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## **Risk Factors Of Hypertension In Jambi City Based On Sehat Indonesiaku Application (Asik) Data In 2023**

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### **Abstract**

Hypertension is a global health problem as it causes high morbidity and mortality, with approximately 9.4 million deaths every year. This condition shows that hypertension remains a significant health burden. The aim of this study was to identify the factors associated with the incidence of hypertension in Jambi City. This research is a secondary data analysis with a cross-sectional design, using data from the Sehat Indonesiaku Application (ASIK) in 2023, conducted from August 2024 to May 2025. The sample included all individuals aged  $\geq 15$  years recorded in the ASIK application, selected using a total sampling technique. Data were analyzed using Chi-Square tests and Logistic Regression to identify risk factors. The proportion of hypertension among individuals aged  $\geq 15$  years was 35.2%. Variables significantly associated with hypertension among those aged  $\geq 15$  years were sex [Adj PR = 1.09; 95% CI: 1.01–1.17], age  $\geq 40$  years [Adj PR = 3.82; 95% CI: 3.53–4.13], physical activity [Adj PR = 0.82; 95% CI: 0.75–0.88], fruit and vegetable consumption [Adj PR = 0.89; 95% CI: 0.83–0.96], salt consumption [Adj PR = 1.56; 95% CI: 1.41–1.73], and obesity [Adj PR = 1.94; 95% CI: 1.80–2.10]. Age is the most influential factor for hypertension incidence; therefore, the community is advised to limit salt intake, maintain a healthy nutritional status to prevent obesity, and increase physical activity, especially among men aged  $\geq 40$  years.

**Keywords:** *Hypertension, Risk Factors, Age*

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## **INTRODUCTION**

Hypertension is one of the non-communicable diseases that has now become a global health priority because it contributes significantly to morbidity and mortality rates<sup>1</sup>. This disease is the most common risk factor for cardiovascular diseases and is the single largest cause of death and disability worldwide<sup>2</sup>. According to WHO data, 45% of deaths from heart disease and 51% from stroke occur due to hypertension<sup>3</sup>.

The impact of hypertension and its resulting complications leads to high morbidity and premature mortality rates. This is evidenced by a WHO report stating that 9.4 million people die due to hypertension and its complications<sup>4</sup>. This condition can affect the family economy, causing loss of household income due to disability or death<sup>5</sup>. In addition, hypertension is known as the silent killer because it shows no symptoms, so patients are often unaware of their condition until they have their blood pressure checked at a health facility<sup>4</sup>. WHO reports that 46% of people with hypertension are unaware that they have it<sup>6</sup>, and only one in five (21%) is able to control it<sup>3</sup>.

Globally, hypertension continues to rise. WHO estimates that the number of people with hypertension will increase significantly by 2025 by 29%, with 1.5 billion adults expected to experience this condition<sup>5</sup>. Therefore, WHO has set a target to reduce the prevalence of hypertension by 33% between 2010 and 2030 as part of the non-communicable disease (NCD) prevention strategy<sup>7</sup>. The Ministry of Health of the Republic of Indonesia highlights that hypertension is one of the non-communicable diseases (NCDs) that continues to increase in Indonesia<sup>8</sup>. This condition is reflected in the increasing number of visits by hypertension patients to Primary Health Care Facilities every year<sup>5</sup>. It is estimated that the number of people with hypertension in Indonesia has reached 63,309,620, with mortality figures reaching up to 427,218 deaths<sup>9</sup>.

In Jambi Province, hypertension ranks first among the ten most prevalent diseases in Jambi City, with cases reaching 18.5% or 141,723 out of a total of 766,264 cases in 2019<sup>10</sup>. In 2021, the number of hypertension cases in Jambi City was recorded at 15,112 cases, with 3,536 cases (23.4%) being under control, while 11,576 cases (76.6%) were uncontrolled<sup>11</sup>. The high proportion of

uncontrolled hypertension cases in Jambi City (76.6%) indicates a significant challenge in managing this disease at the community level.

The increase in hypertension cases cannot be separated from the various factors that influence its occurrence. There are various factors that can increase a person's risk or tendency to suffer from hypertension<sup>12</sup>. According to the World Health Organization (WHO), the risk factors for hypertension are categorized into two groups: non-modifiable risk factors and modifiable risk factors<sup>7</sup>. Non-modifiable risk factors include age, sex, and heredity. Meanwhile, modifiable risk factors include obesity, excessive salt intake, lack of physical activity or exercise, excessive oil consumption, smoking, and alcohol consumption habits<sup>11</sup>.

Hypertension is a serious condition because it often occurs without symptoms and can go undetected for a long period of time<sup>13</sup>. Continuous elevation of blood pressure can cause various complications that may eventually lead to sudden death<sup>13</sup>. Therefore, prevention and control efforts are needed to suppress or reduce its contributing factors within the community<sup>14</sup>. In efforts to control hypertension, digital technology has been utilized to facilitate the monitoring of community health. One of the innovations introduced by the Ministry of Health of the Republic of Indonesia is the Sehat Indonesiaku Application (ASIK). This application was launched in May 2022 and is used in every public health center (puskesmas) as a tool for recording, monitoring, and analyzing community health data, including early detection of hypertension<sup>15</sup>. This application provides comprehensive data covering the results of risk factor screenings for hypertension cases in various regions<sup>30</sup>. By utilizing ASIK data, a clear picture of the hypertension situation in the community can be obtained and used for public health planning<sup>15</sup>.

The high proportion of hypertension cases in Jambi City indicates the need for a more targeted approach in health interventions. Although many studies have been conducted on hypertension risk factors, there has not been any research specifically using ASIK data focusing on analyzing the risk factors for hypertension, particularly in the Jambi City area. Therefore, this study was conducted to identify the dominant risk factors contributing to the high incidence of hypertension. The novelty of this research lies in the analysis of risk factors using an ASIK-based data approach, which has not been widely utilized in previous studies. The results of this study are expected to serve as a basis for formulating more effective policies and intervention strategies that are tailored to the specific needs of the region in order to reduce the incidence of hypertension in a more targeted manner.

## RESEARCH METHODS

This study is a secondary data analysis using secondary data from early detection of hypertension in Jambi City in 2023, recorded in the Sehat Indonesiaku Application (ASIK). All variables were measured using the Non-Communicable Disease (NCD) screening questionnaire integrated in the ASIK Application for 2023. Data were collected through health screening activities conducted at primary health care facilities such as puskesmas, NCD Posbindu, and through field visits by health officers. This study employed a cross-sectional design and was conducted in Jambi City from August 2024 to January 2025. The study sample consisted of all individuals aged  $\geq 15$  years registered in the Sehat Indonesiaku Application in Jambi City in 2023, totaling 15,239 people. Data analysis was performed using Chi-Square tests and Logistic Regression to identify risk factors.

## RESULTS AND DISCUSSION

### Univariate Analysis Results

The univariate analysis conducted on all variables aimed to describe the characteristics of each data point, which were then presented in a frequency distribution table with the following results:

**Table 1. Respondents' Characteristics**

Characteristics	Frequency (n)	Percentage (%)
<b>Sex</b>		
Male	6.474	42,3
Female	8.819	57,7
<b>Age</b>		
15 – 24 years	1.904	12,5
25 – 34 years	2.681	17,5
35 – 44 years	3.169	20,7
45 – 54 years	3.433	22,4
55 – 64 years	2.676	17,5
65 – 74 years	1.157	7,6
≥ 75 years	273	1,8
<b>Waist Circumference Status</b>		
Obesitas Sentral	7.006	45,8
Normal	8.287	54,2
<b>BMI Status</b>		
Obese	4.051	26,5
Overweight	2.364	15,5
Normal	7.880	51,5
Underweight	998	6,5
<b>Random Blood Glucose Status</b>		
Hyperglycemic	974	6,4
Pre-Diabetes	1.986	13,0
Normal	12.333	80,6
<b>Blood Pressure Status</b>		
Hypertension	5.376	35,2
Pre-Hypertension	6.498	42,5
Normal	3.419	22,4

Based on Table 1, the proportion by individual characteristics shows that the majority of individuals screened through the NCD screening program at all primary health centers in Jambi City were female (57.7%), while males accounted for 42.3%. By age group, most respondents were in the 55–64 years age group (22.4%), followed by those aged 45–54 years (21.2%). This indicates that most respondents were in the older adult age group. In terms of waist circumference status, nearly half of the respondents had central obesity (45.8%). In addition, Body Mass Index (BMI) status showed that 26.5% of respondents were obese and 15.5% were overweight. Meanwhile, random blood glucose status showed that the majority of respondents were in the normal category (80.6%), although 6.4% were hyperglycemic and 13.0% were in a pre-diabetic condition. Furthermore, blood pressure status showed that 35.2% of respondents were identified as hypertensive, while 42.5% were in a pre-hypertensive condition.

**Table 2. Proportion of Hypertension Cases Among Individuals Aged ≥ 15 Years (n = 15,293)**

Characteristics	Frequency (n)	Percentage (%)
<b>Hipertensi</b>		
Ya	5.376	35,2
Tidak	9.917	64,8

Based on Table 4.2, the proportion of hypertension cases in Jambi City among individuals aged  $\geq 15$  years was 35.2%, while 64.8% did not have hypertension.

**Table 3. Proportion of Hypertension Risk Factors Among Individuals Aged  $\geq 15$  Years (n = 15,293)**

Variable	Frequency (n)	Percentage (%)
<b>Sex</b>		
Male	6.474	42,3
Female	8.819	57,7
<b>Age</b>		
$\geq 40$ years	9.315	60,9
$< 40$ years	5.978	39,1
<b>Physical Activity</b>		
Insufficient	10.758	70,3
Sufficient	4.535	29,7
<b>Fruit and Vegetable Consumption</b>		
Insufficient	9.274	60,6
Sufficient	6.019	39,4
<b>Sugar Consumption</b>		
Excessive	1.756	11,5
Adequate	13.537	88,5
<b>Salt Consumption</b>		
Excessive	2.150	14,1
Adequate	13.143	85,9
<b>Fat Consumption</b>		
Excessive	2.119	13,9
Adequate	13.174	86,1
<b>Alcohol Consumption</b>		
Yes	77	0,5
No	15.216	99,5
<b>Smoking Status</b>		
Yes	1.318	8,6
No	13.975	91,4
<b>Obesity</b>		
Yes	4.051	26,5
No	11.242	73,5
<b>Total</b>	<b>15.293</b>	<b>100</b>

Based on Table 3, the proportion by individual characteristics shows that the majority of individuals screened through the NCD screening program at all primary health centers in Jambi City were female (57.7%), while males accounted for 42.3%. By age group, most respondents were in the 55–64 years age group (22.4%), followed by those aged 45–54 years (21.2%). In terms of waist circumference status, nearly half of the respondents had central obesity (45.8%). The Body Mass Index (BMI) status showed that 26.5% of respondents were obese and 15.5% were overweight. Meanwhile, random blood glucose status showed that the majority of respondents were in the normal category (80.6%), although 6.4% were hyperglycemic and 13.0% were in a pre-diabetic condition. Furthermore, blood pressure status showed that 35.2% of respondents were identified as hypertensive, while 42.5% were in a pre-hypertensive condition.

**Bivariate Analysis Results**

**Table 4. Bivariate Analysis of the Association Between Risk Factors and Hypertension Among Individuals Aged  $\geq 15$  Years (n = 15,293)**

Variabel	Hypertension				Total	PR (95% CI)	p-value
	Yes		No				
	n	%	n	%			
<b>Sex</b>							
Male	2.252	34,8	4.222	65,2	6.474	1,02 (0,96 – 1,00)	0,424
Female	3.124	35,4	5.695	64,6	8.819	<i>Ref.</i>	
<b>Age</b>							
$\geq 40$ years	4.326	46,4	4.989	53,6	9.315	4,07 (3,76 – 4,40)	0,000
<40 years	1.050	17,6	4.928	82,4	5.978	<i>Ref.</i>	
<b>Physical Activity</b>							
Insufficient	3.551	33,0	7.207	67,0	10.758	0,73 (0,68 – 0,78)	0,000
Sufficient	1.825	40,2	2.710	59,8	4.535	<i>Ref.</i>	
<b>Fruit and Vegetable Consumption</b>							
Insufficient	3.228	30,9	6.046	65,2	9.274	0,96 (0,89 – 1,03)	0,273
Sufficient	2.148	32,7	3.871	64,3	6.019	<i>Ref.</i>	
<b>Sugar Consumption</b>							
Excessive	795	45,3	961	54,7	1.756	1,61 (1,46 – 1,78)	0,000
Adequate	4.581	33,8	8.956	66,2	13.537	<i>Ref.</i>	
<b>Salt Consumption</b>							
Excessive	994	46,2	1.156	53,8	2.150	1,71 (1,56 – 1,88)	0,000
Adequate	4.382	33,3	8.761	66,7	13.143	<i>Ref.</i>	
<b>Fat Consumption</b>							
Excessive	950	44,8	1.169	55,2	2.119	1,60 (1,46 – 1,76)	0,000
Adequate	4.426	33,6	8.748	66,4	13.174	<i>Ref.</i>	
<b>Alcohol Consumption</b>							
Yes	37	48,1	40	51,9	77	1,71 (1,09 – 2,67)	0,024
No	5.339	35,1	9.877	64,9	15.216	<i>Ref.</i>	
<b>Smoking Status</b>							
Yes	424	32,2	894	67,8	1.318	0,86 (0,76 – 0,97)	0,019
No	4.952	35,4	9.023	64,6	13.975	<i>Ref.</i>	
<b>Obesity</b>							
Yes	1.928	47,6	2.123	52,4	4.051	2,05 (1,90 – 2,20)	0,000
No	3.448	30,7	7.794	69,3	11.242	<i>Ref.</i>	

Based on Table 4.8, the variables that had a significant association with the incidence of hypertension ( $p < 0.05$ ) were age  $\geq 40$  years ( $p = 0.000$ ), physical activity ( $p = 0.000$ ), sugar consumption ( $p = 0.000$ ), salt consumption ( $p = 0.000$ ), fat consumption ( $p = 0.000$ ), alcohol consumption ( $p = 0.024$ ), smoking status ( $p = 0.019$ ), and obesity ( $p = 0.000$ ). Meanwhile, the variables that did not have a significant association with hypertension incidence ( $p > 0.05$ ) were sex ( $p = 0.424$ ) and fruit and vegetable consumption ( $p = 0.273$ ).

## Multivariate Analysis Results

**Table 5. Final Adjusted Multivariate Analysis Model of Hypertension**

Variabel	p-value	Adj PR	95% CI	Nagelkerke R Square
Gender	0,014	1,09	1,01-1,17	0,153
Age $\geq 40$ years	0,000	3,82	3,52-4,13	
Physical Activity	0,000	0,82	0,76-0,88	
Fruit and Vegetable Consumption	0,006	0,89	0,83-0,96	
Salt Consumption	0,000	1,56	1,41-1,73	
Obesity	0,000	1,94	1,80-2,10	

Based on Table 5, the dominant factor contributing to the incidence of hypertension was age  $\geq 40$  years. This is indicated by the highest Adjusted PR value, which was 3.82 (95% CI: 3.52–4.13). This means that individuals aged  $\geq 40$  years have a 3.82 times higher risk of developing hypertension compared to individuals aged  $< 40$  years, after controlling for other variables. For the sex variable, males were found to have a 1.09 times higher risk of developing hypertension compared to females [Adj PR = 1.09; 95% CI: 1.01–1.17;  $p = 0.014$ ]. For the physical activity variable, individuals with insufficient physical activity had an 18% lower risk of hypertension compared to those with sufficient physical activity, after controlling for other variables [Adj PR = 0.82; 95% CI: 0.758–0.883;  $p = 0.000$ ].

Based on the fruit and vegetable consumption variable, insufficient fruit and vegetable intake was associated with an 11% lower risk of hypertension [Adj PR = 0.89; 95% CI: 0.83–0.96;  $p = 0.006$ ]. For the salt consumption variable, individuals with excessive salt intake had a 1.56 times higher risk of developing hypertension compared to those with adequate salt intake, after adjusting for other variables [Adj PR = 1.56; 95% CI: 1.41–1.73;  $p < 0.000$ ]. Regarding the obesity variable, individuals who were obese had a 1.94 times higher risk of developing hypertension compared to non-obese individuals, after adjusting for other variables [Adj PR = 1.94; 95% CI: 1.80–2.10;  $p < 0.001$ ].

Overall, this analytical model had a Nagelkerke R Square value of 0.153, indicating that approximately 15.3% of the variation in hypertension incidence could be explained by the variables age  $\geq 40$  years, physical activity, salt consumption, and obesity. Therefore, around 84.8% of the variation may be influenced by other factors outside this model that were not analyzed in this study.

## Discussion

### Description of Respondents' Characteristics

Based on the results of the study, the proportion of respondents by individual characteristics showed that the majority of individuals screened for Non-Communicable Diseases (NCDs) at all primary health centers in Jambi City were female (57.7%), while males accounted for 42.3%. By age group, most respondents were in the 55–64 year age range (22.4%), followed by the 45–54 year age group (21.2%), indicating that most respondents were older adults.

In terms of waist circumference status, nearly half of the respondents were identified as having central obesity (45.8%). In addition, the Body Mass Index (BMI) status showed that 26.5% of respondents were obese and 24.6% were overweight. Meanwhile, the random blood glucose status indicated that most respondents were in the normal category (80.6%), although 6.4% had hyperglycemia and 13.0% were in a pre-diabetic condition.

Furthermore, the blood pressure status showed that 35.2% of respondents were detected as having hypertension, while 24.2% were in a pre-hypertensive state. According to Table 4.3, the proportion of respondents by hypertension risk factors showed that most individuals screened were male (42.3%), aged  $\geq 40$  years (60.9%), had insufficient physical activity (70.3%), consumed insufficient fruits and vegetables (60.6%), had excessive sugar intake (11.5%), excessive salt intake

(14.1%), excessive fat intake (13.9%), consumed alcohol (0.5%), smoked (8.6%), and were obese (26.5%).

### **Association Between Sex and Hypertension**

The results of this study showed that there was a significant association between sex and the incidence of hypertension among residents aged  $\geq 15$  years in Jambi City ( $p$ -value = 0.014). Of the 6,474 males who participated in the screening, 34.8% were identified as having hypertension, while 65.2% did not have hypertension. The multivariate analysis indicated that males had a 1.09 times higher risk of developing hypertension compared to females [Adj PR = 1.09; 95% CI: 1.01–1.17;  $p$  = 0.014]. This finding suggests that sex is one of the risk factors contributing to hypertension in the community.

In general, males are at higher risk of developing hypertension compared to females, especially during productive age periods. This can be explained biologically by the role of the estrogen hormone in females, which helps protect the cardiovascular system by maintaining blood vessel elasticity and increasing levels of High-Density Lipoprotein (HDL). HDL plays a role in preventing plaque buildup on arterial walls. Therefore, premenopausal women generally have more stable blood pressure compared to men. However, after entering menopause (average age  $\geq 40$  years), estrogen levels in women decrease, which reduces the protective effect on blood vessels and increases the risk of hypertension.

The findings of this study are in line with the World Health Organization (WHO, 2019) report, which states that 1 in 4 men worldwide suffers from hypertension, indicating that men do indeed have a higher risk compared to women. In addition, the Indonesian Ministry of Health (2019) also reported that men are 2.3 times more likely to experience an increase in systolic blood pressure compared to women. This result is consistent with a study conducted by Miftahul Falah (2019) in Tamansari Subdistrict, Tasikmalaya City, which found that women have a 0.4 times lower risk of developing hypertension compared to men.

The findings of Gills and Sullivan also show that men generally have a higher prevalence of hypertension than women within the same age groups up to around 60 years of age. In addition to hormonal factors, behavioral aspects distinguish the risk of hypertension between men and women. Men generally have higher rates of smoking and alcohol consumption, habits that can increase blood pressure and lead to hypertension. In this study, the proportion of active smokers and alcohol consumers was relatively higher among men than women, which further increased the risk of hypertension in men. Therefore, these findings highlight that sex should be considered in hypertension prevention efforts, particularly through healthy lifestyle education for men of productive age and early detection among women approaching menopause.

### **Association Between Age and Hypertension Incidence**

The results of this study showed that among 9,315 respondents aged  $\geq 40$  years, 46.4% were identified as having hypertension, while 53.6% did not have hypertension. Individuals aged  $\geq 40$  years had a 3.82 times higher risk of developing hypertension compared to those aged  $< 40$  years [Adj PR = 3.82; 95% CI: 3.53–4.14]. This finding illustrates that the risk of hypertension increases with advancing age.

This finding is consistent with the theory that the risk of hypertension increases with age. The rise in hypertension cases with advancing age is part of the natural aging process, which is also influenced by various external factors. As age increases, the walls of the left ventricle and corpus callosum thicken, while blood vessel elasticity decreases. In addition, the risk of atherosclerosis also increases, especially when accompanied by unhealthy lifestyle habits. This combination of changes triggers an increase in both systolic and diastolic blood pressure, ultimately leading to hypertension.

This result is also supported by previous studies that have shown a significant association between age and the incidence of hypertension. A similar study by Wulandari et al. (2023) in Banyumas found that individuals aged  $>45$  years had a 5.5 times higher likelihood of developing hypertension compared to younger age groups. However, this differs from a study by Juliana et al.

(2024), which found no significant relationship between age and hypertension incidence among productive age groups (15–59 years) in the working area of Cempae Health Center. This difference in findings may be due to the absence of older age groups, which limits the variation and thus the observable effect of age on hypertension in that study.

In this study, the population distribution was dominated by individuals aged  $\geq 40$  years. Biologically, this age group is more vulnerable to hypertension due to the thickening and hardening of arterial walls caused by collagen buildup, which reduces blood vessel elasticity<sup>26</sup>. In addition, urban lifestyle patterns that tend to be sedentary, diets high in salt and fat, and work-related stress further increase the risk of hypertension in this age group. Therefore, these findings emphasize the importance of hypertension prevention and control efforts through routine screening, health behavior education, and early management of risk factors among individuals aged  $\geq 40$  years.

### **Association Between Physical Activity and Hypertension Incidence**

The results of this study showed a significant association between physical activity and the incidence of hypertension among residents aged  $\geq 15$  years in Jambi City ( $p$ -value = 0.000). Of the 10,758 respondents with low physical activity, 33.0% were identified as having hypertension, while 67.0% did not have hypertension. The multivariate analysis indicated that individuals with low physical activity actually had an 18% lower risk of hypertension compared to those with sufficient physical activity [Adj PR = 0.82; 95% CI: 0.758–0.883].

This finding contradicts existing theories and previous scientific evidence, which state that insufficient physical activity is a major risk factor for hypertension. Meanwhile, adequate physical activity is considered one of the protective factors against hypertension. Low physical activity can increase heart rate, which in turn causes the heart muscles to work harder during the contraction phase. The increased frequency and force of heart contractions place greater pressure on arterial walls. This accumulation of conditions significantly contributes to increased blood pressure.

The findings of this study differ from the study by Nubatonis et al. (2021), which found that individuals with low physical activity levels were 5.112 times more likely to develop hypertension compared to those with high physical activity levels. Trinyanto (2014, as cited in Rhamdika et al., 2023) stated that physical activity significantly contributes to maintaining stable blood pressure. Individuals who rarely engage in physical activity tend to have a faster heart rate, causing the heart muscles to work harder with each contraction, which in turn leads to an increase in blood pressure. The Indonesian Ministry of Health, through the GERMAS (Healthy Living Community Movement) program, recommends at least 30 minutes of physical activity per day, five days a week, to reduce the risk of non-communicable diseases, including hypertension.

In this study, there was a statistically significant association between low physical activity and the incidence of hypertension; however, the direction of this relationship contradicts the established theory. Low physical activity in this study actually emerged as a protective factor against hypertension. One possible explanation for this result is the presence of temporal ambiguity bias, which is common in cross-sectional study designs.

In this study, physical activity and hypertension status were measured simultaneously, making it difficult to determine which occurred first. It is possible that individuals who were already aware of their hypertension status may have started to increase their physical activity as a way to control their blood pressure, such as by engaging in regular light exercise or increasing daily activities. This behavioral change may have caused their physical activity status to appear “sufficient” at the time of data collection, even though they may have previously had a sedentary lifestyle that was actually a major risk factor for developing hypertension. Since physical activity and hypertension status were measured at the same time, the direction of the causal relationship cannot be determined with certainty.

### **Association Between Fruit and Vegetable Consumption and Hypertension Incidence**

The results of this study showed that among 9,274 respondents with low fruit and vegetable consumption, 30.9% were identified as having hypertension, while 65.2% did not have hypertension. The multivariate analysis indicated that individuals with low fruit and vegetable consumption actually

had an 11% lower risk of hypertension compared to those with adequate fruit and vegetable intake [Adj PR = 0.89; 95% CI: 0.83–0.96]. This finding is statistically significant but contradicts both the theory and previous studies, which state that adequate fruit and vegetable consumption plays an important role in reducing the risk of hypertension.

In theory, adequate fruit and vegetable consumption can help lower blood pressure through several mechanisms. The fiber, vitamins, minerals (such as potassium and magnesium), and antioxidants contained in fruits and vegetables help maintain blood vessel elasticity, reduce cholesterol levels, and neutralize free radicals that can damage arterial walls. The WHO (2020) and the Indonesian Ministry of Health (2013) recommend consuming at least five servings of fruits and vegetables per day as part of a healthy diet to prevent hypertension<sup>32</sup>. According to Suryani et al. (2020), low fiber intake can lead to obesity, which in turn can increase blood pressure and cause degenerative diseases.

In this study, there was a statistically significant association between fruit and vegetable consumption and the incidence of hypertension. However, the direction of the relationship found was contrary to theoretical expectations. Low fruit and vegetable consumption in this study appeared to act as a protective factor against hypertension. One possible explanation for this result is the presence of temporal ambiguity bias, which is common in cross-sectional study designs.

In this study, data on fruit and vegetable consumption and hypertension status were collected simultaneously, making it difficult to determine which occurred first. It is possible that individuals who were already aware of having hypertension began to improve their diets by increasing their intake of fruits and vegetables as a way to control their blood pressure. This behavioral change may have caused their fruit and vegetable intake status to appear “adequate” at the time of data collection, even though their previous dietary habits may have been unhealthy before being diagnosed with hypertension. Because the data were collected at the same time, the direction of the causal relationship cannot be determined with certainty.

#### **Association Between Salt Consumption and Hypertension Incidence**

The analysis in this study showed that among 2,150 respondents with excessive salt consumption, 46.2% were identified as having hypertension, while 53.8% did not have hypertension. Individuals with excessive salt intake had a 1.56 times higher risk of developing hypertension compared to those who consumed an adequate amount of salt [Adj PR = 1.56; 95% CI: 1.41–1.73]. This finding indicates that excessive salt consumption is a significant risk factor for the incidence of hypertension.

This finding is consistent with the theory that excessive salt consumption is one of the main risk factors for hypertension. High salt intake has a proportional relationship with the onset of hypertension: the higher the salt levels in the body, the greater the increase in plasma volume, cardiac output, and blood pressure. Biologically, the correlation between excessive sodium intake and hypertension is triggered by an increase in blood plasma volume and blood pressure. Sodium from excessive salt consumption is absorbed into the bloodstream, which causes water retention (increased body fluid), leading to an increase in plasma volume and, ultimately, elevated blood pressure. This study is in line with previous research that found excessive salt intake increases the risk of hypertension in both young adults and the elderly.

The pattern of excessive salt consumption is driven by the habit of consuming fast food, processed foods, and flavor enhancers that are high in sodium. According to the 2018 Basic Health Research (Riskesdas), urban residents in Indonesia, including those in Jambi City, generally have higher sodium intake compared to rural populations. This condition shows that the dietary patterns of urban communities are more prone to high salt intake due to easier access to fast food, processed products, and modern eating habits. In addition, a study by Hidayati et al. (2020) found that a lack of habit in reading nutrition labels and limited knowledge about safe daily salt limits are among the main factors contributing to high daily sodium intake among urban populations in Indonesia.

The Ministry of Health, through its Balanced Nutrition Guidelines, recommends a daily salt intake of no more than 2,000 mg, which is equivalent to one teaspoon per day. This study shows that

excessive salt consumption remains a significant risk factor for hypertension in the Jambi City area. Therefore, community-level hypertension control efforts should focus on educating the public about limiting salt intake, improving nutrition literacy to read food labels, and promoting low-salt diets through *Posbindu* programs and primary healthcare services.

### **Association Between Obesity and Hypertension Incidence**

The results of this study show that among the 4,051 respondents classified as obese, 47.6% were identified as having hypertension, while 52.4% did not have hypertension. The analysis of the association between obesity and hypertension incidence among individuals aged  $\geq 15$  years revealed a significant relationship between obesity and the occurrence of hypertension (p-value = 0.000). Statistically, individuals who are obese have a 1.94 times higher risk of developing hypertension compared to those who are not obese [Adj PR = 1.94; 95% CI: 1.80–2.10].

This finding is consistent with the theory that obesity is one of the main risk factors for hypertension. Hypertension can be caused by obesity through various mechanisms, both direct and indirect<sup>40</sup>. Directly, an increase in body mass leads to greater oxygen and nutrient demands, which triggers an increase in blood volume and cardiac output<sup>16</sup>. The larger a person's body mass, the more blood the heart must pump to supply all tissues. Indirectly, obesity stimulates the activation of the sympathetic nervous system and the renin-angiotensin-aldosterone system (RAAS)<sup>41</sup>.

Based on the respondents' characteristics in this study, the Body Mass Index (BMI) status shows that 26.5% of respondents in Jambi City were classified as obese and another 24.6% were overweight. This indicates that more than half of the respondents have excess body weight, which clearly contributes to the high risk of hypertension. Therefore, efforts to prevent obesity through education on balanced nutrition, increased physical activity, and monitoring of community nutritional status need to be strengthened as part of local hypertension control strategies.

This study is consistent with previous research showing a significant association between obesity and hypertension, and that obesity is one of the factors that increases the risk of hypertension. However, a study conducted by Te'ne and Karjadidjaya (2020) did not find a significant association between obesity and hypertension (p-value = 0.69; PR 0.82). This discrepancy may be due to the small sample size, habitual coffee or tea consumption that affects metabolism, and the adiponectin factor, which was not accounted for. The Indonesian Ministry of Health, through the Balanced Nutrition Guidelines, emphasizes that maintaining an ideal body weight is one of the main strategies to prevent non-communicable diseases, including hypertension.

## **CONCLUSION**

Based on the analysis results, the proportion of hypertension among residents aged  $\geq 15$  years in Jambi City, according to the Sehat Indonesiaku Application (ASIK) data for 2023, was 35.2%. The majority of respondents were female (57.7%) and predominantly in the older adult age group, especially those aged 55–64 years (22.4%). A total of 45.8% of respondents had central obesity, 26.5% were obese, and 24.6% were overweight. Blood glucose examination showed that 13.0% were pre-diabetic and 6.4% had hyperglycemia. Blood pressure checks identified 35.2% with hypertension and 24.2% with pre-hypertension. Most respondents had low physical activity levels (70.3%), insufficient fruit and vegetable intake (60.6%), and a high proportion of excessive salt consumption (14.1%). The analysis showed that the factors significantly associated with hypertension were male gender, age  $\geq 40$  years, low physical activity, low fruit and vegetable intake, excessive salt consumption, and obesity. The dominant factor with the strongest influence was age  $\geq 40$  years after controlling for other variables. No significant association was found between sugar, fat, alcohol consumption, or smoking and the incidence of hypertension among residents aged  $\geq 15$  years in Jambi City.

## REFERENCES

- Alfalah NJ, Hasni D, Febrianto BY, Warlem N. Hubungan Obesitas dengan Kejadian Hipertensi pada Perempuan Minangkabau. *Poltekita J Ilmu Kesehat.* 2022;15(4):360–4.
- Ansar J, Dwinata I, M A. Determinan Kejadian Hipertensi Pada Pengunjung Posbindu Di Wilayah Kerja Puskesmas Ballaparang Kota Makassar. *J Nas Ilmu Kesehat.* 2019;1(3):28–35.
- Apriza A, Nurman M. Analisis Hubungan Kebiasaan Merokok dengan Hipertensi di Kuok Kabupaten Kampar. *J Kesehat Komunitas.* 2022;8(2):344–51.
- Ariyani AR. Kejadian Hipertensi pada Usia 45-65 Tahun. *Higeia J Public Heal Res Dev.* 2020;4(3):506–18.
- Badriyah L, Pratiwi RIR. Hubungan Obesitas dengan Kejadian Hipertensi dan Hiperglikemia di Indonesia. *Ghidza J Gizi dan Kesehat.* 2024;8(1):33–8.
- Balitbangkes. Laporan Riskesdas 2018 Nasional.pdf [Internet]. Lembaga Penerbit Balitbangkes. 2018. p. hal 156. Available from: [https://repository.badankebijakan.kemkes.go.id/id/eprint/3514/1/Laporan Riskesdas 2018 Nasional.pdf](https://repository.badankebijakan.kemkes.go.id/id/eprint/3514/1/Laporan_Riskesdas_2018_Nasional.pdf)
- Casmuti C, Fibriana AI. Kejadian Hipertensi di Wilayah Kerja Puskesmas Kedungmundu Kota Semarang. *HIGEIA (Journal Public Heal Res Dev.* 2023;7(1):123–34.
- Dewi S, Ali H, Priyanto DA, Silvia H. Analisis Hubungan Kejadian Hipertensi Pada Dosen UIN Sultan Thahha Saifuddin Jambi. *J Heal Sci ( J Ilmu Kesehatan).* 2022;VII(1):13–23.
- Gerhana Waty GW. Faktor Yang Memengaruhi Kejadian Hipertensi Pada Umur 30 – 40 Tahun Di Wilayah Kerja Puskesmas Palanro Kabupaten Barru. *Bina Gener J Kesehat.* 2022;13(2):61–73.
- Gillis EE, Sullivan JC. Sex Differences in Hypertension: Recent Advances. *Hypertension.* 2016;68(6):1322–7.
- Falah M. Hubungan Jenis Kelamin Dengan Angka Kejadian Hipertensi Pada Masyarakat Di Kelurahan Tamansari Kota Tasikmalaya. *J Keperawatan Kebidanan STIKes Mitra Kencana Tasikmalaya.* 2019;3(1):88.
- Hintari S, Fibriana AI. Hipertensi pada Penduduk Usia Produktif (15-59 Tahun) di Wilayah Kerja Puskesmas Pageruyung Kabupaten Kendal. *HIGEIA (Journal Public Heal Res Dev.* 2023;7(2):208–18.
- Indriani MH, Djannah SN, Ruliyandari R. Pengaruh Aktivitas Fisik terhadap Kejadian Hipertensi. *J Kesehat Masy Terkini [Internet].* 2023;18(4):1–5. Available from: <https://jurnal.unimus.ac.id/index.php/jkmi,jkmi@unimus.ac.id>
- Juliana I, Hengky HK, Umar F, Usman U. Analisis Faktor Yang Berhubungan Dengan Kejadian Hipertensi Pada Usia Produktif (15 – 59 Tahun). *J Gizi Kerja dan Produkt.* 2024;5(1):138–48.
- Kusuma YL hadi, Fatmawati A, Mafticha E. Pedoman Penyelenggaraan Pos Pembinaan Terpadu–Penyakit Tidak Menular (POSBINDU-PTM) Dengan Pendanaan Dana Desa. E-Book Penerbit .... 2020. 4–97 p.
- Fitrianiingsih D, Winahyu KM, Wibisana E, Ahmad SNA. Editorial Team Jurnal JKFT. *Jkft.* 2022;7(2):108–12.
- Oparil S, Acelajado MC, Bakris GL, Berlowitz DR, Cífková R, Dominiczak AF, et al. Hypertension. *Nat Rev Dis Prim.* 2018;4.
- Farhadi F, Aliyari R, Ebrahimi H, Hashemi H, Emamian MH, Fotouhi A. Prevalence of uncontrolled hypertension and its associated factors in 50–74 years old Iranian adults: a population-based study. *BMC Cardiovasc Disord.* 2023;23(1):1–10.
- Hubungan Usia Dan Jenis Kelamin Dengan Kejadian Hipertensi Di Puskesmas Haji Pemanggilan Kecamatan Anak Tuha Kab. Lampung Tengah. 2021;8(September):229–39.
- Imamah S, Prasetyowati I, Antika RB. Analisis Mengenai Hubungan Obesitas, Aktivitas Fisik, dan Stres Kerja Dengan Kejadian Hipertensi Pada Guru SMA Negeri di Kecamatan Kota Kabupaten Sumenep. *J Kesehat Masy.* 2023;11(1):83–8.
- Indriani, Susilo Wulan, Dini Syavani, Nurul Khairani S. STIKES Tri Mandiri Sakti Bengkulu. 2024;1(1):41–51.
- Kementerian Kesehatan Republik Indonesia. Pedoman Teknis Penemuan dan Tata Laksana Hipertensi. Pedoman Teknis Penemuan dan Tata Laksana Hipertensi. 2008.
- Kemenkes. Buku Pedoman Hipertensi 2024. Buku Pedoman Pengendali Hipertensi di Fasilitas Kesehatan Tingkat Pertama. 2023;1–71.
- Lintang SP, Pratiwi ED. Faktor Risiko Hipertensi Jamaah Haji Dki Jakarta Prepotif: Jurnal Kesehatan Masyarakat akibat gangguan jantung dan ginjal . Secara global pada tahun 2019 , lebih dari 50 % kematian fisik yang intens baik didalam ruang tertutup maupun terbuka . Beberapa t. 2024;8:5505–14.
- Lukito AA. Panduan Promotif dan Preventif Hipertensi. *Indones Soc Hypertens Perhimpun Dr*

- Hipertens Indones. 2023;1–88.
- Masri E, Nasution NS, Ahriyasna R. Literasi Gizi dan Konsumsi Gula, Garam, Lemak pada Remaja di Kota Padang. *J Kesehat*. 2022;10(1):23–30.
- Mulyasari S, Wurjanto MA, Hestningsih R, Adi MS. Hubungan Antara Riwayat Hipertensi Dalam Keluarga, Status Merokok, Dan Konsumsi Garam Dengan Kejadian Hipertensi Pada Usia 35-59 Tahun Di Wilayah Kerja Puskesmas Kebumen I. *J Kesehat Masy*. 2023;11(6):639–44.
- Nezha R. Peraturan Menteri Kesehatan Republik Indonesia Nomor 41 Tahun 2014 Tentang Pedoman Gizi Seimbang. 2014;1–203.
- Petrus Apriandre Nubatonis, Yuliana Radja Riwu, Soleman Landi. Hubungan Merokok, Obesitas, Konsumsi Alkohol dan Aktivitas Fisik dengan Kejadian Hipertensi pada Masyarakat yang Berkunjung di Puskesmas Alak Tahun 2021. *SEHATMAS J Ilm Kesehat Masy*. 2024;3(3):522–30.
- Pratiwi A. Pengaruh Slow Deep Breathing Terhadap Tekanan Darah Pada Pasien Hipertensi. *Masker Med*. 2020;8(2):263–7.
- Rosadi E, Gusty RP, Mahathir M. Karakteristik Tekanan Darah dan Kenyamanan pada Pasien Hipertensi. *J Keperawatan Jiwa* [Internet]. 2023;11(3):731–8. Available from: <https://jurnal.unimus.ac.id/index.php/JKJ/article/viewFile/12775/pdf>
- Rahmadia Filda A N, et al. Evaluasi Penerapan Program Aplikasi ASIK (Aplikasi Sehat IndonesiaKu) Pada Imunisasi Anak di Puskesmas Ngoro Mojokerto. *J Phys Educ Sport Heal Recreat*. 2023;12(2):223–8.
- Rosadi D, Hildawati N. Analisis faktor risiko kejadian hipertensi pada masyarakat di wilayah kerja Puskesmas Sungai Raya, Kabupaten Hulu Sungai Selatan. *J Heal Epidemiol Commun Dis*. 2022;7(2):60–7
- Riyada F, Amanah Fauziah S, Liana N, Hasni D. Faktor yang Mempengaruhi Terjadinya Resiko Hipertensi pada Lansia. *Sci J*. 2024;3(1):27–47.
- Rahadian J, Wardhani K, Cahyadi E. Hubungan Usia Dan Jenis Kelamin Dengan Kejadian Hipertensi Pada Pasien Rawat Jalan di Poliklinik Penyakit Dalam RSUD Meuraxa Banda Aceh. 2024;2(4):903–11.
- Ramdhika MR, Widiastuti W, Hasni D, Febrianto BY, Jelmila S. Hubungan Aktivitas Fisik dengan Kejadian Hipertensi pada Perempuan Etnis Minangkabau di Kota Padang. *J Kedokt dan Kesehat*. 2023;19(1):91.
- Susanti N, Siregar PA, Falefi R. Hypertension's Determinant in Coastal Communities Based on Socio Demographic and Food Consumption. *J Ilm Kesehat*. 2020;2(1):43–52.
- Samsiati D, Nurhamidi, Anwar R. Hubungan Aktifitas Fisik , Konsumsi Buah dan Sayur , dan Kualitas Tidur. *J Ris Pangan dan Gizi*. 2023;05(02):52–8.
- Suryani N, Noviana, Libri O. Hubungan Status Gizi, Aktivitas Fisik, Konsumsi Buah dan Sayur dengan Kejadian Hipertensi di Poliklinik Penyakit Dalam RSD Idaman Kota Banjarbaru. *J Kesehat Indones*. 2020;10(2):100–7.
- Sriyani W, Murni NS, Suryani L, Suryanti D. Di Puskesmas Tugumulyo Kabupaten Ogan Komering Ilir Tahun 2024 Program Studi Magister Ilmu Kesehatan Masyarakat , STIK Bina Husada ( Kementerian Kesehatan Republik Menurut data Organisasi Kesehatan Determinan Kejadian Hipertensi .... 2024;13(2):420–9.
- Te'ne CA, Karjadidjaja I. Hubungan overweight dan obesitas terhadap hipertensi pada pengemudi bus antar kota PT GM Jakarta. *Tarumanagara Med J*. 2020;2(1):14–9.
- Ummah MS. World Health Statistic 2019 Monitoring Health For The SDGs [Internet]. Vol. 11, Sustainability (Switzerland). 2019. 1–14 p. Available from: [http://scioteca.caf.com/bitstream/handle/123456789/1091/RED2017-Eng-8ene.pdf?sequence=12&isAllowed=y%0Ahttp://dx.doi.org/10.1016/j.regsciurbeco.2008.06.005%0Ahttps://www.researchgate.net/publication/305320484\\_Sistem\\_Pembetulan\\_Terpusat\\_Strategi\\_Melestari](http://scioteca.caf.com/bitstream/handle/123456789/1091/RED2017-Eng-8ene.pdf?sequence=12&isAllowed=y%0Ahttp://dx.doi.org/10.1016/j.regsciurbeco.2008.06.005%0Ahttps://www.researchgate.net/publication/305320484_Sistem_Pembetulan_Terpusat_Strategi_Melestari)
- World Health Organization (WHO). WHO Asian-BMI classification [Internet]. Available from: <https://www.researchgate.net/profile/Sarit-Sharma/publication/296026141/figure/tbl1/AS:613938219733011@1523385686902/WHO-Asian-BMI-classification.png>
- Yunus MH, Kadir S, Lalu NAS. the Relationship Between Salt Consumption Patterns and the Incidence of Hypertension in the Elderly At the Kota Tengah Health Center. *J Heal Sci Gorontalo J Heal Sci Community*. 2023;7(1):163–71.