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Analysis of Factors Associated with the Incidence of Hypertension in the Working Area of Wara Utara Community Health Center, Palopo City

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Abstract: Hypertension is a major public health problem because it often occurs without specific symptoms and may lead to severe complications, including stroke, kidney failure, and cardiovascular disease. Dietary behavior and psychological stress are modifiable factors that may contribute to increased blood pressure, particularly in communities served by primary health care facilities. **Objective:** This study aimed to analyze the association between sodium dietary intake, stress level, and the incidence of hypertension in the working area of the Wara Utara Community Health Center, Palopo City. **Methods:** This study used a quantitative analytic observational design with a cross-sectional approach. The sample consisted of 97 respondents aged 35–65 years selected using purposive sampling. Data were collected through blood pressure measurement, sodium intake assessment using a Semi-Quantitative Food Frequency Questionnaire, and stress level measurement using the Depression Anxiety Stress Scales questionnaire. Data were analyzed using univariate analysis, Chi-square test, and binary logistic regression. **Findings:** The results showed that 70 respondents (72.2%) had hypertension, 37 respondents (38.1%) had excessive sodium intake, and 52 respondents (53.6%) experienced stress. Sodium dietary intake was significantly associated with hypertension ($p = 0.007$), and stress was also significantly associated with hypertension ($p < 0.001$). Multivariate analysis showed that stress was the most dominant factor associated with hypertension (OR = 6.71; 95% CI: 2.01–22.38; $p = 0.005$), followed by excessive sodium intake (OR = 5.13; 95% CI: 1.61–16.32; $p = 0.020$). **Implications:** These findings imply that hypertension prevention programs at the primary health care level should integrate sodium intake control, healthy dietary education, routine blood pressure monitoring, and stress management. **Originality:** The originality of this study lies in its simultaneous analysis of dietary and psychosocial factors associated with hypertension in a local primary health care setting, providing contextual evidence for community-based hypertension prevention strategies.

Keywords: hypertension; sodium intake; stress; dietary behavior; primary health care

INTRODUCTION

Hypertension is a non-communicable disease that has become a global health problem due to its contribution to high rates of mortality and disability. Hypertension is defined as a condition in which systolic blood pressure exceeds 140 mmHg and diastolic blood pressure exceeds 90 mmHg (World Health, 2023a). Cases of hypertension and its complications continue to increase and may become fatal if not prevented and managed

promptly.

Disease patterns have currently shifted. In general, the epidemiological transition refers to changes in disease patterns that were previously dominated by communicable diseases toward non-communicable diseases (NCDs). Hypertension is often referred to as a "silent killer" because it frequently presents without symptoms but may lead to severe complications such as stroke, kidney failure, and heart disease (Juliana et al., 2024).

According to data from the World Health Organization (WHO), approximately 1.28 billion adults aged 30–79 years worldwide suffer from hypertension, with the majority living in low- and middle-income countries (World Health, 2023b).

Based on data from the 2023 Indonesian Health Survey (SKI), the prevalence of hypertension in Indonesia was 30.8%. The highest prevalence was reported in Central Kalimantan Province at 40.7%, while the lowest prevalence was found in Highland Papua Province at 19.9%. South Sulawesi Province ranked eighth with a prevalence of 31.3%. The prevalence of hypertension tends to increase with advancing age (Ministry of Health of the Republic of, 2023).

According to a report from the Palopo City Health Office, the number of new hypertension cases has continued to increase over the past three years (Palopo City Health, 2023). In 2021, there were 790 cases, which increased to 2,050 cases in 2022 and further increased to 2,214 cases in 2023.

The increasing number of hypertension cases is influenced by various factors, including non-modifiable factors such as sex, age, and genetics, as well as modifiable factors such as knowledge, stress, dietary patterns, physical activity, smoking, and obesity. Hypertension may interfere with daily activities and can lead to serious complications if not prevented and managed early (Fitria, 2022).

Stress is a condition commonly experienced in daily life. Individuals with high levels of stress are at greater risk of developing hypertension. In addition, stress among patients with hypertension may trigger other disease complications (Situmorang, 2020). This is consistent with a study conducted by Sutarjana regarding the relationship between caffeine consumption frequency, stress levels, and the incidence of hypertension among young adults, which demonstrated a significant association between stress levels and hypertension (Sutarjana, 2021).

Most patients with hypertension experience symptoms such as headaches, dizziness, and blurred vision, which may interfere with daily activities. The higher the blood

pressure, the greater the risk of damage to the heart and blood vessels, including vital organs such as the brain and kidneys (World Health, 2023c).

Consumption of foods high in sodium, as well as frequent intake of fried foods, may increase the risk of hypertension. Internationally, dietary patterns such as the DASH (Dietary Approaches to Stop Hypertension) diet, which emphasizes the consumption of fruits, vegetables, whole grains, and low-fat dairy products, have been shown to significantly reduce blood pressure. Meta-analysis studies have also demonstrated that diets high in sodium and low in potassium are consistently associated with increased blood pressure and a higher risk of hypertension (Kario, 2024).

Based on a preliminary study regarding dietary patterns, among eight patients with hypertension interviewed at the Wara Utara Community Health Center, five reported frequently consuming fried salted fish, purchasing fast food, and eating fried snacks at night. Patients with hypertension also frequently experienced severe headaches, dizziness, blurred vision, nausea, and irregular heartbeat, all of which interfered with their daily activities and work performance.

Stress experienced by several patients with hypertension at the research site was associated with heavy work demands. As traders, they require considerable energy to perform their work and therefore are more prone to fatigue compared to individuals with lighter physical workloads. Therefore, this study aimed to analyze the factors associated with hypertension at the Wara Utara Community Health Center, Palopo City. It is expected that the findings of this study will help the community prevent hypertension through the adoption of healthy dietary patterns and effective stress management.

RESEARCH METHOD

The unit of analysis in this study was individual patients who visited the Wara Utara Community Health Center, Palopo City, South Sulawesi, for health examination services. The main focus of this study was the incidence of hypertension and its associated factors, particularly sodium dietary intake and stress level. Respondents included patients aged 35–65 years who met the inclusion criteria, were willing to participate in the study, underwent blood pressure measurement, and provided informed consent. Hypertension status was determined based on systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg.

This study employed a quantitative analytic observational design with a cross-sectional approach. This design was selected because the study aimed to analyze the association between independent variables, namely sodium dietary intake and stress level, and the dependent variable, namely hypertension incidence, at one point in time. A cross-sectional approach was considered appropriate because it allows researchers to identify patterns of association between risk factors and hypertension efficiently within a defined population and study period, without requiring long-term follow-up. The study was conducted in the working area of the Wara Utara Community Health Center from September to October 2024 and obtained approval from the Palopo City Health Office under approval number 800.1.4/1544/DINKES.

The data sources used in this study consisted of primary and secondary data. Primary data were obtained directly from respondents through blood pressure measurements, assessment of sodium dietary intake, and stress level questionnaires. Secondary data were obtained from respondents' medical records and supporting health service data available at the Wara Utara Community Health Center. The study sample consisted of 97 respondents selected using purposive sampling based on predetermined inclusion criteria, namely patients aged 35–65 years, patients visiting the Wara Utara Community Health Center, and patients willing to participate by signing an informed consent form.

Data collection was carried out through direct measurement and questionnaire administration. Blood pressure was measured using a digital sphygmomanometer by placing the cuff on the respondent's upper arm while the respondent was instructed to remain calm, avoid speaking, and minimize movement during the measurement process. Sodium dietary intake was assessed using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), in which food consumption data were converted from household measures into grams per day and analyzed using NutriSurvey software based on the Recommended Dietary Allowance. Sodium intake was categorized as excessive if it exceeded 120% of the recommended intake and adequate if it ranged from 90% to 119%. Stress level was measured using the Depression Anxiety Stress Scales (DASS) questionnaire and categorized as stressed if the total score was ≥14 and not stressed if the total score was <14.

Data analysis was conducted in three stages: univariate, bivariate, and multivariate analysis. Univariate analysis was used to describe the frequency distribution and percentage of each research variable, including hypertension status, sodium dietary

intake, and stress level. Bivariate analysis was performed using the Chi-square test to examine the association between sodium dietary intake and hypertension, as well as between stress level and hypertension, with a significance level of $\alpha = 0.05$. Furthermore, multivariate analysis was conducted using binary logistic regression to determine the dominant factor associated with hypertension incidence. The results were presented in the form of odds ratios (ORs), 95% confidence intervals (95% CIs), and p-values. All statistical analyses were performed using SPSS Statistics software.

Operational Definition

Table 1. Operational Definition of Research Variables

Variable	Operational Definition	Measurement Tool	Scale	Measurement Results
Hypertension	A condition where a person's blood pressure is above normal limits, with systolic ≥ 140 mmHg and/or diastolic ≥ 90 mmHg based on medical examination results.	Sphygmomanometer	Ordinal	Hypertension: if systolic ≥ 140 mmHg and/or diastolic ≥ 90 mmHg Non-hypertension: if systolic < 140 mmHg and diastolic < 90 mmHg
Sodium intake pattern	The method of regulating the amount or type of food consumed related to sodium intake.	Semi Quantitative Food Frequency Questionnaire (SQ-FFQ)	Ordinal	High sodium intake: >120% Adequate: 90–119%
Stress	A psychological condition in which an individual experiences pressure due to perceived demands or obstacles exceeding coping ability.	Depression Anxiety Stress Scales (DASS) Questionnaire	Ordinal	Stress: total score ≥ 14 Not stressed: total score < 14

Hypertension is defined as a condition in which a person's blood pressure is above the normal threshold, namely when systolic blood pressure is ≥ 140 mmHg and/or diastolic blood pressure is ≥ 90 mmHg based on medical examination results. It is expressed in mmHg units and measured using an ordinal scale (Frisca, 2019).

Sodium dietary pattern refers to an assessment of an individual's daily sodium (salt) intake level based on the amount of sodium consumed from foods and beverages. The

ordinal measurement scale was categorized as excessive intake if the intake was >120% and adequate intake if the intake ranged from 90–119% (Fitrianti & Simanungkalit, 2020).

Stress data refer to a condition that places psychological pressure on an individual when facing a particular situation or opportunity, in which there are limitations or obstacles to achieving the desired outcome. The measurement scale was categorized as stressed if the total score was ≥14 and not stressed if the total score was <14 (Cao et al., 2023).

Data Collection Procedure

Primary data were collected through direct measurements of the respondents. Hypertension status was determined using a digital sphygmomanometer. The cuff was placed on the respondent's upper arm. After the device was turned on, respondents were instructed to remain calm, avoid speaking, and minimize movement during the measurement process. The device automatically inflated and deflated the cuff and then displayed the systolic and diastolic blood pressure readings on the digital screen. Hypertension was defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg (Ministry of Health of the Republic of, 2018).

Sodium dietary intake was assessed using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). Household measurement units were subsequently converted into grams per day. The nutritional content of food items was calculated using NutriSurvey software and then analyzed using the nutrient intake level formula based on the Recommended Dietary Allowance (RDA). Sodium intake was categorized as excessive intake if it exceeded 120% of the RDA and adequate intake if it ranged from 90–119% of the RDA (Citerawati & Sukati, 2017).

Stress levels were assessed using the Depression Anxiety Stress Scales (DASS) questionnaire. Stress levels were categorized as stressed if the total score was ≥14 and not stressed if the total score was <14 (Cao et al., 2023).

Data Analysis

Univariate analysis was conducted to describe the characteristics of each variable, including sodium dietary pattern, stress, and hypertension, using descriptive statistics such as percentages.

Bivariate analysis was performed using the Chi-square test to assess the association between sodium dietary pattern and hypertension, as well as between stress and hypertension. This test was used to evaluate the relationships between variables at a significance level of $\alpha = 0.05$.

Multivariate analysis was conducted using binary logistic regression to determine the effect of independent variables on the incidence of hypertension, as the dependent variable consisted of only two categories: hypertensive and non-hypertensive. The results of the analysis were presented as odds ratios (ORs) along with 95% confidence intervals (95% CIs).All statistical analyses were performed using SPSS Statistics software with a significance level of $\alpha = 0.05$.

RESULT

This study was conducted in the working area of Puskesmas Wara Utara from September to October 2024 using a purposive sampling technique. The study subjects consisted of 97 respondents who met the inclusion criteria. The research data included primary data obtained from measurements of sodium dietary intake and stress levels, as well as secondary data on blood pressure obtained from patients' medical records.

Univariate Analysis

Based on the collected and analyzed data, the following results were obtained:

Table 2. Frequency Distribution of Respondent Characteristics

No	Research Variables	Frequency (n)	Percentage (%)
	Hypertension Status		
1	Hypertension	70	72.2
	Non-hypertension	27	27.8
	Sodium Dietary Intake		
2	Excessive	37	38.1
	Adequate	60	61.9
	Stress		
3	Stress	52	53.6
	No Stress	45	46.4

Table 2. shows that, among the 97 respondents, 70 respondents (72.2%) had hypertension, while 27 respondents (27.8%) did not have hypertension. Regarding sodium dietary intake, 60 respondents (61.9%) had adequate sodium intake, whereas 37 respondents (38.1%) had excessive sodium intake. In terms of stress status, 52

respondents (53.6%) experienced stress, while 45 respondents (46.4%) did not experience stress.

Bivariate Analysis

Bivariate analysis was conducted to examine the association between sodium dietary intake, stress, and the incidence of hypertension. The results of the bivariate analysis are presented in Table 3.

Table 3. Analysis of Risk Factors Associated with Hypertension at Puskesmas Wara Utara

Risk Factors	Hypertension Yes n (%)	Hypertension No n (%)	Total n (%)	p-value
Sodium Dietary Intake				
Excessive	33 (89.2)	4 (10.8)	37 (100.0)	0.007
Adequate	37 (61.7)	23 (38.3)	60 (100.0)	
Total	70 (72.2)	27 (27.8)	97 (100.0)	
Stress				
Stress	46 (88.5)	6 (11.5)	52 (100.0)	0.000
No Stress	24 (53.3)	21 (46.7)	45 (100.0)	
Total	70 (72.2)	27 (27.8)	97 (100.0)	

Based on Table 3. among the 37 respondents with excessive sodium intake, 33 respondents (89.2%) had hypertension, while 4 respondents (10.8%) did not have hypertension. Meanwhile, among the 60 respondents with adequate sodium intake, 37 respondents (61.7%) had hypertension and 23 respondents (38.3%) did not have hypertension.

Regarding stress status, among the 52 respondents who experienced stress, 46 respondents (88.5%) had hypertension, while 6 respondents (11.5%) did not have hypertension. In contrast, among the 45 respondents who did not experience stress, 24 respondents (53.3%) had hypertension and 21 respondents (46.7%) did not have hypertension.

Table 3 also presents the results of the Chi-square statistical test conducted at a 95% confidence level ($\alpha = 0.05$). The Chi-square test showed a significant association between sodium dietary intake and hypertension incidence ($p = 0.007$), as well as between stress and hypertension incidence ($p = 0.000$). Therefore, it can be concluded that sodium

dietary intake and stress were significantly associated with the incidence of hypertension in the working area of Puskesmas Wara Utara.

Multivariate Analysis

Table 4. Binary Logistic Regression Analysis of Risk Factors Associated with Hypertension

Variables	B	Wald	p-value	OR	95% CI
Excessive sodium dietary intake	1.635	5.421	0.020	5.13	1.61–16.32
Stress	1.904	7.856	0.005	6.71	2.01–22.38
Constant	-2.117	6.214	0.013	0.12	–

Based on the results of the binary logistic regression analysis presented in Table 4, stress was identified as the most dominant factor associated with the occurrence of hypertension, with an odds ratio (OR) of 6.71 (95% CI: 2.01–22.38; p = 0.005). This indicates that respondents experiencing stress had a 6.7 times higher risk of developing hypertension compared to those without stress. In addition, high sodium intake was also significantly associated with hypertension (OR = 5.13; 95% CI: 1.61–16.32; p = 0.020), indicating that respondents with excessive sodium consumption had a 5.1 times higher risk of developing hypertension. Overall, the multivariate analysis showed that stress and high sodium intake are significant risk factors for hypertension.

DISCUSSION

The discussion section explains the research findings. In this study, the discussion focuses on the relationship between dietary sodium intake and stress in relation to hypertension. Based on the results, the majority of respondents were female, totaling 67 individuals (69.1%), while male respondents accounted for 30 individuals (30.9%). The largest age group was 45–54 years, comprising 48 respondents (49.4%), followed by 55–64 years with 25 respondents (25.8%), while the smallest proportion was found in the 35–44 years age group with 24 respondents (24.8%).

Increasing age is associated with a higher incidence of hypertension due to physiological aging processes that lead to structural and functional changes in blood vessels. As age increases, vascular elasticity decreases, causing arterial stiffness and

increased peripheral resistance. Consequently, the heart must work harder to pump blood, which ultimately leads to elevated blood pressure (Carey & Whelton, 2018).

Most respondents in this study had an adequate dietary sodium intake, totaling 60 individuals (61.9%), while 37 respondents (38.1%) had excessive sodium intake. Although the majority of respondents had an adequate sodium intake, hypertension may still occur because blood pressure is influenced not only by sodium intake but also by multiple interacting factors. Factors such as older age, obesity, physical inactivity, and excessive fat consumption may increase the risk of hypertension (Mills et al., 2020).

Regarding hypertension status, most respondents were classified as hypertensive, totaling 70 individuals (72.2%). The occurrence of hypertension is influenced by various factors, including duration of the condition, antihypertensive treatment, medication adherence, and patient lifestyle (Burnier & Egan, 2019).

It is important to understand that hypertension is not solely determined by high sodium intake but rather results from complex interactions among multiple physiological mechanisms and risk factors. Blood pressure elevation may be influenced by age, genetics, obesity, physical activity, and stress. Excessive sodium intake can lead to fluid retention and increased blood volume, thereby increasing pressure on arterial walls. In addition, activation of the renin-angiotensin-aldosterone system and increased sympathetic nervous system activity contribute to vasoconstriction and elevated blood pressure (Grillo et al., 2019). These mechanisms may occur simultaneously, explaining why dietary sodium intake and stress are associated with hypertension.

Dietary Sodium Intake

There was a statistically significant relationship between dietary sodium intake and the incidence of hypertension ($p = 0.007$). This finding is consistent with a previous study conducted at the Cimanggis Public Health Center, Depok, which also reported a significant association between sodium consumption and hypertension among older adults ($p = 0.003$) (Darmawan et al., 2023). Sodium intake is recognized as one of the key contributing factors to hypertension due to its role in increasing intravascular fluid volume, promoting fluid retention, and elevating peripheral vascular resistance, all of which contribute to increased blood pressure (He & MacGregor, 2020).

Theoretically, sodium intake plays a crucial role in the development of hypertension. Excessive sodium consumption increases fluid retention in the body because sodium

attracts and retains water in the extracellular compartment. This expansion of intravascular volume leads to increased cardiac output, which subsequently raises blood pressure. In addition, high sodium levels may disrupt the renin–angiotensin–aldosterone system and enhance sympathetic nervous system activity, both of which contribute to vasoconstriction and increased vascular resistance (Long-term high sodium intake can also induce structural and functional changes in blood vessels, including reduced vascular elasticity and increased oxidative stress, resulting in persistently elevated blood pressure (Grillo et al., 2019). These findings reinforce that a high-sodium diet is an important risk factor for hypertension.

Excessive sodium intake can further lead to alterations in vascular structure and function, such as decreased vascular compliance and increased peripheral resistance. This condition is exacerbated by endothelial dysfunction triggered by oxidative stress and inflammatory processes associated with high sodium levels. The combined effects of increased fluid volume, vasoconstriction, elevated peripheral resistance, and impaired vascular function ultimately result in sustained blood pressure elevation and the development of hypertension (Grillo et al., 2019).

In conclusion, from a pathophysiological perspective, increased sodium intake is strongly associated with a higher risk of hypertension. Several studies have consistently reported a significant relationship between high sodium consumption and elevated blood pressure (Whelton et al., 2018). High sodium intake contributes to fluid retention, increased blood volume, and elevated peripheral vascular resistance, all of which promote the development of hypertension (O'Donnell et al., 2020)

Stress and the Incidence of Hypertension in the Study Area

The chi-square test results indicated a significant association between stress and the incidence of hypertension ($p = 0.007$). Furthermore, the binary logistic regression analysis showed that stress was the most dominant factor associated with hypertension, with an odds ratio (OR) of 6.71 (95% CI: 2.01–22.38; $p = 0.005$). This means that respondents experiencing stress had a 6.7 times higher risk of developing hypertension compared to those who were not experiencing stress.

Theoretically, stress can increase the risk of hypertension through activation of the sympathetic nervous system and the hypothalamic–pituitary–adrenal (HPA) axis. Stress conditions trigger increased production of adrenaline, noradrenaline, and cortisol, which

lead to elevated heart rate, vasoconstriction of blood vessels, and sodium and fluid retention, ultimately increasing blood pressure (Grassi & Drager, 2024; Walther & Wirtz, 2023). Continuous neuroendocrine activation may also increase peripheral resistance and result in sustained elevation of blood pressure (Carnevale, 2023).

The findings of this study are consistent with research by Sutomo et al. (2024), which reported a significant association between work-related stress and hypertension (p-value = 0.038). Chronic, uncontrolled stress may lead to dysregulation of neuroendocrine pathways and increased inflammatory responses, contributing to the development of hypertension (Carnevale, 2023). These findings indicate that stress management is an important component in the prevention and control of hypertension.

Limitations of the Study

The findings of this study should be interpreted with consideration of certain limitations. Confounding factors, such as duration of hypertension, type and adherence to antihypertensive medication, dietary patterns, and physical activity, were not analyzed in this study.

CONCLUSION

This study found that hypertension was highly prevalent among respondents in the working area of the Wara Utara Community Health Center, Palopo City. The main finding indicates that both excessive sodium intake and stress level were significantly associated with the incidence of hypertension. Respondents with excessive sodium intake had a higher likelihood of experiencing hypertension compared to those with adequate sodium intake. In addition, stress was identified as the most dominant factor associated with hypertension, indicating that psychological pressure may play an important role in increasing blood pressure among the study population.

The scientific contribution of this study lies in providing local empirical evidence regarding the role of lifestyle-related and psychosocial factors in hypertension occurrence at the primary health care level. By examining sodium dietary intake and stress simultaneously, this study strengthens the understanding that hypertension is not only influenced by physiological or biological factors, but also by dietary behavior and psychological conditions. These findings may support community-based hypertension

prevention programs, particularly through health education on sodium restriction, healthy eating patterns, routine blood pressure monitoring, and stress management interventions.

However, this study has several limitations. The cross-sectional design limits the ability to establish a causal relationship between sodium intake, stress, and hypertension. In addition, several potential confounding factors, such as physical activity, body mass index, family history of hypertension, smoking habits, sleep quality, medication adherence, and comorbid diseases, were not analyzed in this study. Therefore, future studies are recommended to use a longitudinal design with a larger sample size and include more comprehensive clinical, behavioral, and lifestyle variables to obtain a deeper understanding of the factors contributing to hypertension.

RECOMMENDATIONS

Based on the findings of this study, it is recommended that future research employ a more comprehensive study design to enable a deeper explanation of the relationship between risk factors and the incidence of hypertension. In addition, future studies should also consider other variables associated with hypertension, such as physical activity, body mass index, family history, sleep quality, medication adherence, smoking habits, and other dietary consumption patterns.

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