pressure (SBP), diastolic blood pressure (DBP), and hypertension in women than in males, according to Yu et al. (2025). U.S. studies have shown that hypertension is more frequent in women than in males with chronic obesity, lending credence to this gender gap (Tu et al., 2025). Possible causes include an overactive sympathetic nerve system, a decline in sex hormone levels (especially after

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menopause), an overactive renin-angiotensin-aldosterone system, and endocrine dysregulation in adipose tissue (2018).

One of the several negative impacts of obesity on blood pressure regulation is an increased risk of hypertension and high blood pressure from the onset of puberty until the middle years of life. This highlights the importance of maintaining a healthy weight as we age. The exact pathophysiological processes underlying the association between weight loss and blood pressure are still a mystery. Weight gain is associated with elevated plasma catecholamine levels, total circulating blood volumes, and cardiac output, all of which may contribute to hypertension (Kushiro et al., 1991). Asuo et al. (2000) noted, obesity has several effects, one of which is the stimulation of the sympathetic nervous system, which is likely mediated by insulin and leptin. The renin-angiotensin system and physical compression of the kidney may also play important roles (Hall et al., 2000).

Thirty percent of Indonesian youths are overweight, putting them at increased risk for developing chronic illnesses. Nutritional status, fat distribution, and overall body composition are all profoundly affected by a person's gender, according to Kusuma (2020). Body mass index (BMI) is more common among women than males in economically poor nations like Indonesia, according to the research. Women often have more fat around their middles and pelvis than males do since this helps them conceive (Wells, 2007). Research conducted in Thailand by Jiamjarasrungsri et al. (2013) indicated that women who are overweight are more prone to have elevated sUA levels. Obese women are more likely to have severe hyperuricemia than males, according to research by Kim et al. (2019). Some studies have proposed hormonal influences, differences in insulin sensitivity across genders, and changes in body fat composition as potential causes (Park et al., 2014). Studies conducted in Bangladesh and Japan discovered a stronger correlation between elevated sUA and obesity in men, which contradicts our results (Ali et al., 2018).

Disorders of lipid metabolism are prevalent in individuals who are overweight. About 60% to 70% of overweight people will also have dyslipidaemia. Adverse lipid profiles, including increased levels of TG, VLDL, apolipoprotein B, and non-HDL-C in the blood, are prevalent in the obese. A rise in blood TG levels is caused by the liver's increased production of very low-density lipoprotein (VLDL) particles and its difficulty in eliminating TG rich lipoproteins. There is a correlation between low HDL-C values and elevated blood TG levels. Although tiny dense LDL cholesterol levels are on the rise, overall levels of low-density lipoprotein (LDL) cholesterol are normal or slightly raised. Treatment of dyslipidaemia is considered routine practice due to the increased risk of cardiovascular disease in obese individuals. According to Feeingold and Grunfeld (2023), a weight reduction program that promotes a healthy lifestyle will result in lower levels of serum TG and LDL-C as well as greater levels of HDL-C.

Conclusions

A number of variables were found to be significantly correlated with one another in the adult population of Beringin Jaya Village, Kemiling District, Bandar Lampung City: systolic blood pressure, age, cholesterol, uric acid levels, and diastolic blood pressure. According to these results, being overweight might raise your chances of developing hypertension, high cholesterol, and uric acid levels. These results point to the need for public health initiatives that educate the public on healthy eating habits and effective weight control to focus on

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weight maintenance throughout life, beginning in early adulthood, in order to lessen the impact of hypertension, high cholesterol, and uric acid.

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