RESEARCH

The Relationship Between Body Mass Index (BMI) and Cholesterol Levels with the Incidence of Hypertension in the Working Area of Wonoayu Health Center

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ABSTRACT

Hypertension has become a growing public health issue in Indonesia, including within the working area of Wonoayu Health Center, Sidoarjo Regency. Risk factors such as abnormal Body Mass Index (BMI) and elevated cholesterol levels are known to contribute to the development of hypertension. This study aimed to examine the relationship between BMI and cholesterol levels with the incidence of hypertension. A quantitative approach with a cross-sectional design was employed. The study involved 46 respondents selected through purposive sampling. Data were collected through direct measurements and interviews, and analyzed using the Chi-Square test. The majority of respondents were classified as obese based on BMI (28.3%) and had high cholesterol levels (41.3%). Hypertension was most prevalent in the hypertensive crisis category (33%) and Stage 1 hypertension (28%). Bivariate analysis showed a significant relationship between BMI and hypertension incidence (p = 0.018), as well as between cholesterol levels and hypertension incidence (p = 0.002). Increases in BMI and cholesterol levels were directly proportional to the severity of hypertension. Fat accumulation and atherosclerotic plaque can worsen blood pressure regulation. Therefore, health education on weight control and cholesterol management should be enhanced as a preventive measure against hypertension.

Keyword: Hypertension, Body Mass Index (BMI), CholesterolKeyword: Hypertension, Body Mass Index (BMI), Cholesterol

INTORDUCTION

According to data from the World Health Organization (2023), the global prevalence of hypertension is estimated at 22% of the total world population, with variations observed across different regions; Africa reports the highest prevalence at 27%, while the Americas have the lowest prevalence at 18%.

The Indonesian Health Survey (Survei Kesehatan Indonesia, 2023) reported that the prevalence of hypertension in Indonesia is relatively high, approximately 30.8% among individuals aged 18 years and older, affecting an estimated 73 million people. Hypertension prevalence varies across provinces. The province with the highest prevalence is DKI Jakarta, where 12.6% of the adult population has been diagnosed with hypertension, followed by DI Yogyakarta (12.3%), North Sulawesi (12.1%), and East Kalimantan (11.1%). The lowest prevalence was reported in the Highland Papua region, with only 2.2% (Survei Kesehatan Indonesia, 2023).

In East Java, the prevalence of hypertension in 2023 reached 32.8%, confirming that hypertension is a significant public health concern in the province, ranking it among the regions with the highest prevalence in Indonesia. Pasuruan Regency reported the highest number of hypertension cases in East Java with 88,502 cases, followed by Ponorogo Regency (59,746 cases), Jombang Regency (53,555 cases), Jember Regency (53,431 cases), and Surabaya City (45,014 cases) (East Java Provincial Health Office, 2023).

In 2023, Sidoarjo Regency recorded 38,063 cases of hypertension. Although Sidoarjo is one of the regions with a relatively high incidence of hypertension in East Java, it is not among the top five regencies with the highest prevalence compared to Pasuruan, Ponorogo, and Jombang (East Java Provincial Health Office, 2023).

Hypertension can lead to serious health complications such as heart attacks, strokes, heart failure, and kidney damage. However, many cases can actually be prevented or managed effectively through

healthy lifestyle practices, including reducing salt intake, engaging in regular physical activity, quitting smoking, and limiting alcohol consumption. Additionally, affordable medications can help control blood pressure. Greater efforts in detecting and treating hypertension could prevent millions of premature deaths from cardiovascular diseases each year (Ministry of Health, 2023).

A higher Body Mass Index (BMI), particularly when exceeding normal limits, increases the likelihood of developing hypertension. Obesity causes an increase in blood volume pumped by the heart, placing additional workload on the heart and blood vessels, which in turn affects blood pressure. This leads to higher vascular resistance, resulting in elevated blood pressure (Abineno & Malinti, 2022).

Furthermore, high cholesterol levels, especially low-density lipoprotein (LDL or "bad" cholesterol), can cause plaque accumulation along the walls of blood vessels. This plaque narrows the blood vessels and increases resistance to blood flow, contributing to elevated blood pressure. High cholesterol is also often associated with other conditions such as diabetes, which further exacerbates the risk of hypertension (Suci & Adnan, 2020).

According to reports from the Sidoarjo Regency Health Profile, hypertension cases at Wonoayu Health Center have increased annually. In 2022, the prevalence of hypertension was 3,164 residents; in 2023, it reached 3,729 residents; and from January to August 2024, the prevalence was 2,328 residents (Sidoarjo Regency Health Office, 2023).

Based on the collected data, the incidence of hypertension has increased each year. Therefore, the researcher is interested in examining the relationship between BMI and cholesterol levels with the incidence of hypertension in the working area of Wonoayu Health Center.

METHOD

This study employed a quantitative approach with a cross-sectional design. The sample consisted of 46 respondents selected using purposive sampling. Data were collected through direct measurements and interviews, and were analyzed using the Chi-Square test.

RESULT

General Characteristics of Respondents

The following is a description of the general characteristics of the respondents involved as the sample in this study.

Table 1   Distribution of Respondents Based on Gender in the Working Area of Wonoayu Health Center, April 2025

Gender	N	Percentage
Female	35	76%
Male	11	24%
Total	46	100%

Source : Primary Data

The majority of respondents were female, totaling 35 individuals (76%), while males accounted for 11 individuals (24%).

Table 2   Distribution of Respondents Based on Age in the Working Area of Wonoayu Health Center, April 2025

Age	N	Percentage
35-44	11	24%
45-54	19	41%
55-65	14	30%
>65	2	4%
Total	46	100%

Source : Primary Data

The respondents' ages were divided into four groups. The largest group was aged 45–54 years, consisting of 19 individuals (41%), followed by the 55–65 years group with 14 individuals (30%), the 35–44 years group with 11 individuals (24%), and those aged 65 years and above with only 2 individuals (4%).

Specific Characteristics of Respondents

Table 3   Distribution of Respondents Based on Hypertension Categories in the Working Area of Wonoayu Health Center, April 2025

Hipertensi	N	Percentage
Normal	3	6%
Elevated	11	24%
Stage 1 Hypertension	13	28%
Stage 2 Hypertension	4	9%
Crisis Hypertension	15	33%
Total	46	100%

Source : Primary Data

Based on blood pressure measurements, the majority of respondents were classified in the hypertensive crisis category, totaling 15 individuals (33%), followed by Stage 1 hypertension with 13 individuals (28%), prehypertension with 11 individuals (24%), and Stage 2 hypertension with 4 individuals (9%). Only 3 individuals (6%) had normal blood pressure.

Table 4   Distribution of Respondents Based on BMI Categories in the Working Area of Wonoayu Health Center, April 2025

IMT	N	Percentage
Underweight	2	4%
Normal	13	28%
Overweight	18	39%
Obesity	13	28%
Total	46	100%

Source : Primary Data

The majority of respondents were classified as obese, totaling 25 individuals (54%), followed by the overweight category with 13 individuals (28%), and the normal weight category with 6 individuals (13%). Respondents in the underweight category were the fewest, with only 2 individuals (4%).

Table 5   Distribution of Respondents Based on Cholesterol Categories in the Working Area of Wonoayu Health Center, April 2025

Category	N	Percentage
Cholesterol		
Normal	8	17%
Borderline	19	41%
High	19	41%
Total	46	100%

Source : Primary Data

A total of 19 individuals (41%) were classified in the borderline cholesterol category, and an equal number, 19 individuals (41%), had high cholesterol levels. The remaining 8 individuals (17%) had normal cholesterol levels.

Data Analysis

Table 6   3x4 Cross-Tabulation of the Relationship Between Cholesterol and Hypertension Incidence in the Working Area of Wonoayu Health Center, April 2025

		Hypertension Status								Total
		Normal		Stage 1 Hypertension		Stage 2 Hypertension		Crisis Hypertension		
		N	%	N	%	N	%	N	%	
Cholesterrol Status	Normal	5	10,9	3	6,5	0	0,0	0	0,0	17,4
	Borderlin	3	6,5	10	21,8	4	8,7	2	4,3	41,3
	Highi	6	13	0	0	0	0,0	13	28,3	41,3
	Total	14	30,4	13	28,3	4	8,7	15	32,6	100

Source : Primary Data

Based on the cross-tabulation between cholesterol status and hypertension status, it was found that respondents with high cholesterol levels most frequently experienced hypertensive crisis, accounting for 28.3%. Meanwhile, respondents with normal cholesterol levels were mostly in the normal category at 10.9%. This normal category includes both normal and prehypertension cases, with only a small proportion experiencing severe hypertension. On the other hand, respondents with borderline cholesterol levels had a more evenly distributed pattern, with the largest proportion in stage 1 hypertension at 21.8%. These findings indicate a tendency for higher cholesterol levels to be associated with an increased degree of hypertension.

Table 7   2x3 Cross-Tabulation of the Relationship Between Cholesterol and Hypertension Incidence in the Working Area of Wonoayu Health Center, April 2025

		Hypertension Status				Total	
		Normal		Hypertension			
		N	%	N	%	N	%
Cholesterrol Status	Normal	5	10,9	3	6,5	8	17,4
	Borderline	3	6,5	16	34,8	19	41,3
	High	6	13	13	28,3	19	41,3
	Total	14	30,4	32	69,6	46	100,0

Source : Primary Data

Based on the reclassification of cholesterol categories (borderline, normal, and high) and hypertension categories (normal and hypertensive), a Chi-Square test was conducted to examine the relationship between cholesterol levels and the incidence of hypertension. The analysis yielded a Pearson Chi-Square value of 9.818 with a significance level of 0.002 ($p < 0.05$). All expected counts were above 5, thus meeting the assumptions for the Chi-Square test. Therefore, it can be concluded that there is a significant relationship between cholesterol levels and the incidence of hypertension in the working area of Wonoayu Health Center in April 2025.

Table 8   4x4 Cross-Tabulation of the Relationship Between BMI and Hypertension Incidence in the Working Area of Wonoayu Health Center, April 2025

		Hypertension Status								Total	
		Normal		Stage 1 Hypertension		Stage 2 Hypertension		Crisis Hypertension			
	Underweight	N	%	N	%	N	%	N	%	N	%
IMT Status	Normal	1	2,2	0	0,0	0	0,0	1	2,2	2	4,3
	Overweight	7	15,2	5	10,9	0	0,0	1	2,2	13	28,3
	Obesity	5	10,8	8	17,4	4	8,7	1	2,2	18	39,1
	Underweight	1	2,2	0	0,0	0	0,0	12	26,1	13	28,3
	Total	14	30,4	13	28,3	4	8,7	15	32,6	46	100

Source : Primary Data

Based on the cross-tabulation between BMI and hypertension status, it was found that the overweight group had the highest proportion experiencing stage 1 hypertension at 17.4% and normal blood pressure at 10.8%, followed by stage 2 hypertension at 8.7%. The normal-weight group also showed a significant distribution, with 15.2% in the normal category.

Meanwhile, the underweight group had a lower incidence of hypertension, which was more evenly distributed across various hypertension stages. These data indicate a fairly strong relationship between increased BMI and the risk of developing hypertension.

Table 9   2x2   Cross-Tabulation   of   the Relationship Between BMI and Hypertension Incidence in the Working Area of Wonoayu Health Center, April 2025

		Hypertension Status				Total	
		Normal		Hypertension			
		N	%	N	%	N	%
IMT Status	Normal	8	17,4	7	15,2	15	32,6%
	Overweight	6	13,1	25	54,3	31	67,4%
	Total	14	30,5	32	69,5	46	100,0%

Source : Primary Data

After simplifying the categories, BMI was divided into two groups: non-overweight (underweight and normal) and overweight (overweight and obese), while hypertension was categorized as normal and hypertensive (stage 1, stage 2, and crisis). The Chi-Square analysis yielded a Pearson Chi-Square value of 5.573 with a significance level of 0.018 ($p < 0.05$). This indicates a significant relationship between BMI status and the incidence of hypertension.

DISCUSSION

Hypertension Incidence at Wonoayu Health Center

Based on the results of the study in the working area of Wonoayu Health Center, the majority of respondents experienced hypertension with varying degrees of severity. A total of 33% of respondents were classified in the hypertensive crisis category, 28% in stage 1 hypertension, and 24% in prehypertension. Only 6% had normal blood pressure. These data indicate that the prevalence of hypertension at Wonoayu Health Center is relatively high, particularly among the elderly population.

These findings are consistent with the World Health Organization (2021), which states that hypertension is a leading cause of premature death worldwide and its prevalence increases with age. Unhealthy lifestyles, such as excessive salt intake, physical inactivity, smoking, and alcohol consumption, are significant risk factors. Additionally, metabolic factors such as obesity and dyslipidemia further exacerbate the risk. Previous research by Maulina et al. (2020) reported that more than 60% of elderly individuals at Health Center X had hypertension without being aware of their condition until complications occurred. A similar study by Yuliana & Kurniasari (2019) highlighted the low awareness and control of blood pressure among the elderly population.

Overview of BMI and Hypertension Incidence

The majority of respondents had excessive nutritional status: 39% were overweight and 28% were obese. Only 4% of respondents were classified as underweight, and 28% had normal weight. These findings indicate that most hypertensive patients at Wonoayu Health Center have abnormal BMI, particularly towards obesity.

Obesity contributes to the pathogenesis of hypertension through mechanisms such as increased sympathetic nervous system activity and activation of the renin-angiotensin-aldosterone system (RAAS). According to Hall et al. (2020), excess body fat directly impacts the elevation of blood pressure. Kotsis et al. (2021) stated that each 1 kg/m² increase in BMI can raise the risk of hypertension by 6–8%. Previous research by Apriliyanti et al. (2021) also found that obesity is significantly associated with the incidence of hypertension, where respondents with excessive BMI have a higher risk compared to those with normal weight. These findings suggest that increased BMI plays a major role in triggering hypertension. Therefore, weight management through a healthy diet and regular physical activity is an essential strategy for the prevention and management of hypertension.

Overview of Cholesterol Levels and Hypertension Incidence

The study results showed that 41% of respondents had high cholesterol levels, 41% were in the borderline category, and only 17% had normal cholesterol levels. The majority of respondents with high cholesterol were classified in the hypertensive crisis and stage 1 hypertension categories.

According to the American Heart Association (2020), high cholesterol levels cause atherosclerosis, which narrows blood vessels and increases blood pressure. Handayani & Sugiarto (2019) also stated that dyslipidemia worsens blood pressure control even when patients undergo antihypertensive therapy. Previous research by Andriani & Nugroho (2021) demonstrated a significant relationship between total cholesterol levels and hypertension incidence, showing that respondents with high cholesterol are at greater risk of developing hypertension compared to those with normal cholesterol levels.

Thus, these findings reinforce evidence that high cholesterol contributes to the worsening of

hypertension. Preventive efforts through cholesterol management, including lifestyle modifications and regular health check-ups, are essential to reduce the risk of hypertension and cardiovascular complications.

Relationship Between BMI and Hypertension Incidence

Statistical analysis showed a significant relationship between BMI and the incidence of hypertension. Respondents who were overweight or obese had a higher prevalence of hypertension compared to those with normal BMI.

This finding is consistent with the study by Jayedi et al. (2022), which explained that excess body weight contributes to elevated blood pressure through systemic inflammation and insulin resistance, as well as accelerating endothelial dysfunction. Therefore, monitoring and managing body weight is an essential strategy for the prevention and control of hypertension, particularly among the elderly.

Relationship Between Cholesterol Levels and Hypertension Incidence

Bivariate analysis showed a Pearson Chi-Square value of 9.818 with a significance of 0.002 ($p < 0.05$), indicating a significant relationship between cholesterol levels and the incidence of hypertension. Respondents with high cholesterol levels were at greater risk of developing severe hypertension.

This finding is supported by Andriani & Nugroho (2021), who reported that individuals with high LDL cholesterol have a 2.5 times greater risk of developing hypertension. Elevated cholesterol exacerbates arterial stiffness and disrupts blood pressure regulation, while accelerating the process of atherosclerosis.

Therefore, managing cholesterol levels should be an integral part of hypertension control efforts, through nutritional education, pharmacological interventions, and increased physical activity. Regular lipid profile screening is also recommended, particularly for the elderly population.

CONCLUSION AND SUGGESTION
Conclusion

Based on the results of the study on the relationship between body mass index (BMI) and cholesterol levels with the incidence of hypertension at Wonoayu Health Center, the following conclusions can be drawn:

1. The majority of respondents experienced hypertension with varying degrees of severity, with hypertensive crisis and stage 1 hypertension being the most prevalent categories. This indicates a high prevalence of hypertension in the Wonoayu Health Center working area.

2. Most respondents had overweight or obese nutritional status. Statistical analysis demonstrated a significant relationship between BMI and the incidence of hypertension, showing that an increase in BMI is directly associated with a higher risk of hypertension.

3. The majority of respondents had borderline or high cholesterol levels. Data analysis indicated a significant relationship between cholesterol levels and hypertension, with high cholesterol more frequently observed among respondents with severe hypertension.

4. The study findings showed a significant relationship between BMI and hypertension incidence. Respondents who were overweight or obese had a higher risk of developing hypertension compared to those with normal BMI.

5. There was a significant relationship between cholesterol levels and hypertension, where respondents with high cholesterol were at greater risk of experiencing severe hypertension. This underscores the importance of cholesterol management as a preventive measure against hypertension.

Suggestion

Based on the conclusions above, the researcher provides the following recommendations:

1. For the Community
   The community is encouraged to adopt a healthy lifestyle by maintaining an ideal body weight, consuming a diet low in fat and cholesterol, and regularly monitoring blood pressure and cholesterol levels.

2. For Healthcare Workers at Wonoayu Health Center
   Routine counseling should be conducted on the importance of a healthy diet, physical activity, and early detection of hypertension and dyslipidemia. The health center is also expected to optimize the monitoring of BMI and cholesterol levels in high-risk patients.

3. For Future Researchers
   It is recommended to conduct further studies with a larger sample size and to include additional variables such as physical activity, family history, salt intake, and stress to provide a more comprehensive understanding of hypertension risk factors.

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