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Relationships of blood pressure with body mass index and total cholesterol among adults aged 19 or older, Bandar Lampung-Indonesia

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Abstract

Background: High blood pressure, obesity, and elevated cholesterol are significant risk factors for cardiovascular diseases, making their interrelationship an important area of research.

Purpose: To investigate the correlation between blood pressure, body mass index (BMI), and total cholesterol levels in adults residing.

Method: Using a cross-sectional approach, data were collected from a sample of adults aged 25–60 years. Blood pressure was measured using a digital sphygmomanometer, BMI was calculated based on height and weight measurements, and total cholesterol levels were assessed through laboratory testing.

Results: The findings indicate a positive correlation between BMI and blood pressure, suggesting that individuals with higher BMI are more likely to experience elevated blood pressure. Similarly, a significant relationship was observed between total cholesterol levels and both systolic and diastolic blood pressure. These results underscore the need for integrated health interventions targeting weight management and cholesterol control to reduce the risk of hypertension and associated health complications in the community.

Conclusion: The study highlights the importance of routine health monitoring and lifestyle modifications in promoting cardiovascular health among adults.

Keyword: Adult; Blood Pressure; Body Mass Index; Hypertension; Total Cholesterol.

INTRODUCTION

Hypertension has been among the most studied topics of the previous century and has been one of the most significant comorbidities contributing to the development of stroke, myocardial infarction, heart failure, and renal failure. Hypertension affects many adults and older adults. Approximately 1.28 billion hypertensive patients are aged 30-79 years old worldwide. Two-thirds live in low and middle-income countries (Wakabayashi, 2024). Cardiovascular disease is the number one cause of death from non-communicable diseases. Total cholesterol and blood pressure are indicators to determine the risk of cardiovascular disease. The prevalence of obesity in adult men and women (> 18 years) continues to increase every year. In 2018, the majority of obesity in Indonesia reached 21.8%. The province with the

highest prevalence of obesity is South Sulawesi and followed by DKI Jakarta (Anwar, Alamsyah, Safrida, Duana, Khairunnas, Putri, & Muliadi, 2024).

Blood pressure, body mass index (BMI), and total cholesterol levels are critical health indicators that play a significant role in determining an individual's risk for cardiovascular diseases. These three parameters are often interconnected and influenced by various lifestyle factors, including diet, physical activity, and socioeconomic conditions. Understanding the relationships among these variables is essential for designing targeted interventions to improve public health outcomes (Kaur & Made, 2017). The increasing prevalence of hypertension, obesity, and dyslipidemia in recent years has raised concerns among health

professionals worldwide. In many developing regions, including Indonesia, these conditions are becoming more common due to urbanization, sedentary lifestyles, and unhealthy dietary patterns. Bandar Lampung, a growing urban area, is no exception to these trends. In the Beringin Raya district, the rise in non-communicable diseases is a pressing health issue that requires urgent attention (Sabatina, Handajani, & Widjaja, 2022). Body mass index is widely recognized as a reliable indicator of overweight and obesity. Excess body weight has been shown to significantly contribute to elevated blood pressure levels and abnormal cholesterol profiles. As adiposity increases, it often leads to physiological changes, including insulin resistance, systemic inflammation, and altered lipid metabolism, all of which are associated with adverse cardiovascular outcomes (Zhang, Lai, Yan, Fang, & Wang, 2025).

Blood pressure, another critical parameter, reflects the force exerted by circulating blood on the walls of arteries. Elevated blood pressure, or hypertension, is a major risk factor for heart disease and stroke. Studies have shown that individuals with higher BMI are more likely to develop hypertension due to increased vascular resistance and cardiac workload. This underscores the importance of examining the relationship between these two variables (Umar & Mariana, 2021). Cholesterol, a type of lipid essential for various bodily functions, becomes problematic when its levels exceed the normal range. High total cholesterol, particularly low-density lipoprotein (LDL) cholesterol, contributes to the development of atherosclerosis and other cardiovascular conditions. Obesity and high blood pressure often exacerbate dyslipidemia, creating a dangerous combination that heightens the risk of cardiovascular events.

Investigating these relationships in a specific demographic context can help identify unique risk factors and protective elements relevant to the population. For instance, dietary habits, cultural practices, and physical activity levels may differ significantly across regions, affecting health outcomes. Understanding these nuances is crucial for tailoring public health strategies (Choi, Ju, Oh, Ryu, Kim, & Kang, 2025). Another critical consideration is the impact of gender and age on

these parameters. Men and women may exhibit different patterns in the correlation between BMI, blood pressure, and cholesterol, while older adults are generally more susceptible to these health issues. Including such demographic factors in the analysis can provide a more comprehensive understanding of the health profile of the Beringin Raya population.

RESEARCH METHOD

The research is a descriptive correlational study using a purposive sampling technique. Research area chosen for this study is Beringin Raya District, Kemiling, Bandar Lampung City, Lampung Province, Indonesia. Body weight, height, blood pressure, blood sugar, and cholesterol were measured during the data collection day. To get the value of fasting blood glucose, and total cholesterol levels, respondents were asked to fast for 10 hours starting at night, where the next morning blood was drawn with a blood glucose and cholesterol measuring device (Accu Check). A total of 66 subjects were included for this study. Univariate analysis used to determine the frequency, percentage, and standard deviation of each variable. Bivariate analysis was performed to determine the correlation, relationship or association between two variables (Spearman's, Pearson's, T-test, Chi-Square, and Regression analysis). The goal of these tests is to determine whether and how two variables are related, and they can be used to test for differences, correlations, or dependencies.

BMI indicator if the BMI value <20 then it is said to be underweight, if the BMI value between 18.5 - 24.9 is said to be overweight, if the BMI value >30 then it is said to be obese. Blood pressure if the Systolic value is 90-120 mmHg and Diastolic 60-80 mmHg is said to be normal, if the Systolic value is 90-120 mmHg and Diastolic 60-80 mmHg is said to be Pre-hypertension, if the Systolic value is 130-139 mmHg and / or Diastolic 85-89 mmHg is said to be Hypertension 1, if the Systolic value is 140 mmHg or more and / or Diastolic 90 mmHg or more is said to be Hypertension 2. Total cholesterol if Less than 200 mg / dL is said to be normal, if between 200-239 mg / dL is said to be Borderline High, if 240 mg / dL or more is said to be high. This study obtained its ethical approval with the No. 402/KEPK-FlK.UNAI/EC/IX/24.

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RESEARCH RESULTS

Table 1. Distribution Characteristics Respondent (N=66)

Variable	Results	Mean $\pm$ SD
Age (Range)(Year)	(19-96)	53.61 $\pm$ 15.1
Gender (n/%)		
Male	20/30.3	
Female	46/69.7	
BMI (n/%)		
Underweight	2/3	
Normal	35/53	24.86 $\pm$ 4.2
Overweight	21/31.8	
Obese	8/12.1	
Blood Pressure (n/%)		
Normal	16/24.2	
Pre-hypertension	23/34.8	
Hypertension 1	20/30.3	
Hypertension 2	7/10.6	
Systolic		127.73 $\pm$ 19.4
Diastolic		79.09 $\pm$ 10.3
Total Cholesterol (n/%)		
Normal	26/39.4	
Borderline High	27/40.9	207.5 $\pm$ 40.7
High	13/19.7	

Table 1 shows the characteristics and distribution of the study population among 66 subjects, the mean age is 53.61, with female dominating the numbers (69.7%) compared to the males (30.3%). Majority are in the normal BMI (54%), followed by overweight (31.8%), with the average BMI score of 24.86 $\pm$ 4.2. 24.2% of the subjects had normal blood pressure, 34.8% pre-hypertension, 30.3% hypertension class 1, and 10.6% hypertension class 2. As for systolic and diastolic, the average measurement is 127.73 mmHg and 79.09 mmHg. Average total cholesterol is 207.5 mg/dL, 39.4% are normal (<200 mg/dL), 40.9% borderline high (200-239 mg/dL), and 19.7% high (>240 mg/dL).

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Table 2. Correlation Between Blood Pressure and Study Population Demographic (Age and Gender)

Variable	Age		Gender	
	r-value	Sig. (2-tailed)	t-value	Sig. (2-tailed)
Systolic	0.485**	0.000**	0.488	0.627
Diastolic	0.094	0.455	0.728	0.470

** Correlation is significant at the 0.01 level (2-tailed).

From Table 2, there is a highly significant correlation (p-value= 0.000) between the systolic measurement and age, with r-value of 0.485, indicating a moderate positive linear relationship between two variables. There is likely no significance between systolic, diastolic, and gender (p-value= >0.05).

Table 3. Correlation Between Systolic, Diastolic, Body Mass Index (BMI), and Total Cholesterol

Variables	BMI		Total Cholesterol	
	r-value	Sig. (2-tailed)	r-value	Sig. (2-tailed)
Systolic	0.113	0.365	0.004	0.976
Diastolic	0.350**	0.004**	-0.066	0.600

** Correlation is significant at the 0.01 level (2-tailed).

Table 3 shows a moderate positive linear relationship between diastolic measurement and BMI with r-value 0.350 (p-value <0.05), whereas no significance is found when correlated with systolic (p>0.05). A very weak or no significance can be found between systolic-diastolic and total cholesterol (p>0.05).

Table 4. Relationship Between Systolic, Diastolic, Age, BMI, and Total Cholesterol

Variable	Age			BMI			Total Cholesterol		
	β	t	Sig.	β	t	Sig.	β	t	Sig.
Systolic	0.607	5.558	0.000*	0.346	3.125	0.003**	-0.40	-0.379	0.706
Diastolic	0.253	2.104	0.039*	0.481	3.947	0.000**	0.006	0.054	0.957

Table 4 shows a moderate positive linear relationship between diastolic, age, BMI, and total cholesterol with r-value 0.253 (p-value <0.05), whereas no significance is found when correlated with systolic (p>0.05). A very weak or no significance can be found between systolic-diastolic and total cholesterol (p>0.05).

DISCUSSION

The age distribution of the population showed an average of 53.61 years, indicating a middle-aged demographic with higher susceptibility to cardiovascular conditions. Females comprised 69.7% of the sample, dominating the study group. Gender imbalance in the sample may reflect

population characteristics or recruitment patterns, but it is essential to consider how this distribution impacts the findings. BMI results revealed that the majority of participants fell within the normal range (53%), followed by those classified as overweight (31.8%) and obese (12.1%). Only 3% were underweight, suggesting a significant portion of the population is at risk for weight-related health issues. The average BMI was recorded at 24.86 ± 4.2 , aligning with the overweight threshold. In terms of blood pressure distribution, only 24.2% had normal readings, while 34.8% exhibited pre-hypertension, and 30.3% and 10.6% were categorized as hypertension class 1 and class 2, respectively. These findings demonstrate a high prevalence of

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elevated blood pressure within the population, signaling a public health concern. The mean systolic and diastolic measurements were 127.73 mmHg and 79.09 mmHg, respectively, indicating borderline elevated readings for many participants. Cholesterol levels were another critical focus, with an average total cholesterol of 207.5 mg/dL. Only 39.4% had normal levels (<200 mg/dL), while 40.9% were borderline high (200–239 mg/dL), and 19.7% fell into the high-risk category (>240 mg/dL). The elevated cholesterol prevalence suggests a heightened risk for cardiovascular events in this population.

From Table 2, a significant correlation was observed between systolic blood pressure and age ($r = 0.485$, $p < 0.01$), indicating a moderate positive linear relationship. This result highlights that blood pressure tends to increase with age, consistent with physiological changes such as arterial stiffening. Conversely, no significant relationship was found between systolic or diastolic blood pressure and gender, suggesting that blood pressure levels were not influenced by gender differences in this sample (Fitriani, Hutahut, & Riansyah, 2022). Table 3 analyzed the correlation between blood pressure, BMI, and total cholesterol. A moderate positive linear relationship was found between diastolic blood pressure and BMI ($r = 0.350$, $p < 0.01$), indicating that higher BMI levels are associated with increased diastolic pressure. However, no significant correlation was observed between systolic pressure and BMI. This finding implies that weight primarily impacts diastolic pressure rather than systolic (Nikbakht, Najafi, Shakiba, Darbandi, Navabi, & Pasdar, 2023). The analysis also showed no significant correlation between blood pressure and total cholesterol. Both systolic and diastolic readings had weak or negligible associations with cholesterol levels, as evidenced by p -values exceeding 0.05. This suggests that while cholesterol is a risk factor for cardiovascular disease, it may not directly correlate with blood pressure in this population (Tang, Ma, Tao, Chen, Yang, He, & Zhou, 2022).

Table 4 further examined the relationships using regression analysis. Age was significantly associated with systolic ($\beta = 0.607$, $p < 0.001$) and diastolic ($\beta = 0.253$, $p = 0.039$) blood pressure. This supports earlier findings that age is a critical determinant of blood pressure, with older individuals more likely to

experience elevated levels. Several studies have established a strong correlation between age and increased blood pressure, supporting the findings presented in Table 4. Aging is associated with arterial stiffness and reduced elasticity of blood vessels, leading to higher systolic and diastolic blood pressure levels (Fukui, 2020). The progressive thickening of arterial walls and endothelial dysfunction further contribute to hypertension risk in older individuals (Lee, Lee, Cho, Lee, & Kwon, 2021). Additionally, the cumulative effects of lifestyle factors such as diet, physical inactivity, and metabolic changes exacerbate age-related blood pressure elevation (Cirillo, Senigalliesi, Laurenzi, Alfieri, Stamler, Stamler, & De Santo, 2018). These findings reinforce that aging is a critical determinant of blood pressure regulation, necessitating targeted interventions for older populations.

BMI also showed a strong positive relationship with both systolic ($\beta = 0.346$, $p = 0.003$) and diastolic ($\beta = 0.481$, $p < 0.001$) blood pressure. These findings emphasize the importance of weight management in controlling blood pressure and reducing cardiovascular risk. The stronger association with diastolic pressure aligns with previous correlations observed in this study. Total cholesterol did not demonstrate significant relationships with systolic ($\beta = -0.040$, $p = 0.706$) or diastolic ($\beta = 0.006$, $p = 0.957$) blood pressure. This outcome reinforces earlier findings that cholesterol levels may not directly influence blood pressure, despite their role in cardiovascular health. The results collectively highlight that age and BMI are the primary factors influencing blood pressure in this population. The absence of significant correlations with total cholesterol suggests that interventions targeting blood pressure should prioritize weight management and age-specific strategies (Arini & Wijana, 2020). Numerous studies have demonstrated a strong link between body mass index (BMI) and blood pressure, reinforcing the findings that BMI is a primary factor influencing systolic and diastolic blood pressure. Higher BMI is associated with increased cardiac output, elevated sympathetic nervous system activity, and insulin resistance, all of which contribute to hypertension (Huo, Zhai, Liao, & You, 2023).

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Excess adiposity leads to structural and functional changes in blood vessels, including endothelial dysfunction and arterial stiffness, further exacerbating blood pressure elevation (Toulabi, Yarahmadi, Goudarzi, Ebrahimzadeh, Momenizadeh, & Yarahmadi, 2022). Additionally, weight gain has been shown to increase sodium retention and blood volume, creating additional pressure on vascular resistance and contributing to both systolic and diastolic hypertension (Diaf, Benchikh, Bennour, Oumnia, & Khaled, 2022). Given these mechanisms, weight management strategies such as dietary modifications, increased physical activity, and obesity prevention play a crucial role in blood pressure regulation, aligning with the study's conclusion that interventions should prioritize BMI control and age-specific approaches. Gender differences in blood pressure were not observed, which may reflect similar lifestyle or genetic influences across male and female participants in this population. This finding underscores the need for inclusive interventions applicable to all genders (Suka, Yoshida, & Yamauchi, 2016).

The significant prevalence of elevated blood pressure and borderline or high cholesterol levels in this population indicates an urgent need for public health measures. Educational campaigns promoting healthy lifestyles, dietary modifications, and regular health screenings could help mitigate these risks (Chen, Chen, Wu, Cai, Chen, Yan, & Wu, 2021). Further research could explore other factors influencing blood pressure and cholesterol, such as physical activity, dietary patterns, and genetic predispositions (Mulyasari, Afiatna, Maryanto, & Aryani, 2023). Additionally, longitudinal studies could provide more robust insights into causal relationships and the effectiveness of interventions over time.

CONCLUSION

This study highlights the significant role of age and body mass index (BMI) in influencing blood pressure levels among adults. A moderate positive correlation was found between systolic blood pressure and age, as well as between diastolic pressure and BMI, emphasizing that advancing age and excess body weight are key contributors to hypertension. In contrast, total cholesterol levels showed no significant relationship with blood

pressure, indicating that while cholesterol is a risk factor for cardiovascular health, it may not directly affect blood pressure in this population.

SUGGESTION

Furthermore, gender differences were not associated with variations in blood pressure. These findings underscore the need for targeted public health strategies focusing on weight management, age-specific interventions, and awareness campaigns to mitigate the risks of hypertension and related cardiovascular conditions in the community.

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