

Risk Factors Associated with the Incidence of Hypertension in Dukupuntang, Cirebon, West Java, Indonesia

Ezar Tiar Zulizar¹, Uswatun Khasanah², Nanang Ruhyana²

¹Student of Medical Faculty Swadaya Gunung Jati University, Cirebon, Indonesia

²Department of Public Health Sciences, Faculty of Medicine, Swadaya Gunung Jati University

*Corresponding Author: Ezar Tiar Zulizar

Email: ezartiarzulizar123@gmail.com

Article Info

Article History:

Received March 12, 2026

Revised April 3, 2026

Accepted: May 13, 2026

Keywords:

Hypertension, Risk Factors,
Family History,
Demographic, Determinants,
Rural Health.

Abstract

Hypertension is a major global public health problem and a leading risk factor for cardiovascular disease, stroke, and premature mortality. Despite extensive research, evidence regarding hypertension risk factors remains inconsistent across different populations and settings, particularly in rural communities. This study aimed to identify demographic, hereditary, socioeconomic, and behavioral factors associated with hypertension among adults attending the Dukupuntang Health Center, Cirebon Regency, Indonesia. A cross-sectional analytic study was conducted in June 2024 involving 147 adult respondents recruited through consecutive sampling. Data were collected using structured questionnaires, medical records, and blood pressure measurements. Hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg. Independent variables included gender, age, education level, occupation, family history of hypertension, smoking habits, physical activity, sodium intake, obesity status, and socioeconomic status. Data were analyzed using descriptive statistics and Chi-square tests with a significance level of $p < 0.05$. Of the 147 respondents, 51.0% were classified as hypertensive. Bivariate analysis revealed significant associations between hypertension and gender ($p = 0.018$), age ($p = 0.015$), education level ($p = 0.015$), occupation ($p = 0.010$), and family history of hypertension ($p < 0.001$). In contrast, smoking habits ($p = 0.056$), physical activity ($p = 0.154$), sodium intake ($p = 0.808$), obesity status ($p = 0.134$), and socioeconomic status ($p = 0.301$) were not significantly associated with hypertension. Hypertension in this rural population was primarily associated with demographic, hereditary, and social determinants. These findings highlight the importance of targeted screening, health education, and family-history-based prevention strategies to strengthen hypertension control and cardiovascular disease prevention in rural communities.

Introduction

Hypertension remains one of the most significant public health challenges worldwide and is recognized as a leading contributor to cardiovascular morbidity and mortality. As a chronic non-communicable disease, hypertension affects millions of individuals across all age groups and socioeconomic backgrounds. The condition is commonly referred to as the “silent killer” because it often develops without obvious symptoms while progressively damaging vital organs such as the heart, brain, kidneys, and blood vessels (Ahmed et al., 2025; Sudayasa et al., 2020; Bale & Doneen, 2022). Persistent elevation of blood pressure increases the risk of severe complications, including stroke, coronary artery disease, heart failure, chronic kidney disease, and premature death (Lukitaningtyas & Cahyono, 2023). According to current clinical guidelines, hypertension is generally defined as a systolic blood pressure of ≥ 140 mmHg and/or a diastolic blood pressure of ≥ 90 mmHg measured on repeated assessments (Sudayasa et al., 2020).

The global burden of hypertension continues to increase despite substantial advances in prevention, diagnosis, and treatment. The World Health Organization estimated that approximately 1.28 billion adults aged 30–79 years are living with hypertension, with nearly two-thirds residing in low- and middle-income countries (Bhandari et al., 2024; Katete, 2023; Ryabinina et al., 2026). Furthermore, a considerable proportion of individuals with hypertension remain undiagnosed, untreated, or inadequately controlled, thereby increasing the risk of cardiovascular complications and placing substantial pressure on healthcare systems worldwide (Goorani et al., 2024; Shariff et al., 2024; Minja et al., 2022). Population aging, urbanization, unhealthy dietary patterns, physical inactivity, obesity, tobacco use, and psychosocial stress have all been identified as factors contributing to the growing prevalence of hypertension globally (Lukitaningtyas & Cahyono, 2023; Marwaha, 2022; Ojangba et al., 2023).

Indonesia is experiencing a similar epidemiological transition characterized by an increasing burden of non-communicable diseases, including hypertension (Rusyda, 2025; Arifin et al., 2022; Rukmini et al., 2022). Data from the Indonesian Health Survey indicated that hypertension remains one of the most prevalent chronic diseases affecting Indonesian adults, with a national prevalence of approximately 30.8% (Kemenkes RI, 2023). This figure reflects a substantial public health concern because hypertension contributes significantly to disability, healthcare expenditures, and mortality. The prevalence of hypertension varies across provinces, with West Java consistently reporting one of the highest rates in the country, reaching approximately 34.4% (Kemenkes RI, 2023). Such findings underscore the urgent need for region-specific investigations to better understand the factors associated with hypertension and to support the development of effective prevention strategies.

The increasing prevalence of hypertension is influenced by a complex interaction of non-modifiable and modifiable risk factors. Non-modifiable factors include age, sex, genetic predisposition, and family history, whereas modifiable factors encompass smoking habits, obesity, physical inactivity, dietary patterns, sodium consumption, alcohol intake, and socioeconomic conditions (Lukitaningtyas & Cahyono, 2023; Setiandari, 2022; Abeywickrama & NirANJI, 2024). Previous studies have consistently shown that advancing age is one of the strongest predictors of hypertension because aging is associated with arterial stiffness, endothelial dysfunction, and reduced vascular elasticity (Nurhayati et al., 2023; Yunus et al., 2021). Similarly, individuals with a family history of hypertension tend to have a greater likelihood of developing elevated blood pressure due to genetic susceptibility and shared environmental influences (Sidik, 2023; Setiandari, 2022; Khan et al., 2025; Meng et al., 2024).

Gender has also been identified as an important determinant of hypertension. Several studies have reported differences in hypertension prevalence between men and women, which may be explained by biological, hormonal, behavioral, and social factors (La Ode et al., 2023; Yunus et al., 2021). While men often demonstrate a higher prevalence of hypertension during early adulthood, women may experience increased risk after menopause due to hormonal changes that affect vascular function and blood pressure regulation (Sadiman & Triesya, 2024; Bond et al., 2026; D'Ignazio et al., 2023; Ghazi et al., 2022). These findings suggest that sex-specific approaches may be necessary for hypertension prevention and management.

In addition to biological factors, socioeconomic and educational characteristics play an important role in influencing hypertension risk. Individuals with lower educational attainment may possess limited health literacy, reduced access to healthcare information, and lower awareness of healthy lifestyle practices, all of which may contribute to the development and progression of hypertension (Hastutik et al., 2020; Osborne et al., 2022; Sarkar, 2024).

Occupation and income level may also affect health outcomes through differences in stress exposure, healthcare accessibility, working conditions, and lifestyle behaviors (Setiandari, 2022; Frank et al., 2023; Lee et al., 2022; Majcherek et al., 2022). Consequently, understanding the social determinants of hypertension is essential for designing effective public health interventions.

Behavioral and lifestyle factors have also been extensively studied in relation to hypertension. Smoking is recognized as a major cardiovascular risk factor because nicotine and other tobacco-related substances can increase blood pressure, promote vascular damage, and accelerate atherosclerosis (Erman et al., 2021; Fu et al., 2024; Dahdah et al., 2022). Likewise, excessive sodium intake has been associated with increased blood pressure through mechanisms involving fluid retention and alterations in vascular resistance (Jhee et al., 2023; Duan et al., 2024; Hall et al., 2024; Rahman et al., 2024). Obesity contributes to hypertension through multiple physiological pathways, including increased sympathetic nervous system activity, insulin resistance, and inflammation (Sadiman & Triesya, 2024). Physical inactivity further exacerbates cardiovascular risk by reducing cardiovascular fitness and promoting weight gain (WHO, 2023). However, despite the established theoretical relationships between these factors and hypertension, previous studies have reported varying findings regarding their relative contributions across different populations and settings.

Research conducted in Indonesia has produced inconsistent results concerning several hypertension risk factors. Some studies reported significant associations between hypertension and age, gender, obesity, family history, smoking behavior, and dietary habits (Imelda et al., 2020; Sidik, 2023; Nurhayati et al., 2023). In contrast, other studies found weak or non-significant relationships for certain behavioral and socioeconomic variables (Erman et al., 2021; Setiandari, 2022). These inconsistencies may arise from differences in study populations, measurement approaches, sample characteristics, cultural practices, environmental conditions, and healthcare accessibility. Therefore, localized investigations are needed to better understand how risk factors operate within specific communities.

Dukupuntang District in Cirebon Regency represents a unique rural setting undergoing demographic and lifestyle transitions that may influence hypertension risk. According to the Cirebon Regency Health Profile, hypertension remains one of the most frequently reported chronic diseases, with approximately 88,047 recorded cases in the regency and 238 patients registered at the Dukupuntang Health Center (Dinkes Kabupaten Cirebon, 2023). Rural communities often face challenges related to health literacy, preventive healthcare utilization, economic constraints, and access to health services, which may affect the occurrence and management of hypertension differently from urban populations (Kemenkes RI, 2023). Moreover, changing dietary habits, occupational patterns, and population aging may further contribute to the burden of hypertension in this area.

Despite the growing burden of hypertension in Dukupuntang, evidence regarding the relative contribution of demographic, hereditary, socioeconomic, and behavioral factors remains limited. Understanding these factors is important because effective prevention and control strategies require context-specific evidence that reflects the characteristics of local populations. Identifying the factors associated with hypertension in rural communities can assist healthcare providers and policymakers in developing targeted interventions, strengthening community-based screening programs, improving health education, and promoting healthy lifestyles among high-risk groups. Therefore, examining hypertension risk factors in Dukupuntang is essential to support evidence-based public health planning and contribute to broader efforts aimed at reducing the burden of cardiovascular diseases in Indonesia.

Method

Study Design and Setting

This study employed an observational analytic design with a cross-sectional approach to investigate factors associated with hypertension among adult patients attending the Dukupuntang Health Center, Cirebon Regency, West Java, Indonesia. A cross-sectional design was selected because it allows the simultaneous assessment of exposure variables and health outcomes within a defined population at a specific point in time. This design is particularly useful for identifying factors associated with chronic diseases such as hypertension and for generating evidence to support local public health interventions.

The study was conducted in June 2024 at the Dukupuntang Health Center, a primary healthcare facility serving both urban and rural communities within the Dukupuntang District. The health center was selected because hypertension represents one of the most commonly reported non-communicable diseases in its service area, making it an appropriate setting for investigating factors associated with the condition.

Study Population and Sampling

The target population consisted of adult patients who attended the Dukupuntang Health Center during the study period. Participants were recruited using a consecutive sampling technique, whereby all eligible individuals presenting to the health center during the data collection period were invited to participate until the required sample size was achieved. This approach was chosen because it enabled the inclusion of all accessible participants meeting the eligibility criteria and facilitated efficient recruitment within the available timeframe.

A total of 147 respondents were enrolled in the study. The minimum sample size was estimated using the formula for cross-sectional studies with a 95% confidence level and an expected prevalence of hypertension based on regional health statistics. The final sample exceeded the minimum required sample size, thereby providing sufficient observations for the planned statistical analyses.

Eligibility Criteria

Participants were eligible for inclusion if they were aged 18 years or older, attended the Dukupuntang Health Center during the study period, and were willing to participate by providing written informed consent. Individuals were excluded if they had documented psychiatric disorders that could interfere with communication and questionnaire completion or if they had severe hypertension-related complications, including stroke, chronic kidney failure, or heart failure. Information regarding these conditions was obtained from medical records and participant interviews conducted during data collection.

Variables and Operational Definitions

The dependent variable in this study was hypertension status. Hypertension was defined according to World Health Organization criteria as a systolic blood pressure of ≥ 140 mmHg and/or a diastolic blood pressure of ≥ 90 mmHg measured during the study assessment.

The independent variables included demographic, hereditary, behavioral, and socioeconomic factors. Demographic variables consisted of sex, age, education level, and occupation. Sex was categorized as male or female. Age was classified into three groups: 18–45 years, 46–59 years, and 60 years or older. Educational attainment was categorized as elementary school, junior high school, senior high school, and college/university. Occupation was classified as self-employed, civil servant, private employee, laborer, fisherman, housewife, or other occupations.

Hereditary factors were assessed through family history of hypertension and categorized as present or absent based on participant self-report. Behavioral variables included smoking status, physical activity level, and sodium intake. Smoking status was categorized as smoker or non-smoker. Physical activity was classified as low, moderate, or high according to participants' routine daily activities and occupational workload. Sodium intake was categorized as high or low based on participants' reported dietary habits and frequency of consuming salty foods.

Obesity status was assessed using Body Mass Index (BMI), calculated as weight in kilograms divided by height in meters squared (kg/m^2). Participants were classified as underweight, normal weight, overweight, obesity class I, or obesity class II according to standard BMI classification criteria. Socioeconomic status was determined using monthly income and categorized as below the regional minimum wage, equal to the regional minimum wage, or above the regional minimum wage established for Cirebon Regency.

Data Collection Procedures

Data collection was conducted using a structured questionnaire and direct blood pressure measurements. Prior to data collection, participants were informed about the objectives and procedures of the study and provided written informed consent. Trained research assistants administered the questionnaires through face-to-face interviews to ensure consistency and completeness of responses.

The questionnaire collected information regarding demographic characteristics, educational background, occupation, family history of hypertension, smoking habits, physical activity, dietary sodium intake, and socioeconomic status. Secondary information relevant to participant health conditions was obtained from medical records when necessary to verify eligibility criteria and clinical information.

All collected data were coded and entered into a database for analysis. Variables were recorded using nominal and ordinal measurement scales according to their respective categories.

Blood Pressure Measurement

Blood pressure was measured using a calibrated sphygmomanometer following standard measurement procedures. Participants were instructed to rest in a seated position for at least five minutes before measurement. Blood pressure was measured while participants were seated comfortably with their backs supported and feet resting flat on the floor.

Two blood pressure measurements were obtained at five-minute intervals. The average of the two readings was used for analysis to minimize measurement error and improve reliability. Participants with an average systolic blood pressure of ≥ 140 mmHg and/or an average diastolic blood pressure of ≥ 90 mmHg were classified as having hypertension.

Ethical Considerations

Ethical approval for this study was obtained from the Ethics Committee of the Faculty of Medicine, Universitas Swadaya Gunung Jati, Cirebon (Approval No. 63/EC/FKUGJ/V/2024). The study was conducted in accordance with established ethical principles for research involving human participants. All respondents received information regarding the purpose, procedures, potential benefits, and confidentiality of the study before participation. Written informed consent was obtained from all participants, and confidentiality of personal information was maintained throughout the research process.

Statistical Analysis

Data were analyzed using statistical software. Descriptive statistics were used to summarize participant characteristics and study variables. Categorical variables were presented as frequencies and percentages.

Bivariate analysis was performed using the Chi-square test to examine associations between independent variables and hypertension status. Variables analyzed included sex, age, education level, occupation, family history of hypertension, smoking status, physical activity level, sodium intake, obesity status, and socioeconomic status. Statistical significance was determined at a p-value of less than 0.05 with a 95% confidence level. The results were presented in tabular form to facilitate interpretation of the relationships between potential risk factors and hypertension.

Result and Discussion

A total of 147 respondents participated in this study and met the eligibility criteria. The results are presented in two sections. First, the characteristics of respondents are described to provide an overview of the demographic, hereditary, behavioral, and socioeconomic profiles of the study population. Second, bivariate analysis was conducted to examine the associations between selected risk factors and hypertension status. The findings are presented in Tables 1 and 2.

Table 1. Characteristics of Respondents (N = 147)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	40	27.2
	Female	107	72.8
Age (years)	18–45	78	53.1
	46–59	55	37.4
	≥60	14	9.5
Education Level	Elementary School	97	66.0
	Junior High School	31	21.1
	High School	13	8.8
	College/University	6	4.1
Occupation	Self-employed	18	12.2
	Laborer	22	15.0
	Housewife	102	69.4
	Others	5	3.4
Family History of Hypertension	Yes	63	42.9
	No	84	57.1
Smoking Habits	Yes	33	22.4
	No	114	77.6
Physical Activity	Low	9	6.1
	Moderate	96	65.3
	High	42	28.6
Sodium Intake	High	75	51.0
	Low	72	49.0
Obesity Status	Underweight	6	4.1
	Normal Weight	52	35.4
	Overweight	18	12.2

	Obesity I	44	29.9
	Obesity II	27	18.4
Socioeconomic Status	Below Regional Minimum Wage	85	57.8
	At Regional Minimum Wage	41	27.9
	Above Regional Minimum Wage	21	14.3
Hypertension Status	Hypertension	75	51.0
	Non-hypertension	72	49.0

Table 1 presents the characteristics of the 147 respondents included in this study. Most participants were female (72.8%), while males accounted for 27.2% of the sample. More than half of the respondents were aged 18–45 years (53.1%), followed by those aged 46–59 years (37.4%) and those aged 60 years or older (9.5%). Most respondents had completed elementary school education (66.0%), whereas only 4.1% had attained college-level education. Regarding occupation, housewives constituted the largest proportion of participants (69.4%), followed by laborers (15.0%) and self-employed workers (12.2%). More than half of the respondents reported no family history of hypertension (57.1%), and the majority were non-smokers (77.6%).

Moderate physical activity was the most frequently reported category (65.3%), while only 6.1% of respondents reported low physical activity. Sodium intake was relatively balanced, with 51.0% classified as having high sodium intake and 49.0% having low sodium intake. Based on BMI classification, normal weight was the most common category (35.4%), although a substantial proportion of respondents were classified as obesity class I (29.9%) and obesity class II (18.4%). In terms of socioeconomic status, most respondents reported monthly income below the regional minimum wage (57.8%). Overall, 75 respondents (51.0%) were classified as hypertensive, indicating that hypertension was slightly more prevalent than non-hypertension within the study population.

Table 2. Association Between Risk Factors and Hypertension

Variable	Category	Hypertension n (%)	Non-Hypertension n (%)	p-value
Gender	Male	14 (18.7)	26 (36.1)	0.018*
	Female	61 (81.3)	46 (63.9)	
Age	18–45 years	31 (41.4)	47 (65.3)	0.015*
	46–59 years	35 (46.6)	20 (27.8)	
	≥60 years	9 (12.0)	5 (6.9)	
Education	Elementary School	57 (76.0)	40 (55.6)	0.015*
	Junior High School	13 (17.3)	18 (25.0)	
	High School	5 (6.7)	8 (11.1)	
	College/University	0 (0.0)	6 (8.3)	
Occupation	Self-employed	7 (9.3)	15 (20.8)	0.010*
	Housewife	60 (80.0)	42 (58.3)	
	Student	0 (0.0)	5 (6.9)	
	Private Employee	8 (10.7)	10 (13.9)	
Family History	Yes	63 (84.0)	0 (0.0)	<0.001*

	No	12 (16.0)	72 (100.0)	
Smoking Habits	Yes	12 (16.0)	21 (29.2)	0.056
	No	63 (84.0)	51 (70.8)	
Physical Activity	Low	7 (9.3)	2 (2.8)	0.154
	Moderate	50 (66.7)	46 (63.9)	
	High	18 (24.0)	24 (33.3)	
Sodium Intake	Low	36 (48.0)	36 (50.0)	0.808
	High	39 (52.0)	36 (50.0)	
Obesity	Underweight	2 (2.7)	4 (5.5)	0.134
	Normal Weight	23 (30.7)	29 (40.3)	
	Overweight	7 (9.3)	11 (15.3)	
	Obesity I	24 (32.0)	20 (27.8)	
	Obesity II	19 (25.3)	8 (11.1)	
Socioeconomic Status	Below UMR	48 (64.0)	37 (51.4)	0.301
	At UMR	18 (24.0)	23 (31.9)	
	Above UMR	9 (12.0)	12 (16.7)	

Table 2 presents the results of the bivariate analysis examining the association between potential risk factors and hypertension. The analysis revealed statistically significant associations between gender ($p = 0.018$), age ($p = 0.015$), education level ($p = 0.015$), occupation ($p = 0.010$), and family history of hypertension ($p < 0.001$) with hypertension status.

Female respondents constituted a significantly greater proportion of hypertensive individuals compared with males. Similarly, respondents aged 46 years and older were more likely to experience hypertension than younger adults. Lower educational attainment, particularly elementary school education, was more prevalent among hypertensive respondents, suggesting that limited educational background may contribute to increased hypertension risk.

Occupation was also significantly associated with hypertension, with housewives representing the largest proportion of hypertensive respondents. Furthermore, a family history of hypertension demonstrated the strongest association with hypertension status, indicating that hereditary factors may play a substantial role in the occurrence of hypertension within this population.

Conversely, smoking habits ($p = 0.056$), physical activity ($p = 0.154$), sodium intake ($p = 0.808$), obesity status ($p = 0.134$), and socioeconomic status ($p = 0.301$) were not significantly associated with hypertension. Although obesity and smoking showed higher proportions among hypertensive respondents, the observed differences did not reach statistical significance. Therefore, the findings suggest that demographic and hereditary factors were more strongly associated with hypertension than behavioral and socioeconomic factors in this study population.

Understanding the Interplay of Demographic, Genetic, and Social Factors in Hypertension Risk

The present study contributes to the growing body of evidence demonstrating that hypertension in rural communities cannot be adequately understood solely through a biomedical lens. Rather, the findings suggest that hypertension emerges from the interaction between biological susceptibility, demographic characteristics, and social determinants operating within specific

local contexts. While hypertension is frequently discussed as an individual health condition, the present findings reinforce the argument that it should also be viewed as a population-level phenomenon shaped by structural and social circumstances. This perspective is particularly important in rural Indonesia, where demographic transitions, population aging, and changing lifestyles are occurring simultaneously with persistent inequalities in health literacy and healthcare access.

One of the most important contributions of this study lies in its identification of demographic and hereditary characteristics as dominant factors associated with hypertension within the Dukupuntang population. This finding suggests that interventions focused exclusively on modifying lifestyle behaviors may be insufficient if they fail to account for the underlying social and biological contexts in which individuals live. Contemporary public health discourse increasingly recognizes that cardiovascular disease prevention requires a life-course perspective, where inherited predispositions and cumulative social exposures interact over time to influence health outcomes. The present study supports this perspective by demonstrating that factors linked to social position and biological vulnerability remain highly relevant in a rural Indonesian setting.

The significance of educational attainment warrants particular attention because it highlights the role of health literacy as a fundamental determinant of cardiovascular health. Education influences not only knowledge acquisition but also an individual's ability to access, interpret, and utilize health information. In many rural communities, limited educational opportunities may restrict awareness regarding hypertension prevention, routine blood pressure monitoring, dietary modification, and long-term treatment adherence. Consequently, disparities in hypertension prevalence may reflect broader inequalities in access to health-promoting resources rather than merely differences in personal behavior. This interpretation has important implications for public health policy because it suggests that sustainable hypertension control requires investments in community education and health communication strategies that extend beyond conventional clinical interventions.

Similarly, the observed association between occupational status and hypertension should be interpreted within a broader socioeconomic framework. Occupation is frequently used as a proxy indicator of social position, economic security, daily stress exposure, and access to healthcare resources. In rural environments, occupational roles often shape patterns of physical activity, social responsibilities, and healthcare-seeking behavior. The predominance of housewives among hypertensive respondents may therefore reflect more than a simple occupational category; it may indicate the cumulative effects of caregiving responsibilities, limited economic autonomy, restricted access to preventive healthcare services, and prolonged exposure to psychosocial stressors. These findings underscore the importance of recognizing unpaid domestic work as a potentially relevant social determinant of health, particularly in low- and middle-income countries where women continue to bear a disproportionate share of household responsibilities.

Perhaps the most consequential finding of this study concerns the role of family history. The strong association observed between hereditary background and hypertension reinforces the growing consensus that cardiovascular risk cannot be fully explained by contemporary lifestyle factors alone. Genetic predisposition influences numerous physiological pathways involved in blood pressure regulation, including vascular resistance, renal sodium handling, neurohormonal activity, and inflammatory processes. However, family history should not be interpreted purely as a genetic phenomenon. Families also transmit behavioral norms, dietary practices, health beliefs, and environmental exposures across generations. Consequently,

family history represents a convergence of biological inheritance and social inheritance. From a public health perspective, this finding supports the implementation of family-centered approaches to hypertension prevention, whereby individuals with a known family history are prioritized for earlier screening, risk assessment, and preventive interventions.

An equally important aspect of the present study concerns the absence of significant associations between several commonly cited behavioral risk factors and hypertension. These findings should not be interpreted as evidence that smoking, obesity, physical inactivity, or excessive sodium intake are unimportant determinants of hypertension. The extensive global literature has consistently established these factors as major contributors to elevated blood pressure and cardiovascular disease. Rather, the present findings highlight the contextual nature of epidemiological relationships and the limitations of assuming that risk factors operate uniformly across populations. The strength and visibility of particular risk factors may vary according to demographic composition, cultural practices, environmental conditions, and measurement approaches. Consequently, the findings serve as a reminder that public health evidence generated in one setting cannot always be generalized uncritically to another.

The absence of statistically significant associations for several behavioral variables also raises important methodological considerations. Many behavioral exposures are difficult to measure accurately through self-reported questionnaires because they are susceptible to recall bias, social desirability bias, and reporting inaccuracies. For example, dietary sodium consumption is notoriously difficult to quantify without objective assessments such as dietary recalls, food diaries, or urinary sodium measurements. Similarly, self-reported physical activity often fails to capture the complexity of occupational, domestic, and leisure-time activities that characterize daily life in rural communities. Therefore, the present findings should be viewed as an invitation for future research to employ more sophisticated measurement approaches rather than as evidence against the relevance of these behavioral factors.

From a policy perspective, the findings suggest that hypertension prevention strategies in rural Indonesia should move beyond generalized health promotion campaigns toward more targeted and risk-based interventions. Population-wide approaches remain important; however, limited healthcare resources necessitate prioritization of groups with the greatest vulnerability. Individuals with a family history of hypertension, older adults, women approaching or exceeding middle age, and populations with limited educational attainment may represent priority targets for early detection and prevention programs. Community-based initiatives such as Posbindu should therefore be strengthened not only as screening facilities but also as platforms for continuous cardiovascular risk assessment, education, and follow-up care.

More broadly, the findings contribute to ongoing discussions regarding the epidemiological transition occurring throughout many low- and middle-income countries. As infectious diseases gradually decline and life expectancy increases, chronic non-communicable diseases are becoming dominant causes of morbidity and mortality. Rural populations, once perceived as relatively protected from lifestyle-related diseases, are increasingly experiencing similar cardiovascular risks to urban populations while simultaneously facing greater barriers to healthcare access. The present study provides localized evidence supporting this transition and underscores the need for health systems to adapt accordingly.

Several limitations should be acknowledged when interpreting these findings. The cross-sectional design precludes conclusions regarding causal relationships, and the use of consecutive sampling from a single health center may limit generalizability to other populations. In addition, reliance on self-reported behavioral measures may have introduced measurement error, while the absence of multivariable analysis limited the ability to control

for potential confounding factors. Nevertheless, despite these limitations, the study offers valuable insights into the complex interplay between biological, demographic, and social determinants of hypertension within a rural Indonesian context.

Taken together, the findings suggest that hypertension prevention in rural communities should be conceptualized as both a clinical and a social challenge. Effective control strategies will require greater attention to demographic vulnerability, hereditary risk, health literacy, and community-level determinants of health. By situating hypertension within its broader social context, policymakers and healthcare providers may be better positioned to develop interventions that are not only medically effective but also socially responsive and sustainable.

Conclusion

This study demonstrates that hypertension among adults attending the Dukupuntang Health Center is primarily associated with demographic, hereditary, and social determinants rather than behavioral factors alone. Gender, age, educational attainment, occupation, and family history of hypertension were identified as significant factors associated with hypertension, highlighting the importance of biological vulnerability and social context in shaping cardiovascular health outcomes within rural communities. These findings suggest that hypertension prevention strategies should move beyond generalized lifestyle interventions and prioritize risk-based approaches that focus on individuals with hereditary predisposition, older adults, women, and populations with limited educational attainment. Strengthening community-based screening, health education, and early detection programs through primary healthcare services may improve hypertension prevention and control in rural settings. Although the study is limited by its cross-sectional design and reliance on self-reported measures, it provides valuable localized evidence that contributes to a better understanding of hypertension risk in rural Indonesia and supports the development of more targeted and contextually appropriate public health interventions.

References

- Abeywickrama, N. P., & Niranji, G. U. (2024). Comprehensive analysis of the relationship between modifiable and non-modifiable risk factors and the development of arterial hypertension. *ПРОБЛЕМЫ И ПЕРСПЕКТИВЫ РАЗВИТИЯ СОВРЕМЕННОЙ МЕДИЦИНЫ*, 81.
- Ahmed, K., Dubey, M. K., Dubey, S., & Pandey, D. K. (2025). Chronic kidney disease: Causes, treatment, management, and future scope. In *Computational Intelligence for Genomics Data* (pp. 99-111). Academic Press. <https://doi.org/10.1016/B978-0-443-30080-6.00010-9>
- Arifin, H., Chou, K. R., Ibrahim, K., Fitri, S. U. R. A., Pradipta, R. O., Rias, Y. A., ... & Pahria, T. (2022). Analysis of modifiable, non-modifiable, and physiological risk factors of non-communicable diseases in Indonesia: evidence from the 2018 Indonesian basic health research. *Journal of multidisciplinary healthcare*, 2203-2221. <https://doi.org/10.2147/JMDH.S382191>
- Bale, B., & Doneen, A. (2022). *Healthy Heart, Healthy Brain: The Personalized Path to Protect Your Memory, Prevent Heart Attacks and Strokes, and Avoid Chronic Illness*. Hachette UK.
- Bhandari, T. R., Paudel, S., Chalise, A., Ojha, J., Paudel, G., Khatiwada, B., & Yadav, U. N. (2024). Hypertension and its associated factors in a middle-aged population. *Journal*

- Bond, R. M., Purewal, V., Cameron, N., Tobb, K., Adedinsewo, D., Isiadinso, I., & Phillips, K. (2026). Hypertension in Women Across the Life Cycle: Unique Aspects and Challenges. *Current hypertension reports*, 28(1), 14. <https://doi.org/10.1007/s11906-026-01362-x>
- Dahdah, A., Jagers, R. M., Sreejit, G., Johnson, J., Kanuri, B., Murphy, A. J., & Nagareddy, P. R. (2022). Immunological insights into cigarette smoking-induced cardiovascular disease risk. *Cells*, 11(20), 3190. <https://doi.org/10.3390/cells11203190>
- D'Ignazio, T., Grand'Maison, S., Bérubé, L., Forcillo, J., & Pacheco, C. (2023). Hypertension Across a Woman's lifespan. *Maturitas*, 168, 84-91. <https://doi.org/10.1016/j.maturitas.2022.11.006>
- Duan, S., Ma, Y., Lu, F., Zhang, C., Guo, H., Zeng, M., ... & Zhang, B. (2024). High sodium intake and fluid overhydration predict cardiac structural and functional impairments in chronic kidney disease. *Frontiers in Nutrition*, 11, 1388591. <https://doi.org/10.3389/fnut.2024.1388591>
- Erman, I., Damanik, H., & Sya'diyah. (2021). Hubungan merokok dengan kejadian hipertensi di Puskesmas Kampus Palembang. *Jurnal Keperawatan Merdeka (JKM)*, 1(1), 54–61. <https://doi.org/10.36086/jkm.v1i1.983>
- Frank, J., Mustard, C., Smith, P., Siddiqi, A., Cheng, Y., Burdorf, A., & Rugulies, R. (2023). Work as a social determinant of health in high-income countries: past, present, and future. *The Lancet*, 402(10410), 1357-1367. [https://doi.org/10.1016/s0140-6736\(23\)00871-1](https://doi.org/10.1016/s0140-6736(23)00871-1)
- Fu, M., Mei, A., Min, X., Yang, H., Wu, W., Zhong, J., ... & Chen, J. (2024). Advancements in cardiovascular disease research affected by smoking. *Reviews in cardiovascular medicine*, 25(8), 298. <https://doi.org/10.31083/j.rcm2508298>
- Ghazi, L., Annabathula, R. V., Bello, N. A., Zhou, L., Stacey, R. B., & Upadhyya, B. (2022). Hypertension across a woman's life cycle. *Current hypertension reports*, 24(12), 723-733. <https://doi.org/10.1007/s11906-022-01230-4>
- Goorani, S., Zangene, S., & Imig, J. D. (2024). Hypertension: a continuing public healthcare issue. *International journal of molecular sciences*, 26(1), 123. <https://doi.org/10.3390/ijms26010123>
- Hall, J. E., Omoto, A. C., Wang, Z., Mouton, A., Li, X., & Hall, M. E. (2024). Pathophysiology of hypertension. In *Hypertension* (pp. 71-86). Elsevier. <https://doi.org/10.1016/B978-0-323-88369-6.00005-0>
- Hastutik, K. P., Ningsih, R., & Syahleman, R. (2020). Hubungan tingkat pengetahuan dengan tekanan darah pada penderita hipertensi di ruang rawat inap RSUD Sultan Imanuddin Pangkalan Bun. *Jurnal Borneo Cendekia*, 6(1), 66–75.
- Imelda, Sjaaf, F. F., & Puspita, P. A. F. (2020). Faktor-faktor yang berhubungan dengan kejadian hipertensi pada lansia di Puskesmas Air Dingin Lubuk Minturun. *HEME*, 11(2), 69–77. <https://doi.org/10.33854/heme.v2i2.459>

- Jhee, J. H., Park, H. C., & Choi, H. Y. (2022). Skin sodium and blood pressure regulation. *Electrolytes & Blood Pressure: E & BP*, 20(1), 1. <https://doi.org/10.5049/EBP.2022.20.1.1>
- Katete, R. S. (2023). Hypertension: unmasking the silent epidemic in developing countries. *Biomedical Sciences*, 9(4), 84-96. <https://doi.org/10.11648/j.bs.20230904.12>
- Kementerian Kesehatan Republik Indonesia. (2023). *Survei kesehatan Indonesia dalam angka*. Kementerian Kesehatan RI.
- Khan, J. A., Ahmed, F. W., Shaikh, N., Jamali, A. G., Binoy, J. G., Rahman, F. A., ... & Chaudhry Jr, Z. J. (2025). Relationship between perceived stress and blood pressure control in young adults with a family history of hypertension. *Cureus*, 17(7). <https://doi.org/10.7759/cureus.87821>
- La Ode, N. S., Mulyati, Suwardha, Y., & Ricky, Z. (2023). Hubungan usia dan jenis kelamin dengan kejadian hipertensi. *Jurnal Ilmiah Keperawatan dan Kebidanan Holistic Care*, 6(2). <https://doi.org/10.54184/jikkhc.v6i2.275>
- Lee, S. Y., Jung, S., & Lee, W. (2022). Status of workers' health behavior and the association between occupational characteristics and health behavior. *International Journal of Environmental Research and Public Health*, 19(20), 13021. <https://doi.org/10.3390/ijerph192013021>
- Lukitaningtyas, D., & Cahyono, E. A. (2023). Hipertensi: Artikel review. *Jurnal Pengembangan Ilmu dan Praktik Kesehatan*, 2(2), 100–117. <https://doi.org/10.56586/pipk.v2i2.272>
- Majcherek, D., Kowalski, A. M., & Lewandowska, M. S. (2022). Lifestyle, demographic and socio-economic determinants of mental health disorders of employees in the European countries. *International journal of environmental research and public health*, 19(19), 11913. <https://doi.org/10.3390/ijerph191911913>
- Marwaha, K. (2022). Examining the role of psychosocial stressors in hypertension. *Journal of Preventive Medicine and Public Health*, 55(6), 499. <https://doi.org/10.3961/jpmph.21.266>
- Meng, Y., Mynard, J. P., Smith, K. J., Juonala, M., Urbina, E. M., Niiranen, T., ... & Magnussen, C. G. (2024). Pediatric blood pressure and cardiovascular health in adulthood. *Current Hypertension Reports*, 26(11), 431-450. <https://doi.org/10.1007/s11906-024-01312-5>
- Minja, N. W., Nakagaayi, D., Aliku, T., Zhang, W., Ssinabulya, I., Nabaale, J., ... & Kayima, J. (2022). Cardiovascular diseases in Africa in the twenty-first century: gaps and priorities going forward. *Frontiers in Cardiovascular Medicine*, 9, 1008335. <https://doi.org/10.3389/fcvm.2022.1008335>
- Nurhayati, U. A., Ariyanto, A., & Syafriakhwan, F. (2023). Hubungan usia dan jenis kelamin terhadap kejadian hipertensi. *Prosiding Seminar Nasional Penelitian dan Pengabdian kepada Masyarakat LPPM Universitas 'Aisyiyah Yogyakarta*, 1, 363–369.
- Ojangba, T., Boamah, S., Miao, Y., Guo, X., Fen, Y., Agboyibor, C., ... & Dong, W. (2023). Comprehensive effects of lifestyle reform, adherence, and related factors on hypertension control: A review. *The Journal of Clinical Hypertension*, 25(6), 509-520. <https://doi.org/10.1111/jch.14653>

- Osborne, R. H., Elmer, S., Hawkins, M., Cheng, C. C., Batterham, R. W., Dias, S., ... & Fones, G. (2022). Health literacy development is central to the prevention and control of non-communicable diseases. *BMJ Global Health*, 7(12). <https://doi.org/10.1136/bmjgh-2022-010362>
- Rahman, S., Hasan, H., Uddin, N., & Haque, A. (2024). Assessment of the Clinical Outcomes of Sodium and Fluid-Restricted Diets on Blood Pressure and Volume Status in CKD Patients. *Bangladesh Journal of Advanced Clinical Research*, 2(1), 23-32. <https://doi.org/10.70945/bjacr.v02i01.010>
- Rukmini, R., Handajani, A., Paramita, A., Andarwati, P., & Laksono, A. D. (2022). Non-communicable diseases among the elderly in Indonesia in 2018. *Indian Journal of Forensic Medicine & Toxicology*, 16(1), 1026-1036. <https://doi.org/10.37506/ijfmt.v16i1.17631>
- Rusyda, A. L. (2025). Exploring the Non-Communicable disease burden in Indonesia—Findings from the 2023 health survey. *Indonesian Journal of Public Health Nutrition (IJPHN)*, 5(2), 6. <https://doi.org/10.7454/ijphn.v5i2.1064>
- Ryabinina, O., Addo, F. O., Thomford, N. E., Zumesew, F., Debrah, A. A., Nsiah, P., ... & Donkoh, E. T. (2026). Antihypertensive medication adherence and associated risk factors among adults with hypertension: a cross-sectional study in a teaching hospital, Ghana. *BMC Cardiovascular Disorders*, 26(1), 156. <https://doi.org/10.1186/s12872-025-05410-3>
- Sadiman, & Triesya, M. D. (2024). Hubungan antara faktor usia dan obesitas dengan kejadian hipertensi pada wanita menopause. *Jurnal Riset Ilmiah*. <https://dx.doi.org/10.55681/sentri.v3i6.2889>
- Sarkar, P. (2024). Exploring the Socio-economic Ramifications of Health Literacy and Medication Adherence on Hypertensive Patients. *Economic Affairs*, 69(2), 1053-1058. <https://doi.org/10.46852/0424-2513.3.2024.28>
- Setiandari, E. (2022). Hubungan pengetahuan, pekerjaan dan genetika (riwayat hipertensi dalam keluarga) terhadap perilaku pencegahan penyakit hipertensi. *Media Publikasi Promosi Kesehatan Indonesia*, 5(4), 457–462. <https://doi.org/10.56338/mppki.v5i4.2386>
- Shariff, R. E. R., Jiang, H., Yap, J., Tan, S. Y., Cuenza, L., Dwiputra, B., ... & Tan, J. W. (2024). Overview of the burden and challenges of hypertension in Asia-Pacific. *J Asian Pac Soc Cardiol*, 3, e44. <https://doi.org/10.15420/japsc.2024.35>
- Sidik, A. B. (2023). Hubungan usia, jenis kelamin, dan riwayat keluarga dengan kejadian hipertensi pada lansia di Puskesmas Talang Ratu Palembang tahun 2023. *Jurnal Ilmiah Multidisiplin*, 1(6), 307–315.
- Sudayasa, I. P., Rahman, M. F., Eso, A., Jamaluddin, J., Parawansah, P., Alifariki, L. O., et al. (2020). Deteksi dini faktor risiko penyakit tidak menular pada masyarakat Desa Andepali Kecamatan Sampara Kabupaten Konawe. *Journal of Community Engagement in Health*, 3(1), 60–66. <https://doi.org/10.59870/bd6cm658>
- Yunus, M., Aditya, I., & Eksa, D. R. (2021). Hubungan usia dan jenis kelamin dengan kejadian hipertensi di Puskesmas Haji Pemanggilan Kecamatan Anak Tuha Kabupaten Lampung Tengah. *Jurnal Ilmu Kedokteran dan Kesehatan*, 8(3), 230–239. <https://doi.org/10.33024/jikk.v8i3.5193>