



Correlation of Body Mass Index (BMI), Abdominal Circumference, Total Cholesterol and Random Blood Glucose with Severity of Hypertension in Watubelah Community Health Center

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KEYWORDS	ABSTRACT
Body Mass Index; Abdominal Circumference; Total Cholesterol; Blood Glucose; Blood Pressure.	The prevalence of hypertension in Indonesia is predicted to continue to increase. Among the risk factors that can lead to hypertension are metabolic diseases caused by obesity (increased BMI and abdominal circumference) and increased total cholesterol and blood glucose levels. This study aimed to determine the correlation of Body Mass Index (BMI), abdominal circumference, total cholesterol, and random blood glucose with the severity of hypertension at Posbindu Watubelah Health Center. This research was conducted at the working area of the Watubelah Health Center using a cross-sectional method. The total sample in this study was 117 respondents, obtained using primary data through a consecutive sampling method and analyzed using Spearman's test and logistic regression. The results of the bivariate analysis showed a significant correlation between BMI (p 0.001; r 0.306), abdominal circumference (p 0.000; r 0.326), and total cholesterol (p 0.000; r 0.328) with hypertension. Meanwhile, random blood glucose did not show significant results with hypertension (p 0.197; r 0.120). Logistic regression analysis showed that total cholesterol was the most influential factor for hypertension (OR = 2.448; 95% CI = 1.350–4.440). Risk factors related to blood pressure are body mass index, abdominal circumference, and total cholesterol.

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INTRODUCTION

Although various studies have examined the relationship between metabolic risk factors and the incidence of hypertension, several gaps remain to be addressed (Kibria et al., 2023; Leggio et al., 2017; Sharma et al., 2017; Stanciu et al., 2023; Zhang et al., 2025). Previous studies by Yogeswara et al. (2023) and Firmansyah et al. (2020) focused primarily on the relationship between individual factors, such as Body Mass Index (BMI) and waist circumference, without simultaneously analyzing the influence of all four risk factors (BMI, waist circumference, total cholesterol, and random blood sugar) on the severity of hypertension. Furthermore, most studies were conducted in hospitals or advanced healthcare facilities, while research at the primary care level, such as the Integrated Health Service Post (Posbindu PTM), remains limited, even though Posbindu is at the forefront of early detection and monitoring of non-communicable disease risk factors. Research in the Watubelah Community Health Center (Puskesmas) area has never been conducted before, even though data from the Cirebon Regency Health Office (2023) indicate that the Watubelah Community

Health Center has the second-highest number of hypertension cases in the Sumber area, with 1,710 patients. Previous studies also failed to identify the most dominant factors influencing the incidence of hypertension in the area, necessitating multivariate analysis to determine the primary risk factors (Burnier & Egan, 2019; Li et al., 2023; Owolabi et al., 2018; Sambah et al., 2025).

Hypertension is one of the most common diseases that can occur in the population across all age groups and is a major risk factor for cardiovascular diseases and death due to cardiovascular events (Pradono et al., 2020). The World Health Organization estimates that 1.28 billion adults aged 30–79 years worldwide suffer from hypertension, and about 46% of adults with hypertension are unaware that they have the condition (WHO, 2023).

Based on the Basic Health Research (Riset Kesehatan Dasar) of 2018, the prevalence of hypertension in Indonesia increased to 34.1% compared to 25.8% in 2013. According to the 2022 Health Profile of the West Java Provincial Health Office, the highest number of hypertension patients receiving standard healthcare services was in Sukabumi Regency, with 879,091 patients (63.27%). The lowest number was in Tasikmalaya Regency at 0.82%, while Cirebon Regency had 4.46% of recorded hypertension patients (Dinas Kesehatan Jawa Barat, 2023). Meanwhile, data from the Cirebon Regency Health Office recorded that in 2023, the highest number of hypertension cases receiving healthcare services in Cirebon Regency was in Arjawinangun Subdistrict, specifically at the Tegalgubug Community Health Center, with 2,690 people. In Sumber Subdistrict, the highest number of hypertension cases was at the Watubelah Community Health Center, with 1,710 people, while the fewest cases were at the Sumber Community Health Center, with 486 people (Dinas Kesehatan Kabupaten Cirebon, 2023).

One of the global targets for addressing non-communicable diseases (NCDs) is to reduce the prevalence of hypertension by 33% between 2010 and 2030 (Chen et al., 2025; Farzadfar et al., 2024; Organization, 2023). Hypertension is one type of NCD or chronic illness that results from a combination of genetic, physiological, environmental, and behavioral factors. One of the strategies for preventing NCDs employed by Community Health Centers is optimizing integrated community-based counseling at Posbindu PTM. This initiative is a community-based health effort that is both promotive and preventive, focusing on early detection and monitoring of risk factors. It includes activities such as gathering risk factor information through simple interviews, measuring body weight and height (for BMI), abdominal circumference, cholesterol levels, and blood sugar levels (Ranti et al., 2022). The main types of NCD cases that frequently occur are cardiovascular diseases, including hypertension and metabolic syndrome. Metabolic syndrome can arise from several key components, including obesity, insulin resistance, dyslipidemia, and hypertension. Metabolic syndrome is considered a risk factor for hypertension (Adam et al., 2021).

Many factors can trigger hypertension, including uncontrollable risk factors such as genetics, gender, and age. Controllable risk factors include obesity, lack of physical activity, salt consumption, alcohol consumption, stress, and others (Yulanda et al., 2021). One of the common risk factors for hypertension is being overweight or obese. According to the Indonesian Ministry of Health (2020), a person is considered obese if their Body Mass Index (BMI) is ≥ 27 kg/m². Measuring abdominal circumference can also be useful, as it reflects the

presence of harmful fat in the abdominal area (Yogeswara et al., 2023). Obesity can affect glucose levels due to an increase in leptin in the body. Excessive fat accumulation can lead to insulin resistance, which may result in the development of diabetes mellitus. Insufficient physical activity can increase cholesterol levels in the body, which is a risk factor for heart and vascular diseases.

This study offers several novelties that distinguish it from previous research. First, substantively, this study simultaneously analyzes the relationship between four metabolic risk factors (BMI, waist circumference, total cholesterol, and random blood sugar) and hypertension severity (stages 1 and 2) within a single, integrated framework, rather than analyzing each factor separately. Second, this study was conducted at the primary healthcare level, namely the Posbindu PTM (Non-Communicable Disease Health Post) at Watubelah Community Health Center (Puskesmas), a relatively rare research setting despite its high relevance to community-based NCD prevention and control programs. Third, this study uses multivariate regression analysis to identify the most dominant risk factors influencing hypertension incidence, thus providing more targeted recommendations for intervention priorities. Fourth, this study integrates anthropometric data (BMI and waist circumference), laboratory data (cholesterol and random blood sugar), and lifestyle data (family history, physical activity, coffee, alcohol, and smoking consumption) into one comprehensive analysis, providing a more complete picture of the factors contributing to hypertension in the community. Thus, this study not only provides theoretical contributions to the development of community medicine, but also offers practical input for hypertension control programs at the community health center level.

This study has theoretical implications for the development of community medicine and the epidemiology of non-communicable diseases, particularly in enhancing understanding of the role of metabolic risk factors in the severity of hypertension at the primary care level. The finding that total cholesterol is the most dominant factor influencing the incidence of hypertension (OR = 2.448) provides a new theoretical basis suggesting that hypertension control interventions should not only focus on weight management, but should also emphasize lipid profile control. Practically, this study implies the need to strengthen screening and early detection programs at Posbindu PTM, particularly routine total cholesterol measurements, given that this factor carries a two-fold risk for hypertension. For the Watubelah Community Health Center, the results of this study can serve as a basis for designing more targeted interventions, such as counseling on healthy, low-cholesterol diets, increasing physical activity, and regular monitoring of hypertensive patients with dyslipidemia. For the Cirebon District Health Office, these findings can be used as evidence-based input for policies on resource allocation for hypertension prevention and control programs, as well as for strengthening the capacity of Posbindu cadres in conducting metabolic risk factor screening. This study also highlights the need for further research with a cohort design to examine the causal relationship between metabolic risk factors and the incidence of hypertension, as well as integrated intervention trials that combine weight control and lipid profile management in community-based hypertension management.

METHOD

This study uses an observational analytic method with a cross-sectional design. This research was conducted at the Posbindu Watubelah Community Health Center from June to July 2024. The sampling technique used was consecutive sampling, and the sample size was calculated using a cross-sectional formula. The value of N was already known, based on the prevalence of hypertension patients receiving healthcare services in 2023 at the Watubelah Community Health Center, which was 1,710 (Dinas Kesehatan, 2023). After calculation, the sample for this study was 117 respondents. The inclusion criteria were patients aged ≥ 45 years and diagnosed with primary hypertension, while the exclusion criteria were patients diagnosed with secondary hypertension and pregnant women. Data were collected after respondents provided their consent. Respondent measurements included Body Mass Index using a weight scale and height measurement, abdominal circumference using a measuring tape, blood tests to measure total cholesterol levels and random blood glucose levels, blood pressure measurement with a digital sphygmomanometer, and completion of a questionnaire.

This study has two types of variables: dependent and independent variables. The dependent variable is hypertension, while the independent variables are Body Mass Index (BMI), abdominal circumference, total cholesterol, and random blood glucose. Data were analyzed using univariate statistics, bivariate analysis with Spearman's test, and multivariate statistical analysis with logistic regression. This research obtained approval from the Ethics Committee of the Faculty of Medicine, Swadaya Gunung Jati University, with reference number NO.82/EC/FKUGJ/V/2024.

RESULT AND DISCUSSION

Based on Table 1. the results from the 117 respondents after examination showed that 60 respondents had stage 1 hypertension. The majority of these respondents were aged 55-65 years (23.1%) and were female (44.4%). The anthropometric examination, respondents had a BMI category of obesity level 1 (18.8%) and abdominal circumference category of central obesity (24.4%). The blood tests, the majority of respondents had total cholesterol levels in the high borderline category (29.1%) and random blood glucose levels in the normal category (43.9%). In the lifestyle assessment, the majority of respondents had a heredity of hypertension (51.3%), physical activity ≥ 3 times per week (37.6%), and most commonly performed walking as their physical activity (39.3%), consumed coffee (27,4%), did not consume alcohol (51.3%) and 44.4% not smoke.

Based on Table 1. the 57 respondents with stage 2 hypertension, the majority were aged 45-54 years (23.1%) and were female (38.5%). The anthropometric examination, respondents had a BMI category of obesity level 1 (20.5%) and abdominal circumference category of central obesity (45.3%). The blood tests, the majority of respondents had total cholesterol levels in the high category (23.9%) and random blood glucose levels in the normal category (34.8%). Lifestyle assessment, the majority of respondents had a heredity of hypertension (48.7%), physical activity ≥ 3 times per week (30.8%), and most commonly performed walking as their physical activity (29.9%), (30.8%) consumed coffee, (48.7%) not consume alcohol and (38.5%) not smoke.

Table 1. Univariat Analysis

Variable	Hipertensi Stage 1		Hipertensi Stage 2	
	F (n)	P (%)	F (n)	P (%)
Age				
45-54 (Middle Age)	21	17.9	27	23.1
55-65 (Elderly)	27	23.1	23	19.7
66-74 (Young Elderly)	10	8.5	6	5.1
75-90 (Old Elderly)	2	1.7	1	0.9
>90 (Very Old ELderly)	0	0.0	0	0.0
Gender				
Male	8	6.8	12	10.3
Female	52	44.4	45	38.5
BMI (kg/m²)				
Underweight (<18,5)	2	1.7	0	0.0
Normal (18,5-22,9)	12	10.3	6	5.1
Overweight (23-24,9)	20	17.1	12	10.3
Obesity Stage 1 (25-29,9)	22	18.8	24	20.5
Obesity Stage 2 (>30)	4	3.4	15	12.8
Abdominal Circumference (cm)				
Normal (Male: <90; Female: <80)	20	17.1	4	3.4
Central Obesity (Male: >90; Female: >80)	40	24.2	53	45.3
Total Cholesterol (mg/dl)				
Normal (<200)	17	14.5	9	7.7
Borderline High (200-239)	34	29.1	20	17.1
High (>240)	9	7.7	28	23.9
Random Blood GLucose (mg/dl)				
Normal (<200)	51	43.6	43	34.8
High (>200)	9	7.7	14	12.0
Family History of Hypertension				
Yes	60	51.3	57	48.7
No	0	0.0	0	0.0
Physical Activity				
<3x/minggu	16	13.7	21	17.9
≥3x/minggu	44	37.6	36	30.8
Type of Physical Activity				
Walking	46	39.3	35	29.9
Running	4	3.4	8	8.6
Cycling	10	8.5	14	12.0
Coffe Consumption				
Yes	32	27.4	36	30.8
No	28	23.9	21	17.9
Alcohol Consumption				

Variable	Hipertensi Stage 1		Hipertensi Stage 2	
	F (n)	P (%)	F (n)	P (%)
Yes	0	0.0	0	0.0
No	60	51.3	57	48.7
Smoking				
Yes	8	6.8	12	10.3
No	52	44.4	45	38.5

Source: Primary data from research at the Posbindu (Community Health Post) at Watubelah Community Health Center, Cirebon Regency (2024).

The distribution of hypertension patients at the Posbindu Watubelah Community Health Center show in Table 2. there were 60 respondents with stage 1 hypertension (51.3%) and 57 respondents with stage 2 hypertension (48.7%).

Table 2. The distribution of hypertension patients at the Posbindu Watubelah Community

Variable (mmHg)	F(n)	P(%)
Stage 1 Hypertension	60	51.3
Stage 2 Hypertension	57	48.7
Total	117	100.0

Source: Primary data from research at the Posbindu (Community Health Post) at Watubelah Community Health Center, Cirebon Regency (2024).

Table 3. The results of the bivariate analysis using *Spearman's* test show a significant correlation of Body Mass Index (BMI), abdominal circumference and total cholesterol with hypertension with p-values <0.05. But random glucose did not show a significant result in relation to hypertension, with a p-value >0.05.

Tabel 3. Bivariat Analysis

Variable	Rs	P value
Body Mass Index (BMI)	0,306	0,001
Abdominal Circumference	0,326	0,000
Total Cholesterol	0,328	0,000
Random Blood Glucose	0,120	0,197

Source: Spearman correlation test results based on primary research data from the Watubelah Community Health Center (Posbindu) in Cirebon Regency (2024).

Table 4. The results of the multivariate analysis using *Logistic Regression* show that total cholesterol levels are significantly associated with the occurrence of hypertension, with a p-value <0.05, odds ratio (OR) of 2.2448, and a 95% confidence interval (CI) of 1.350-4.440.

Table 4. Multivariat Analysis

Variable	P value	OR	CI 95%	
			Min	Maks
BMI	0,110	1.559	0,904	2.687
Abodminal Circumference	0,167	2.764	0,654	11.678
Total Cholesterol	0,003	2.448	1.350	4.440

Source: Results of a logistic regression test based on primary research data from the Posbindu (Community Health Post) at Watubelah Community Health Center, Cirebon Regency (2024).

Based on Table 3, the bivariate analysis using Spearman’s test reveals a significant correlation between Body Mass Index (BMI) and hypertension, with a p-value < 0.005 and an rs value of 0.306, indicating a weak positive correlation. This finding is consistent with research conducted by Yogeswara et al. (2020), which found that 22 out of 30 respondents (76.7%) with hypertension had a BMI categorized as obese, with statistical test results showing a p-value of 0.000 and a correlation coefficient of 0.671. The findings of that study indicate that as BMI increases, blood pressure also tends to rise, and a high BMI suggests that a person is likely to be overweight or obese.

As body mass increases, the volume of blood required to supply oxygen and nutrients to body tissues also increases. This condition causes the heart to work harder, which leads to increased blood pressure. This increase can indirectly occur through stimulation of the sympathetic nervous system and the renin–angiotensin–aldosterone system (RAAS) by mediators such as the hormone aldosterone. Aldosterone is associated with water and sodium retention, which in turn increases blood volume (Yogeswara et al., 2023).

Based on Table 3, the bivariate analysis using Spearman’s test indicates a significant correlation between abdominal circumference and hypertension, with a p-value < 0.005 and an rs value of 0.326, suggesting a weak positive correlation. This study is consistent with research conducted by Firmansyah et al. (2020), which found that central obesity was present in 20 out of 30 respondents (66.7%) with hypertension, while the incidence of hypertension in the group with normal abdominal circumference was observed in 3 respondents (30%). It can be concluded that central obesity increases the risk of developing hypertension by a factor of 2.

The mechanism by which obesity increases blood pressure is related to diet, hemodynamics, insulin resistance, endocrine factors, and neurohormonal factors. Sympathetic nerve stimulation caused by obesity will stimulate the release of catecholamines, which leads to an increase in blood pressure. Neurohormonal changes in individuals with obesity are associated with leptin. In normal individuals, leptin levels in the blood are relatively low. However, in individuals with obesity, leptin levels increase, leading to hyperleptinemia. The effects of this resistance depend on the responding organ. When resistance occurs in the kidneys, it can lead to disturbances in diuresis and natriuresis, causing changes in hemodynamic mechanisms that trigger an increase in blood pressure (Firmansyah et al., 2020).

Based on Table 3, the bivariate analysis using Spearman’s test indicates a significant correlation between total cholesterol levels and hypertension, with a p-value < 0.005 and an

rs value of 0.328, suggesting a weak positive correlation. This study is consistent with research conducted by Solikin et al. (2020), which found that the majority of respondents had borderline high total cholesterol levels, with 27 respondents (65.85%) experiencing hypertension. The statistical analysis showed a significant relationship between total cholesterol levels and the degree of hypertension, with a p-value of 0.004. The results of that study indicate that individuals with hypertension are more likely to experience increased cholesterol levels.

High levels of cholesterol in the blood can lead to the deposition of cholesterol in the walls of blood vessels. Over time, as these deposits accumulate, they can obstruct blood flow, which increases the workload on the heart. The presence of blockages in blood vessels causes the lumen to narrow and reduces the elasticity of the vessel walls. This can lead to high blood pressure and potentially contribute to the development of heart disease and stroke (Solikin et al., 2020).

Based on Table 3, the bivariate analysis using Spearman's test shows no significant relationship between random blood glucose levels and hypertension, with a p-value > 0.005 and an rs value of 0.120, indicating a very weak positive correlation. Several studies have shown that random blood glucose levels are related to hypertension. However, the results of this study did not find a significant relationship between random blood glucose levels and hypertension. These findings are in line with research conducted by Wijaya et al. (2024), which found no significant correlation between random blood glucose levels and the incidence of hypertension. Their study revealed that the majority of respondents had random blood glucose levels between 110–199 mg/dL, which falls into the normal category, with 43 respondents (78.2%) in this range. The study results indicate that there is no correlation between random blood glucose levels and either systolic or diastolic blood pressure. The lack of association between random blood glucose levels and the incidence of hypertension may be due to the absence of microvascular and macrovascular complications at the time of the study. Macrovascular complications occur due to thickening of blood vessels, while in microvascular complications, hyperglycemia in the endothelial layer increases endothelial cell permeability, which can trigger hypertension (Pratama et al., 2023).

Based on Table 4, the results of the multivariate analysis using logistic regression indicate that total cholesterol levels have a significant effect on the incidence of hypertension, with a p-value of 0.003, an odds ratio (OR) of 2.448, and a 95% confidence interval (CI) of 1.350–4.440. The results of this study indicate that individuals with high cholesterol levels have twice the risk of developing hypertension compared with other risk factors, such as BMI and abdominal circumference. These results align with research conducted by Sulastri et al. (2020), which suggests that high cholesterol levels increase the likelihood of developing high blood pressure by 3.7 times compared with respondents with normal cholesterol levels.

High cholesterol levels can cause significant problems, particularly in the blood vessels and brain. When cholesterol levels exceed normal limits, they can lead to atherosclerosis. Atherosclerosis involves the buildup of cholesterol deposits in arterial blood vessels, causing the arterial walls to become thickened and stiff. This narrowing and hardening of the arteries can obstruct blood flow (Permatasari et al., 2022).

This study has several limitations. Sampling was conducted during Posbindu activities at Puskesmas Watubelah, and data collection occurred only during working hours at the health center. As a result, the majority of study subjects were female, primarily homemakers. Additionally, when the examination procedures were explained to respondents, including the measurement of total cholesterol and random blood glucose levels, a significant number of respondents refused to participate due to fear of finger-prick procedures.

CONCLUSION

From the discussion, it can be concluded that Body Mass Index (BMI), abdominal circumference and total cholesterol have a significant correlation with hypertension (p-value <0.005). Among these factors, total cholesterol has the highest impact on the occurrence of hypertension compared to other risk factors identified at Posbindu Watubelah Community Health Center. It is hoped that the health center will enhance the quality of prevention efforts for hypertension patients to prevent complications, as well as improve non-communicable disease screening to better manage both diagnosed hypertensive patients and healthy individuals.

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