



Original research Articles

Correlation Between Body Mass Index and Diastolic Blood Pressure in Adults

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Abstract:-

BACKGROUND : Blood pressure is a parameter used to determine the high and low pressure of blood pumped by the heart against the walls of the arteries to evaluate the condition of the cardiovascular system. Body mass index (BMI) is a method used to assess the risk of health problems and obesity, based on measurements of body weight and height. Based on research by The Framingham Heart Study, 65% of hypertension cases in women and 78% in men are associated with obesity. This study aimed to determine the correlation between body mass index and diastolic blood pressure.

METHOD : This study used an observational analytical design with a cross-sectional approach. The data was obtained from the medical records of MCU patients at Karawang Regional Hospital, ranging in age from 19 - 44 years. The sample of this study was 71 samples, consisting of 39 men and 32 women. The sample selection technique used was consecutive sampling and analyzed using the Spearman Correlation Test.

RESULTS : Based on the results of the study on 71 respondents, there was a significant correlation between body mass index and diastolic blood pressure in adults at Karawang Regional Hospital. The correlation between the two variables showed a positive correlation ($r = 0.562$; $p = 0.000$).

CONCLUSION: There is a significant relationship between body mass index and diastolic blood pressure in adults at Karawang Regional Hospital.

Keywords: Body Mass Index, Diastolic, Adults.

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Introduction:

Blood pressure is a parameter used to determine the high or low pressure of the blood pumped by the heart against the artery walls to evaluate the condition of the cardiovascular system.⁽¹⁾ Blood pressure is recorded in two values, namely systolic blood pressure and diastolic blood pressure. Diastolic blood pressure occurs when the ventricles relax and are filled with blood that is pumped from the atrium.⁽²⁾ Blood pressure is influenced by various factors, including food intake, physical activity, salt consumption, genetics, alcohol consumption, age, gender, race or ethnicity, and obesity.⁽³⁾

Body mass index (BMI) is a method used to identify the risk of health problems and obesity through simple measurement results between ideal body weight and ideal height.⁽⁴⁾ Decreased body metabolism and lack of physical activity can cause calories to be stored as fat, which will lead to obesity.⁽⁵⁾ According to Basic Health Research data, the prevalence of obesity in Indonesia continues to increase every year, reaching 23.4% in 2023.⁽⁶⁾ Metabolic syndrome is closely related to body mass index (BMI) because it is related to the distribution of body fat.⁽⁷⁾ High body mass index and high diastolic blood pressure are criteria for metabolic syndrome that increase the risk of disease, cardiovascular disease, diabetes, and stroke.^(8,9)

Based on research by The Framingham Heart Study, there is a correlation between the incidence of hypertension and obesity; 65% of hypertension risk factors are related to obesity in women and 78% in men.⁽¹⁰⁾ Obesity will directly increase cardiac output, and indirectly, obesity will activate the sympathetic nervous system and the renin-angiotensin-aldosterone system.⁽¹¹⁾

In a study conducted by Simanjorang B, et al, it was found that an increase in BMI of 1 kg/m² would be associated with an increase in diastolic blood pressure of 0.612 mmHg.⁽¹²⁾ A study conducted by Johansyah TKP et al, 2018 found that there was a significant relationship between BMI and systolic and diastolic blood pressure.⁽¹³⁾ However, a study conducted by Abineno AP, et al, 2023 found significant research results on BMI with systolic pressure and on diastolic blood pressure there was no significant relationship, because systolic blood pressure was found to exceed 140 mmHg, while diastolic blood pressure was within normal limits, and often occurs in the elderly which is called isolated contraction conditions.⁽¹⁴⁾

The difference in research results encouraged researchers to investigate the relationship between body mass index and diastolic blood pressure in adults.

Materials and Methods:

This study used an analytical observational design with a cross-sectional approach. Data were obtained through the collection of medical record data with a population of adult patients aged 19-44 years who underwent MCU at Karawang Regional Hospital in the period August 2023 - January 2024. The sample of this study was 71 samples, consisting of 39 men and 32 women. The sample selection technique used was consecutive sampling. The research sample had inclusion criteria: aged between 19 - 44 years. Sample exclusion criteria included: currently taking hypertension medication, steroid medication, and undergoing treatment for liver cirrhosis with ascites confirmed by medical records.

Statistical Analysis:

The data were analyzed using the SPSS program through univariate analysis to describe the characteristics of the body mass index and diastolic blood pressure variables, displayed in the form of frequency and percentage. To determine the correlation of the two variables, a bivariate analysis was carried out using the Spearman

correlation test method.

Result:

This study was attended by 71 respondents, with the following characteristics.

Table 1. Distribution of Subject Characteristics

Variable	Frequency (n)	Percentage (%)
Age (year)		
19 - 25	25	35,2
26 - 35	37	52,1
36 - 44	9	12,7
Gender		
Male	39	54,9
Female	32	45,1
Body Mass Index (Kg/m²)		
Very thin	4	5,6
Thin	2	2,8
Normal	39	54,9
Overweight	14	19,7
Obese	12	16,9
Diastolic Blood Pressure (mmHg)		
Normal diastolic	45	63,4
Pre hypertension	25	35,2
Hypertension I	1	1,4
hypertension II	0	0

In this study, the average age of respondents was 28 years, indicating that most respondents were in their productive age. The average body mass index (BMI) of respondents was 23.62 kg/m², which is included in the normal weight category based on the classification of the Indonesian Ministry of Health in 2014. The body mass index of respondents was in the range of 15.40 kg/m² (very thin) to 35.40 kg/m² (obese). The average diastolic blood pressure of respondents was 76.46 mmHg, which is included in the normal category according to the JNC VII guidelines, with a range between 60 mmHg - 92 mmHg.

Table 2. Normality Test with Kolmogorov Smirnov

Kolmogorov Smirnov Data Normality Test	
Variable	P
Body Mass Index	0,200
Diastolic Blood Pressure	0,001

The results of the normality test with Kolmogorov Smirnov in Table 2 showed that the body mass index variable showed that the data was normally distributed ($p = 0.200$), but for the diastolic blood pressure variable, the data was not normally distributed ($p = 0.001$).

Table 3. Spearman Correlation Test

Spearman Correlation Test	R	N	P
Measurement			
Body Mass Index and Diastolic Blood Pressure	0,562	71	0,000

Based on the results of the Spearman correlation test in Table 3, there is a significant correlation between body mass index and diastolic blood pressure, with a value of $r = 0.562$ and $p = 0.000$. The correlation between the two variables shows a positive correlation direction, meaning that an increase in body mass index will also be followed by an increase in diastolic blood pressure, with the strength of the relationship between the variables having sufficient correlation strength.

Discussion:

Based on data analysis using SPSS on 71 samples studied, most of the samples were aged 26-35 years (52.1%). The average age of respondents in this study was 28 years, with the youngest being 19 years and the oldest being 44 years. In addition, in a study conducted by Johansyah et al, which involved 79 respondents, with an age range of 17-79 years, the average age of respondents reached 47.3 years, and the most respondents were aged 50-69 years (44.3%).⁽¹³⁾ The significant age difference between these two studies may affect the results, considering that the wide age factor can increase the factor that influence the results of the study.

In this study, the sample was dominated by men at 54.9%, while women were 45.1%. This is different from the data from the Karawang Regency Health Office in 2020, which recorded 51.16% of men and 48.83% of women. This difference in prevalence is because in this study, the author only involved 71 samples aged 19-44 years, while the Karawang Regency Health Office used data from the entire population of Karawang Regency, ranging from 0-75+ years.⁽¹⁵⁾

Based on the body mass index (BMI), of the 71 samples in this study, 39 samples (54.9%) had normal body weight with an average BMI of 23.92 Kg/m². This is in line with research by Suharni et al. in Padang City which showed results from 131 respondents, there were 55 respondents (42%) with normal BMI, with an average of 23.08 Kg/m².⁽¹⁶⁾ The results of these two studies reflect that most respondents are in the healthy weight range, although there are still some individuals with BMI outside the normal range. Differences in BMI values indicate variations in body condition that can be influenced by factors such as the amount of food or eating patterns and physical activity.⁽¹⁶⁾

In this study, the results showed that the most diastolic blood pressure samples were in the normal category of 74.46 mmHg (63.4%). However, data from the West Java Provincial Health Office in Karawang Regency 2023 showed that around 80.32% of the population of Karawang Regency had hypertension.⁽¹⁷⁾ Research conducted by Johansyah et al. showed something different from this study, namely, with data from respondents aged 17-79 years, the results of diastolic blood pressure data in the prehypertension category were 81.58 mmHg.⁽¹³⁾ Meanwhile, research conducted by Abineno et al. with respondents aged 25-50

obtained diastolic blood pressure results with an average value of 85.36 mmHg, which fell into the category of grade 1 hypertension.⁽¹⁴⁾

This study shows a significant positive correlation between body mass index and diastolic blood pressure, indicating that an increase in BMI will also be followed by an increase in diastolic blood pressure. This is in line with Suharni's research conducted on students; the results of the correlation value between BMI and diastolic blood pressure ($r = 0.566$, $p = 0.000$). The results of this data indicate that the higher the BMI value, the higher the systolic and diastolic blood pressure.⁽¹⁶⁾ This is likely caused by the lifestyle of students, such as a lack of rest time and a lack of physical activity. Another study by Malinti et al also supports these results, finding a significant relationship between BMI and diastolic blood pressure ($p < 0.05$, $r = 0.452$), which is associated with the habit of consuming fast food, snacks, and lack of fruit and vegetable consumption among dormitory students.⁽¹⁸⁾ This is possible because these habits cause BMI to increase and affect blood pressure. A high body mass index will increase cardiac output that which will affect blood pressure.⁽¹⁸⁾

In visceral obesity, there is an increase in sodium and water reabsorption by the kidneys through the activity of the RAAS and the sympathetic nervous system, which causes an increase in blood volume and vasoconstriction, thus triggering an increase in blood pressure.⁽¹⁸⁾ In addition, endothelial dysfunction due to increased BMI will interfere with the production of vasoactive substances, namely leptin and adiponectin. This hormone is produced by adipose tissue, in obesity adiponectin levels decrease and leptin increases, which increases sympathetic tone and blood pressure. Adipose tissue also produces proinflammatory cytokines (TNF- α , IL-6), which contribute to endothelial dysfunction, insulin resistance, and which can worsen blood vessel vasoconstriction and contribute to increased blood pressure.⁽¹⁹⁾

Research by Yusni shows that an increase in BMI of 1 kg/m² in individuals aged 18-22 years results in an increase in diastolic blood pressure of 0.834 mmHg. There is a strong correlation between blood pressure and weight; losing weight will also lower blood pressure. A weight loss of around 5 kg can lower diastolic blood pressure by 3.6 mmHg.⁽¹⁹⁾

This study obtained results that were contrary to the study conducted by Thapa et al, involving 245 samples, it was found that there was no significant relationship between BMI and diastolic blood pressure ($p > 0.128$).⁽²⁰⁾ This difference in results is likely due to differences in diet, work, culture, genetics, and different physical activities. However, to find out the cause further, more extensive research must be conducted. A similar study by Abineno et al found that there was no significant relationship between BMI and diastolic blood pressure ($p > 0.05$, $r = 0.98$). This is due to the condition where, when systolic blood pressure exceeds 140 mmHg, while diastolic blood pressure remains below 90 mmHg, which is still considered normal, this condition is more common in the elderly and is known as isolated systolic hypertension. This study was conducted on the largest age group in the 40-50 years,⁽¹⁴⁾ so the difference in results with this study is likely due to differences in the age range of respondents. The difference in results between this study and other studies is likely due to other factors that affect blood pressure, such as older age, genetics, lack of physical activity, high salt diet, excessive alcohol consumption, or influenced by other uncontrolled variables.^(12,18)

Research limitations:

This study applied an observational design with a cross-sectional design, conducted with a limited number

of samples and a short time, so it cannot determine the cause-and-effect relationship. Eliminating the exclusion of the use of steroid drugs and hypertension drugs is only based on previous medical record data, so it cannot be ascertained whether the patient is taking the drug outside the available medical records. Reduction of confounding factors has not been done statistically; still applying exclusion and inclusion criteria.

Conclusion:

There is a significant correlation between body mass index and diastolic blood pressure ($p=0.000$, $r=0.562$) which means that an increase in body mass index will also be followed by an increase in Diastolic Blood Pressure. Although several previous studies did not find a significant correlation between the two variables, the results of this study show a positive correlation. The difference is likely due to subject variation, differences in methods, and is influenced by other uncontrolled variables, so further studies are needed with larger samples and more in-depth analysis.

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Ethics Approval

This research has received ethical approval from the Research Ethics Committee of the Faculty of Medicine, Universitas Trisakti. Number 027/KER/FK/08/2024.

Availability of Data and Material

The data sets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Faculty of Medicine, Trisakti University, Jakarta, Indonesia.

Conflict of Interest

The author declares that there is no conflict of interest.

Research Contribution

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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