



The Incidence of Hypertension Among the Elderly in Boyolali Regency

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Article Info	Abstract
Article History: Submitted 12 September 2025 Revised 04 November 2025 Accepted 21 January 2026 Keywords: Risk Factors, Hypertension, Elderly DOI: https://doi.org/10.15294/phpj.v9i3.30587	Hypertension is one of the most common non-communicable diseases (NCDs) and remains a major public health concern worldwide. Although the prevalence of hypertension in Indonesia declined from 34.1% in 2018 to 30.8% in 2023, this figure still falls short of the national Sustainable Development Goals (SDGs) target of 25%. The prevalence of hypertension increases with age, recorded at 13.2% among individuals aged 18–24 years, 45.3% among those aged 45–54 years, and as high as 63.8% among individuals aged 75 years and older. This study aimed to identify the factors associated with the incidence of hypertension among the elderly in Boyolali Regency. The research employed an analytical observational design with a case-control approach. Data were collected from December 2024 to February 2025, involving 164 respondents consisting of 82 elderly individuals in the case group and 82 in the control group. The variables examined included sex, family history, marital status, physical activity, obesity, smoking habits, and coffee consumption. Univariate analysis was used to describe the basic characteristics of the respondents, while bivariate analysis using the Chi-Square test was conducted to examine the relationship between the independent variables and the incidence of hypertension. The study findings revealed significant associations between family history, marital status, physical activity, obesity, and coffee consumption with the incidence of hypertension among the elderly in Boyolali Regency.

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INTRODUCTION

Hypertension is one of the most common non-communicable diseases (NCDs) and remains a major public health concern worldwide (Kemenkes, 2018). This condition is defined as a persistent systolic blood pressure of ≥ 140 mmHg and/or diastolic pressure of ≥ 90 mmHg (Kemenkes, 2013). The global prevalence of hypertension continues to rise in both developed and developing countries, making it a critical issue in the prevention of chronic diseases and the control of public health burdens (Unger et al., 2020; WHO, 2023). Aging is one of the main determinants of hypertension. As individuals age, physiological changes such as arterial wall stiffness and narrowing of the vascular lumen occur, leading to elevated blood pressure—particularly systolic pressure (Dzau & Hodgkinson, 2024). Consequently, older adults (≥ 60 years) are among the most vulnerable populations for hypertension (Kemenkes, 2018; Unger et al., 2020).

The Sustainable Development Goals (SDGs) have set a global target to reduce hypertension prevalence by 25% by 2025 as part of efforts to decrease premature mortality from NCDs. WHO data shows that the global prevalence of hypertension increased from 26.4% in 2018 to 29.2% in 2021, and is projected to reach 1.5 billion cases by 2025 with an estimated 10.44 million deaths annually if left unaddressed (WHO, 2022; WHO, 2023).

Indonesia is among the countries with a high burden of hypertension, ranking fifth globally in the number of cases (WHO, 2022). National Basic Health Research (Riskesdas) data show a decline in prevalence from 34.1% (2018) to 30.8% (2023), although this remains insufficient to meet the national SDG target. Hypertension prevalence increases with age: 13.2% among those aged 18–24 years, 45.3% in those aged 45–54 years, and up to 63.8% in individuals aged ≥ 75 years. Elderly women have a higher prevalence (36.9%) compared to men (31.3%) (Kemenkes RI, 2018).

Central Java Province is among the regions with the highest hypertension prevalence in Indonesia. Riskesdas reported an increase from 25.8% (2013) to 37.57% (2018), still falling short

of the provincial target of 25% by 2025. The prevalence is higher in women (40.17%) than in men (34.83%) (Kemenkes RI, 2018). According to the 2022 Central Java Provincial Health Profile, hypertension accounted for 76.5% of all NCD cases, with Boyolali Regency ranking eighth out of 35 districts/cities in terms of highest prevalence (Dinkes Provinsi Jawa Tengah, 2022).

In Boyolali Regency, the prevalence of hypertension increased significantly from 23.3% (2013) to 38.63% (2018), with most cases found in the 45–70 age group (Dinas Kesehatan Kabupaten Boyolali, 2022). Efforts to address this issue have included promotive, preventive, and curative interventions. Ngemplak, Nogosari, and Andong Health Centers were recorded as the facilities with the highest number of hypertension cases, with 17,575, 12,194, and 11,828 cases respectively (Dinas Kesehatan Kabupaten Boyolali, 2022). A preliminary study conducted in March 2024 using medical record data from these three health centers revealed that the majority of hypertensive patients were elderly: 81.9% in Ngemplak, 75.7% in Andong, and 74.5% in Nogosari.

There are various risk factors for hypertension, including non-modifiable factors such as age, sex, and family history, as well as preventable factors such as low levels of physical activity, excessive intake of salt and fat, smoking habits, coffee consumption, and obesity (Kemenkes, 2013). Nevertheless, several studies have reported contradictory findings regarding these risk factors. For instance, Imelda et al. (2020) stated that smoking and coffee consumption could increase the risk of hypertension depending on frequency. Ariyani (2020) found a significant association between smoking and hypertension ($p=0.001$), but not with marital status ($p=0.438$). Meanwhile, being widowed or divorced has been linked to increased risk due to psychological stress following the loss of a partner (Duarsa et al., 2020; Imelda et al., 2020).

If left untreated, hypertension can lead to chronic complications such as stroke, kidney failure, heart disease, diabetes, and dementia, all of which contribute to decreased life expectancy (Pokharel et al., 2022; Dzau & Hodgkinson, 2024). Therefore, identifying risk factors among

the elderly is essential for planning evidence-based health interventions. Based on this context, this study aims to analyze the factors associated with the incidence of hypertension among the elderly in Boyolali Regency as a foundation for formulating more targeted and effective health intervention policies.

METHOD

This study employed an analytical observational approach using a case-control design. Through a retrospective framework, elderly individuals diagnosed with hypertension (cases) were compared to those without hypertension (controls) to identify factors contributing to the condition. The research was conducted in Boyolali Regency, with data collected from selected health centers based on specific criteria—namely, those with the highest number of hypertension cases over the past two years and complete medical records. Health centers that did not grant permission or lacked adequate data were excluded. As a result, the study was conducted at Ngemplak, Cepogo, and Mojosoongo Health Centers.

The study population comprised two main groups: a case population of elderly individuals (aged ≥ 60 years) with a primary diagnosis of hypertension (ICD-10 code I10), and a control population of elderly individuals without a diagnosis of hypertension, as documented in medical records from several health centers in Boyolali Regency between January and November 2024.

Sample selection was carried out using strict inclusion and exclusion criteria. The case group consisted of elderly individuals who were first diagnosed with hypertension at age ≥ 60 , resided in Boyolali Regency, and had complete medical data. The control group included elderly individuals whose age differed by no more than two years from their matched case subjects, had no history of hypertension, and possessed equivalent data completeness. Respondents who were uncooperative, had cognitive impairments, or failed to complete the interview process were excluded.

The minimum sample size was calculated using the Lameshow formula, yielding a requirement of at least 37 subjects per group. However, to ensure proportionality and accommodate age categories (young-old and middle-old), the sample size was increased to 74 respondents per group. An additional 10% was added to account for potential dropouts, resulting in a total of 82 respondents in each group.

Non-probability sampling methods were used. Purposive sampling was applied to the case group, while the control group was selected using a matching technique, with age serving as the matching variable. Age was categorized into two groups: young-old (60–69 years) and middle-old (70–79 years), to explore potential risk variation based on age stratification.

This study involved both independent and dependent variables. The independent variables included sex, family history, marital status, physical activity, obesity, smoking habits, and coffee consumption. The dependent variable was the incidence of hypertension among the elderly. Data were collected using a structured questionnaire developed from theoretical concepts and adapted from established instruments such as the Global Physical Activity Questionnaire (GPAQ) for physical activity and the Brinkman Index for smoking habits. Data collection methods included direct observation and structured interviews. All interviews were conducted using a standardized guideline encompassing all study variables.

Data analysis was performed in stages. Univariate analysis was used to describe the distribution of each variable through frequency tables. Bivariate analysis was conducted using the Chi-Square test to assess associations between independent variables and the incidence of hypertension among the elderly. If Chi-Square assumptions were not met, Fisher's exact test was used as an alternative. This study received ethical clearance from the Ethics Committee of the Faculty of Medicine, Universitas Negeri Semarang (UNNES), and adhered to ethical procedures, including obtaining informed consent from elderly participants or their legal guardians prior to participation.

RESULTS AND DISCUSSIONS

Table 1 presents the distribution of case and control samples based on the variables studied. Regarding the sex variable, the proportion of female participants was 58.5% in the case group and 51.2% in the control group. For the family history variable, 67.1% of the case group and 41.5% of the control group had a family history of hypertension. In terms of marital status, 52.4% of the case group and 36.6% of the control group did not have a spouse. For the physical activity variable, 59.8% of the case group and 39.0% of the control group had low levels of physical activity. Concerning the obesity variable, 57.3% of the case group and 37.8% of the control group were categorized as obese. In the smoking variable, 36.6% of the case group and 31.7% of the control group were classified as moderate smokers.

Lastly, in the coffee consumption variable, 56.1% of the case group and 29.3% of the control group were found to have a high level of coffee consumption.

Table 2 shows the analysis results of the relationship between sex and the incidence of hypertension in the elderly, where it was found that there was no statistically significant relationship ($p = 0.346$). Although females were more dominant in the case group, the difference was not significant. These findings are in line with research conducted by Imelda et al. (2020), which also found no significant relationship between sex and hypertension (Imelda et al., 2020). However, several other studies revealed that elderly women, especially postmenopausal, are more susceptible to hypertension due to decreased estrogen hormone levels, which play a role in maintaining blood vessel elasticity (Hanif et al., 2021).

Table 1. Frequency Distribution of Respondents Based on Characteristics and Study Group

Variable	Category	Case (N=82)		Control (N=82)		Total (N=164)	
		F	%	F	%	F	%
Gender	Female	48	58,5	42	51,2	90	54,9
	Male	34	41,5	40	48,8	74	45,1
Family History	Present	55	67,1	34	41,5	89	54,3
	Absent	27	32,9	48	58,5	75	45,7
Marital Status	Not married	43	52,4	30	36,6	73	44,5
	Married	39	47,6	52	63,4	91	55,5
Physical Activity	Low	49	59,8	32	39,0	81	49,4
	Sufficient	33	40,2	50	61,0	83	50,6
Obesity	Obese	47	57,3	31	37,8	78	47,6
	Not obese	35	42,7	51	62,2	86	52,4
Smoke	Moderate smoker	30	36,6	26	31,7	56	34,1
	Non-smoker	52	63,4	56	68,3	108	65,9
Coffee Consumption	High	46	56,1	24	29,3	70	42,7
	Low	36	43,9	58	70,7	94	57,3

A study by Prastiwi et al. showed that elderly women are more likely to develop hypertension than men, with an odds ratio of 3.9 indicating a statistically significant difference (Prastiwi et al., 2023). Conditions such as sarcopenia, which are more common in women, also increase this risk (N. He et al., 2022), while depressive symptoms, which are more dominant in women, are also associated with high blood pressure (Shu et al., 2025).

The inconsistency of these research findings underscores the importance of adopting a gender-sensitive approach in understanding the risk of hypertension. The divergence between the study results and existing theories may be influenced by several factors. One possible explanation is that gender is not an independent determinant of hypertension but rather one of several contributing risk factors. This aligns with the theoretical perspective suggesting that

hypertension generally does not result from a single risk factor alone but is instead the outcome of complex interactions among multiple interrelated factors, commonly referred to as common underlying risk factors.

Family history showed a significant relationship with the incidence of hypertension ($p = 0.001$; OR = 2.876; 95% CI: 1.522–5.435). Elderly individuals with a family history of hypertension are nearly three times more likely to develop the condition than those without such a history. This result aligns with the findings of Prastiwi et al. (2023), who highlighted the contribution of genetic factors to the incidence of hypertension (Prastiwi et al., 2023).

Individuals with a family history of hypertension carriers are approximately twice as likely to develop the same condition compared to those without such a history. Genetically, the aldosterone gene receives a symmetrical genetic code, which subsequently triggers ectopic aldosterone production. Mutations in the endothelial sodium channel gene lead to increased aldosterone activity, accompanied by

decreased plasma renin activity and the occurrence of hypokalemia—a condition characterized by abnormally low potassium levels in the blood. This dysfunction may result in a mineralocorticoid excess syndrome, marked by increased sodium and water retention in the body. Consequently, blood volume rises, leading to elevated blood pressure (Kanchan et al., 2023). In addition to genetic factors, family lifestyle patterns can also trigger hypertension, especially if there is mimicry of dietary habits and physical activity (Ranasinghe et al., 2015).

The relationship between family history and hypertension is also supported by demographic studies. In one case-control study, 29.3% of elderly individuals with a family history were found to have hypertension, compared to only 24.4% in the group without such a history (Hari et al., 2021). Additionally, studies focusing on rural communities have found that hereditary factors directly influence the prevalence of hypertension, confirming that genetic aspects significantly contribute to the manifestation of the disease (Zekewos et al., 2019).

Table 2. Relationship Between Sex, Family History, Marital Status, Physical Activity, Obesity, Smoking, and Coffee Consumption with the Incidence of Hypertension in the Elderly

Variables	Case	Control	<i>p-value</i>	OR 95% CI	Description
Gender					
1. Female	48	42	0,346	-	Not significant
2. Male	34	40			
Family History					
1. Present	55	34	0,001	2,876 (1,522-5,435)	Significant
2. Absent	27	48			
Marital Status					
1. Not married	43	30	0,041	1,911 (1,024-3,568)	Significant
2. Married	39	52			
Physical Activity					
1. Low	49	32	0,008	2,320 (1,241-4,338)	Significant
2. Sufficient	33	50			
Obesity					
1. Obese	47	31	0,012	2,209 (1,182-4,128)	Significant
2. Not obese	35	51			
Smoke					
1. Moderate smoker	30	26	0,510	-	Not significant
2. Non-smoker	52	56			
Coffee Consumption					
1. High	46	24	0,001	3,088 (1,620-5,888)	Significant
2. Low	36	58			

Similar results have been found in countries such as Sri Lanka and Ethiopia, where individuals with a positive family history tend to have higher blood pressure and a greater likelihood of developing hypertension (Ranasinghe et al., 2015). Beyond contributing to hypertension, family history is also closely associated with the risk of more serious health complications (Valerio et al., 2016). Therefore, family history should be a primary component in elderly health evaluations to detect and address risks early. Overall, a positive family history in hypertension cases is a key factor that must be considered in efforts to prevent and manage the disease among the elderly. Existing scientific evidence clarifies that genetic factors greatly influence individual risk, necessitating proactive preventive and monitoring actions in groups with hereditary predisposition.

Marital status in bivariate analysis showed a significant relationship with the incidence of hypertension ($p = 0.041$; OR = 1.911; 95% CI: 1.024–3.568), although this relationship was not significant in the multivariate model. This means that when controlled together with other stronger variables, the effect of marital status was no longer dominant. These findings support previous studies indicating that elderly individuals who do not have a spouse are more likely to experience psychological stress, loneliness, and depression, all of which can increase the risk of hypertension (Ramezankhani et al., 2019; Bhise & Patra, 2018).

On the other hand, the presence of a life partner can provide emotional support that contributes to heart health and blood pressure balance. Furthermore, marital status also influences various other health outcomes beyond high blood pressure. Ningharto and colleagues noted that more than half of the hypertensive patients in their study were married individuals, suggesting the potential role of spousal support in reducing psychological stress due to chronic illness, although the causal relationship is not yet fully understood (Ningharto et al., 2020).

Although most evidence shows that married individuals tend to have better mental health and lower stress, the emotional benefits of marriage do not appear to be uniform. Those who

have lost a spouse or experienced divorce are more likely to suffer from depression and deeper feelings of loneliness, which can ultimately worsen health conditions (Zhang et al., 2020). Overall, the accumulation of evidence shows that marital status is closely and complexly related to the incidence of hypertension in the elderly. Married life seems to provide social support that can protect individuals from physical and mental stress, while separation or loss of a partner may increase vulnerability to various health problems.

Physical activity was proven to have a significant relationship with the incidence of hypertension ($p = 0.008$; OR = 2.320; 95% CI: 1.241–4.338). Elderly individuals with low physical activity had a 2.3 times higher risk of developing hypertension compared to those who were sufficiently active. This is in line with various studies that confirm the important role of physical activity in maintaining normal blood pressure through mechanisms such as increasing vascular elasticity and reducing peripheral resistance (Prajayanti, 2023; Cahyani et al., 2019).

Similar findings were presented by Hashidi and colleagues, who found that sedentary behavior is highly correlated with an increased risk of hypertension, and that physical activity can reduce that risk (Hashidi et al., 2021). Activities such as walking, elderly exercise, or other light physical activities have proven effective in lowering blood pressure and improving the quality of life of the elderly (Zheng et al., 2021). Interventions such as aerobic and resistance training have been proven effective in reducing blood pressure and improving overall cardiovascular condition (Reia et al., 2020). As age increases, the risk of hypertension rises, especially in those with declining physical activity (Urifah et al., 2022).

Comorbid conditions and physiological changes such as decreased muscle strength add challenges in controlling blood pressure (Sasarari et al., 2024). Overall, physical activity plays a strategic role in the prevention and management of hypertension in the elderly. Promoting regular physical activity can be an effective preventive measure to improve quality of life and slow the progression of chronic disease in the elderly population (Khalishah & Salmiyati, 2022).

Obesity also showed a significant relationship with the incidence of hypertension ($p = 0.012$; OR = 2.209; 95% CI: 1.182–4.128). Obese elderly respondents had twice the risk of developing hypertension. Excess body fat, especially in the abdominal area, contributes to increased blood pressure through activation of the renin-angiotensin system, sodium retention, and increased cardiac workload (Putri et al., 2022). These results support the literature stating that body mass index and waist circumference are important indicators in assessing the risk of hypertension in the elderly (Wang et al., 2018; Hamzeh et al., 2022). These studies also emphasize that anthropometric measurements have important predictive value in more accurately identifying hypertension risk in the elderly.

Epidemiologically, the relationship between obesity and hypertension shows a consistent pattern across various geographic regions and ethnic groups. Research conducted in Asian countries such as China and Southeast Asia shows that obesity is significantly correlated with increased incidence of hypertension based on biomarker results and clinical evaluations in the elderly population (Nagar et al., 2022). On the other hand, He et al. found that metabolic indicators such as the triglyceride-glucose index have the potential to predict hypertension, further emphasizing the link between metabolic dysfunction and high blood pressure in the elderly (Z. He et al., 2025).

Therefore, the formulation of public health policies focused on obesity control is necessary as a primary preventive step against hypertension in the elderly. Intervention strategies involving the promotion of healthy lifestyles, dietary improvements, increased physical activity, and consistent health education are crucial in reducing the incidence of hypertension and its impact on elderly well-being.

Smoking did not show a significant relationship with the incidence of hypertension in the elderly in this study ($p = 0.510$). These results are consistent with the findings of Imelda et al. (2020), who also found no significant relationship between smoking habits and hypertension (Imelda et al., 2020). Although theoretically nicotine can increase blood pressure through

stimulation of the sympathetic nervous system and acceleration of atherosclerosis (Gao et al., 2023), its effect appears to be highly influenced by contextual factors and other accompanying lifestyle factors. Therefore, although smoking did not emerge as a dominant risk factor in this study, educational efforts are still needed to reduce smoking consumption as part of overall cardiovascular disease prevention.

On the other hand, there are also inconsistent findings. For example, Rajati et al. stated that in bivariate analysis, current smoking habits showed a protective effect against hypertension, indicating the possibility of bias or the influence of other uncontrolled variables (Rajati et al., 2019). A similar approach was taken by Kario et al., who stated that the relationship between smoking and hypertension prevalence could vary depending on lifestyle factors, nutritional status, and other accompanying health conditions (Kario et al., 2020). Irawati et al. also found that in certain contexts, smoking did not show a statistically significant relationship with hypertension in the elderly, highlighting the importance of understanding specific health behavior dynamics in each region (Irawati et al., 2022). Furthermore, Gao et al. emphasized that the relationship between smoking and hypertension can be influenced by other factors, such as alcohol consumption, so its impact cannot be understood in isolation (Gao et al., 2023).

Coffee consumption was found to be the strongest factor associated with the incidence of hypertension ($p = 0.001$; OR = 3.088; 95% CI: 1.620–5.888). Elderly individuals with high coffee consumption had a 3.1 times higher risk of developing hypertension. Caffeine, as the main component in coffee, is known to increase blood pressure through the release of adrenaline and vasoconstriction of blood vessels (Han et al., 2022). High coffee consumption (≥ 3 cups/day) has been associated with significant increases in systolic and diastolic blood pressure (Shah et al., 2023).

Overall, the relationship between coffee consumption and high blood pressure in the elderly reflects a complex interaction network between consumption factors, genetics, and lifestyle. The complexity of this relationship is

reinforced by the influence of genetic factors. For example, the CYP1A2 gene is known to play a role in caffeine metabolism. Individuals with certain variants of this gene may experience increased blood pressure after consuming coffee (Hou et al., 2021). The implications of this genetic factor become even more significant in the context of the elderly, who tend to show greater genetic diversity. Further studies with more specific approaches and population stratification are needed to gain a more comprehensive understanding.

CONCLUSION

This study shows that there is a significant relationship between the variables of family history, marital status, physical activity, obesity, and coffee consumption with the incidence of hypertension among the elderly in Boyolali Regency. Meanwhile, there is no meaningful relationship between sex and smoking with the incidence of hypertension among the elderly. These findings underscore the importance of promotive and preventive efforts in controlling hypertension in the elderly, with a focus on lifestyle modification and early detection of high-risk groups.

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