

Original Research Article

The Relationship between Sodium Intake and Nutritional Status with Blood Pressure among High School Adolescents in Maros Regency, Indonesia

ABSTRACT

Hypertension is a non-communicable disease whose prevalence continues to increase, including in adolescents. Excessive sodium consumption and abnormal nutritional status play a role in increasing blood pressure. Adolescents tend to consume foods high in sodium which can increase the risk of hypertension. To determine the relationship between sodium intake and nutritional status with hypertension in high school adolescents in Turikale District, Maros Regency. This study used a cross-sectional design with 86 respondents selected using a multistage cluster random sampling method. Sodium intake was measured using a 2 × 24-hour food recall and Semi-FFQ. Nutritional status was determined based on BMI/A, while blood pressure was measured using an omicron digital sphygmomanometer. Data analysis used the Chi-Square and Spearman tests. There was no significant relationship between sodium intake and systolic ($p=0.919$) or diastolic ($p=0.736$) blood pressure. Nutritional status was also not significantly related to blood pressure based on the Chi-Square test on systolic ($p=0.151$) and diastolic ($p=1.000$). However, Spearman test showed a significant relationship between nutritional status and systolic blood pressure ($p=0.002$; $r=0.324$), while no significant relationship was found in diastolic blood pressure ($p=0.211$; $r=0.136$). Sodium intake is not associated with hypertension in high school adolescents in Turikale District, Maros Regency. Nutritional status is not associated with blood pressure based on the Chi-Square test, but has a weak positive relationship with systolic blood pressure based on the Spearman test.

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INTRODUCTION

Non-communicable diseases (NCDs) encompass a group of serious, non-communicable health conditions that significantly contribute to the global mortality rate. This group of diseases is responsible for approximately 71% of all deaths worldwide. Hypertension is one type of disease categorized as an

NCD. This classification is based on the fact that hypertension is a serious condition that can increase the risk of heart, brain, and kidney disease.¹ According to data from the World Health Organization, an estimated 1.28 billion individuals aged 18 and over worldwide suffer from hypertension. The highest prevalence is recorded in Africa, at 27%, while Switzerland has the lowest prevalence, at 18%.²

In Indonesia, the prevalence of hypertension among adolescents aged 15 to 17 years reaches 8.3%. Furthermore, the prevalence in rural areas is higher than in urban areas, with 5.6% in rural areas and 5.1% in urban areas. The Indonesian Health Survey (HIS) shows that the prevalence of hypertension diagnosed by doctors in the population aged 18 years and older remains a significant non-communicable health problem in Indonesia. Nationally, the prevalence of hypertension was recorded at 8.6% across Indonesia's 38 provinces. Meanwhile, in South Sulawesi, the prevalence of hypertension diagnosed by doctors was 7.2%, and the prevalence of hypertension based on measurements was 31%.³ Based on data from the Maros Regency Health Office, the percentage of hypertension sufferers among residents aged 15 years and above in Turikale District, Maros Regency, reached 92.17%. This data indicates that hypertension remains a significant health problem in the Turikale area.⁴

According to the Basic Health Research (Riskesdas), the prevalence of hypertension in Indonesia has reached 34.1%. In South Sulawesi Province, the prevalence of hypertension is reported to be in the range of 30–32%, indicating that hypertension remains a significant public health problem in the region. Among adolescents in South Sulawesi, the prevalence of hypertension in the 15–24 age group was recorded at 0.5%, while in the 25–34 age group it was 2.0%.⁵ Although the relationship between sodium intake and hypertension has been widely studied in adult populations, scientific evidence in adolescents in Indonesia is still limited and shows inconsistent results, especially in South Sulawesi.

Excessive sodium consumption elevates blood pressure via several physiological mechanisms. High sodium levels induce renal fluid retention, thereby expanding extracellular fluid and total blood volume. Consequently, this volumetric expansion increases cardiac output and intravascular pressure against arterial walls. Over the long term, high sodium consumption can also increase peripheral resistance and cause structural changes in blood vessels, contributing to hypertension.⁶ Excessive nutritional status, particularly overweight and obesity, also plays a role in increasing blood pressure. The accumulation of fat tissue can increase the activity of the sympathetic nervous system and the renin-angiotensin-aldosterone system (RAAS), as well as increase sodium and water retention by the kidneys. Furthermore, obesity can increase peripheral vascular resistance, leading to higher blood pressure. Therefore, nutritional status is an important risk factor for hypertension in adolescents.⁷

Hypertension is often known as the silent killer because in many cases, it doesn't show any obvious signs or symptoms in the early stages. This condition means many individuals don't realize they have high blood pressure until more serious complications develop. The risk of developing hypertension is higher in adolescents with a higher Body Mass Index (BMI), also known as obesity. This condition is caused by blood pressure increasing with age, weight, and height. Tall or overweight adolescents at this stage tend to experience increased levels of high-density lipoprotein, triglycerides, and cholesterol, decreased activity, and insulin resistance. Furthermore, fat can cause blockages in blood vessels, which require the heart to pump more blood to circulate.⁸

Risk factors for hypertension in adolescents can be classified into two main categories: changes in nutritional status and lifestyle. Adolescent lifestyles, including sleep duration, stress levels, and physical activity intensity, have been shown to influence blood pressure fluctuations. An unhealthy lifestyle can lead to increased body mass, which further increases the risk of hypertension. Nutritional status, including micronutrients such as sodium, potassium, and calcium, as well as an imbalance in fat and fruit intake, contributes to blood pressure elevation. Beyond these factors, there are non-modifiable variables, such as gender and a family history of hypertension.⁹

Adolescents are an age group vulnerable to high sodium consumption due to changes in lifestyle, taste preferences, and social environmental factors. During adolescence, there is increased independence in food choices, which often leads to the consumption of fast food, processed foods, and high-salt snacks that are easily accessible in schools and digital media. Exposure to food advertising, peer influence, and family consumption habits contribute to reinforcing high-sodium dietary patterns in this age group. Furthermore, adolescents tend to pay less attention to nutritional information and the long-term impacts on health, putting them at risk of exceeding the recommended daily sodium intake.¹⁰

Based on various theories and previous research results, adolescents were chosen as research subjects because they are an age group experiencing rapid growth and development, accompanied by the formation of lifestyle habits that will continue into adulthood. During this period, adolescents begin to

gain independence in making food choices, making them more at risk of consuming foods high in sodium, which can affect blood pressure.¹¹ In addition, changes in nutritional status, particularly overweight and obesity, have been shown to play a role in increasing the risk of hypertension through various physiological mechanisms. Therefore, research on the relationship between sodium intake and nutritional status with blood pressure in high school adolescents is important for early detection of cardiovascular disease risk factors and as a basis for developing promotive and preventive programs to prevent hypertension from a young age.¹²

Based on previous research, it was shown that there is a significant relationship between nutritional status and consumption of foods high in sodium and hypertension.¹³ According to previous research, there is a significant relationship between BMI and blood pressure in adolescents at SMK NU Ungaran. Adolescents with an excessive BMI are at a 5.57-fold increased risk of high blood pressure compared to adolescents with a normal BMI.¹⁴ Turikale District was chosen as the research location because there has been no research examining the relationship between sodium intake, nutritional status, and blood pressure in high school adolescents in the area. Furthermore, this area has a significant population of school-aged adolescents, making it important as a basis for developing early hypertension prevention efforts.

METHODS

This research is an analytical observational study with a cross-sectional design. The study was conducted in March–April 2026 at a location in a high school in Turikale District, Maros Regency, South Sulawesi. The study population was all high school students in grades X and XI. The initial sample of the study was 90 respondents selected using a multistage cluster random sampling technique. The initial sample size was 90 respondents. However, 4 respondents were excluded from the analysis due to incomplete data/not participating in the entire series of studies, so the final analysis was carried out on 86 respondents and the analysis was carried out using SPSS 2025. The sample in the study was high school students in Turikale District, Maros Regency, totaling 90 respondents using a multistage sampling cluster random sampling technique.

The sample was determined using a multistage cluster random sampling technique. In the first stage, all 16 high schools in Turikale District were grouped geographically into central areas (10 schools) and peripheral areas (6 schools). Six schools were then selected proportionally, consisting of four schools in the central area and two schools in the peripheral area. Furthermore, selection was based on the number of students who met the sample requirements, so one school did not meet the criteria due to limited number of respondents. Therefore, the study was conducted in five schools.

Nutritional status data was obtained through weight measurements using a digital scale and height using a stadiometer. Body Mass Index for Age (BMI/U) values were calculated and categorized based on WHO standards. Sodium intake data was obtained through interviews using the 2×24-hour food recall method, and the Semi Quantitative Food Frequency Questionnaire (SQ-FFQ). The sodium content of each type of food was calculated using the Indonesian Food Composition Table (TKPI). Furthermore, sodium intake was categorized based on the 2019 Nutritional Adequacy Intake (AKG) according to age group. Blood pressure was measured using a digital sphygmomanometer with an adult-sized cuff with the Amicron brand. Measurements were taken in the morning, at 08.00–09.00 WITA, on the left arm after the respondent had rested for 5 minutes in a sitting position. Each respondent underwent two measurements with an interval of 1–2 minutes, then the average value of the two measurement results was used as the respondent's blood pressure value.

The Chi-Square test is used to analyze the relationship between categorical variables, while the Spearman test is used to analyze the relationship between variables that are ordinal or not normally distributed. Univariate analysis was performed to describe the characteristics of the respondents and the distribution of the study variables. The relationship between sodium intake and nutritional status with blood pressure was analyzed using the Chi-Square test and Spearman's test with a significance level of $p < 0.05$. This study was conducted in accordance with all applicable ethical requirements. Ethics approval was granted by the Ethics Committee of the Muslim University of Indonesia, with ethics approval number 34/A.1/KEP-UMI/IV/2026.

RESULT AND DISCUSSION

Table 1. Distribution of Respondent Characteristics

Respondent Characteristics	n	%
Gender		
Man	17	19,8
Woman	69	80,2
Total	86	100,0
Age		
15-16 year	54	62,8
17-18 year	32	37,2
Total	86	100,0
Father's occupation		
Doesn't work	5	5,8
PNS, police, military	16	18,6
Self-employed, Private sector employee	34	39,5
Farmers, fishermen, laborers	19	22,1
Entrepreneur, trader	6	7,0
Lecturer	2	2,3
Other	4	4,7
Total	86	100,0
Systolic		
Normal	46	53,5
Tall	40	46,5
Total	86	100
Diastolic		
Normal	68	79,1
Tall	18	20,9
Total	86	100.0
Sodium Intake		
not enough	76	88,4
Enough/more	10	11,6
Total	86	100,0
Nutritional status		
Malnutrition	15	17,4
Good nutrition	71	82,6
Total	86	100,0

Source: Primary Data, 2026

Based on Table 1, the majority of respondents were female (69 people) (80.2%), while 17 respondents were male (19.8%). Based on age group, the majority of respondents were in the 15–16 year age range (54 people) (62.8%), while 32 respondents were aged 17–18 years (37.2%). These results indicate that the majority of respondents were in the middle adolescent category. The characteristics of fathers' occupations show that most worked as self-employed or private employees (34 people) (39.5%), followed by farmers, fishermen, and laborers (19 people) (22.1%), and civil servants, police, and military (16 people) (18.6%). Meanwhile, the dominance of respondents in the 15–16 year age group indicates that most respondents were in the middle adolescent phase. During this period, rapid physical growth occurs as well as changes in behavior and food consumption patterns that can affect nutritional status and health, including blood pressure. In addition, the high proportion of female respondents in this study can provide an overview of the characteristics of the student population that was the research sample. Of the 86 respondents, most had normal systolic blood pressure (53.5%) and normal diastolic blood pressure (79.1%). The majority of respondents had insufficient sodium intake (88.4%) and good nutritional status (82.6%), while respondents with sufficient/excessive sodium intake and poor nutritional status were 11.6% and 17.4%, respectively.

Gender is one factor that can influence blood pressure in adolescents. Boys tend to have higher blood pressure than girls due to differences in hormones, body composition, and body fat distribution. Furthermore, the increase in blood pressure during puberty generally occurs more rapidly in boys than in girls. However, hypertension can still occur in both genders if other risk factors such as obesity, physical inactivity, and unhealthy diet are present.¹³ Hypertension in adolescents can occur in the age range of 10–19 years, but hypertension is more often found in the late adolescent group aged 15–19 years due to

changes in lifestyle, consumption patterns, and increased risk factors such as obesity.¹⁴ Parental occupation can influence adolescents' nutritional status and health through family income levels. Parents with stable employment and adequate income tend to be better able to meet their children's nutritional needs and support healthy lifestyles. Parental occupation can be a factor indirectly related to adolescents' nutritional status and hypertension through family socioeconomic conditions.¹⁵

Table 2. Distribution of Respondents' Average

Variable	Mean ± SD
Sodium Intake	678,02 ± 558,75
Systolic	121,47 ± 12,892
Diastolic	74,2 ± 8,298
Nutritional status	-0,118 ± 1,693
Age	16,21 ± 0,769

Source: Primary Data, 2026

Based on Table 2, the mean sodium intake of respondents was 678.02 mg with a standard deviation of 558.75 mg. The mean systolic blood pressure was 121.47 mmHg SD = 12.892, while the mean diastolic blood pressure was 74.20 mmHg SD = 8.298. The mean nutritional status of respondents was -0.118 SD = 1.693, and the mean age was 16.21 years SD = 0.769. The standard deviation values for each variable indicate variations in sodium intake, blood pressure, nutritional status, and age among respondents.

Table 3. The Relationship Between Sodium Intake and Systolic and Diastolic Blood Pressure in Adolescents at Senior High Schools in Turikale District, Maros Regency

Sodium Adequacy	Systolic Blood Pressure		Diastolic Blood Pressure	
	n	%	n	%
Normal	46	53.5	40	46.5
Sodium adequate	6	7.0	4	4.7
Sodium inadequate	40	46.5	36	41.9
High	68	79.1	18	20.9
Sodium adequate	7	8.1	3	3.5
Sodium inadequate	61	70.9	15	17.4
Total	86	100.0	86	100.0

Source: Primary Data, 2026

Table 4. Correlation between Sodium Adequacy and Blood Pressure

Variable Relationship	Correlation Coefficient (r)	p-value
Sodium adequacy and systolic blood pressure	0.919	0.011
Sodium adequacy and diastolic blood pressure	0.736	0.000

Source: Primary Data, 2026

Based on Table 3, the results of the analysis using the Chi-Square test show a systolic p-value of 0.919 and a diastolic of 0.736 ($p > 0.05$), so it can be concluded that there is no significant relationship between sodium intake and systolic and diastolic blood pressure in adolescents at SMA Turikale District, Maros Regency. These results are supported by the Spearman test which shows a systolic p-value of 0.917 with a correlation coefficient (r) = 0.011 and a diastolic p-value of 0.997 with a correlation coefficient (r) = 0.000. The very weak correlation coefficient value and close to zero indicates that sodium intake does not have a significant effect on the respondents' blood pressure. Thus, respondents who have sufficient sodium intake do not necessarily experience increased blood pressure, likewise respondents with insufficient sodium intake do not necessarily have normal blood pressure. Excessive sodium consumption can increase blood pressure by increasing extracellular fluid volume. Sodium has osmotic properties that cause water retention in the body, thereby increasing plasma volume and cardiac output. This increase in blood volume will increase pressure on the artery walls so that blood pressure increases.¹⁶ In addition, high sodium consumption can also activate the renin-angiotensin-aldosterone system (RAAS), increase sympathetic nervous system activity, and cause endothelial dysfunction and

blood vessel stiffness, which contribute to increased blood pressure.¹⁷ Because blood pressure is influenced not only by sodium intake but also by other factors such as physical activity, nutritional status, sleep patterns, stress, and genetics, this suggests that sodium intake is not always directly related to hypertension.

The lack of a relationship between sodium intake and blood pressure in this study may be influenced by other unmeasured factors, such as stress levels and potassium intake. Stress can increase sympathetic nervous system activity, thereby increasing heart rate, blood vessel vasoconstriction, and blood pressure. Furthermore, adequate potassium intake is known to play a role in aiding sodium excretion through the kidneys, maintaining fluid balance, and lowering blood pressure. Therefore, variations in stress levels and potassium intake among respondents may influence blood pressure, thus preventing a significant relationship between sodium intake and blood pressure in this study.¹⁸

This research aligns with the findings of Ratih Kurniasari Eka Andriani (2018), which found no significant association between sodium intake from street food and blood pressure in adolescents. Furthermore, research by Elfira Duwi Setyaningsih and Ratna Mutu Manikam (2021) found no association between fast food consumption and sodium intake and blood pressure in adolescents.

Table 5. The Relationship Between Nutritional Status and Systolic and Diastolic Blood Pressure in Adolescents at Senior High Schools in Turikale District, Maros Regency

Status Gizi	Systolic Blood Pressure		Diastolic Blood Pressure	
	n	%	n	%
Malnutrition	15	17,4	15	17,4
Good Nutrition	71	82,6	71	82,6
Total	86	100	86	100

Source: Primary Data, 2026

Table 6. Correlation between Nutritional Status and Blood Pressure

Variable Relationship	Correlation Coefficient (r)	p-value
Nutritional status and systolic blood pressure	0.324	0.002
Nutritional status and diastolic blood pressure	0.136	0.211

Source: Primary Data, 2026

Based on Table 4, the results of the Chi-Square test indicate that there is no significant relationship between nutritional status and systolic or diastolic blood pressure in high school students in Turikale District, Maros Regency ($p=0.151$ and $p=1.000$; $p>0.05$). However, the results of the Spearman correlation test indicate a significant relationship between nutritional status and systolic blood pressure ($p=0.002$; $r=0.324$), indicating a weak positive correlation. Meanwhile, no significant relationship was found between nutritional status and diastolic blood pressure ($p=0.211$; $r=0.136$). The results indicated that the majority of respondents maintained a favorable nutritional status across both normal and elevated blood pressure categories. This suggests that adolescent blood pressure is regulated not solely by nutritional status, but by a multifactorial interplay of physical activity, dietary habits, psychological stress, familial predisposition, and sleep quality. Several studies in adolescents have shown that nutritional status has a stronger relationship with systolic blood pressure than diastolic blood pressure. This is because systolic blood pressure is more sensitive to changes in blood volume and vascular resistance due to increased body mass index. Meanwhile, the relationship between nutritional status and diastolic blood pressure tends to be weaker or inconsistent in some studies.

The results of this study indicate a relationship between nutritional status and systolic blood pressure in adolescents, but no relationship with diastolic blood pressure. This is in line with Novianingsih's (2021) study, which stated that body mass index was significantly associated with systolic blood pressure, while the relationship with diastolic blood pressure was not significant. This condition is thought to be because systolic blood pressure is more sensitive to increased blood volume due to weight gain, while diastolic blood pressure is more influenced by blood vessel elasticity. This study is in line with research conducted by Rifka Annisa Aura Nuradina (2023). This study found a significant relationship between nutritional status and consumption of high-sodium foods with the incidence of hypertension in adolescents in the urban community of Neroktog, Tangerang City, Banten Province, Indonesia. And previous research by Romadhiyana Kisno Saputri (2021) which showed a relationship between nutritional status and the incidence of hypertension in adolescents.

CONCLUSION

No statistically significant relationship was found between sodium intake and blood pressure in high school adolescents in Turikale District, Maros Regency. A statistically significant relationship was found between nutritional status and systolic blood pressure, but no statistically significant relationship was found between nutritional status and diastolic blood pressure. School-based nutrition education that emphasizes healthy eating patterns and maintaining ideal body weight can contribute to efforts to prevent hypertension in adolescents. It is recommended for future researchers to examine other factors that can influence blood pressure in adolescents, such as physical activity, stress, and sleep patterns. In addition, it is recommended to use a larger sample size, more accurate measurement methods, and a wider research area to obtain more representative results.

AUTHOR'S CONTRIBUTION STATEMENT

The contributions of each author are as follows: SB conceptualized the research, collected data, analyzed the data, and wrote the manuscript. ARMB supervised the research, provided input on the research methods, and reviewed the manuscript. KY provided input on the discussion of the research results and reviewed the manuscript. S assisted in data analysis, manuscript editing, and final review of the manuscript. All authors have read and approved the final version of the manuscript.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest related to the research, authorship, or publication of this article.

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REFERENCES

1. Anggita Trianaputri, R., & Rantung, J. (2025). Factors influencing the risk of hypertension among students of the Faculty of Nursing at Universitas Advent Indonesia. *Jurnal Impresi Indonesia*, 4(4), 1199–1208. <https://doi.org/10.58344/jii.v4i4.6435>
2. World Health Organization. (2023). Guideline for sodium intake reduction to prevent hypertension and cardiovascular disease. World Health Organization.
3. Ministry of Health of the Republic of Indonesia. (2024). Thematic report of the 2023 Indonesian Health Survey (SKI): A portrait of Indonesia's health. Health Development Policy Agency.
4. Maros District Health Office. (2025). Blood pressure cases by sub-district in Maros District in 2025 (Unpublished data). Maros District Health Office.
5. Ministry of Health of the Republic of Indonesia. (2019). Basic Health Research (Riskesdas) 2018: National Report. Ministry of Health of the Republic of Indonesia.
6. Grillo A, Salvi L, Coruzzi P, Salvi P, Parati G. Sodium Intake and Hypertension. *Nutrients*. 2019;11(9):1970.
7. Hall JE, do Carmo JM, da Silva AA, Wang Z, Hall ME. Obesity, kidney dysfunction and hypertension: mechanistic links. *Nature Reviews Nephrology*. 2019;15(6):367–385.
8. Nurkhofifah, S. W., & Putriningtyas, N. D. (2023). Nutritional status, fast-food consumption, and stress levels associated with hypertension among adolescents. *Indonesian Journal of Public Health and Nutrition*, 3(3), 402–407. <https://doi.org/10.15294/ijphn.v3i3.62711>
9. Sabillah, V., & Aidha. (2023). Factors influencing the risk of hypertension among students of the Faculty of Nursing at Indonesian Adventist University. *Journal of Indonesian Impressions*.
10. Popkin, B. M. (2006). Global nutrition dynamics: The world is shifting rapidly toward a diet linked to noncommunicable diseases. *American Journal of Clinical Nutrition*, 84(2), 289–298.
11. World Health Organization. (2023). Guideline for the pharmacological treatment of hypertension in adults. Geneva: World Health Organization.
12. Nuradina, R. A. A., Lestari, W. A., & Arumsari, I. (2023). Overweight and high sodium intake increased risk of hypertension among adolescents: A case-control study in urban settings. *Amerta Nutrition*, 7(2), 274–278. <https://doi.org/10.20473/amnt.v7i2.2023.274-278>

13. Widyaningsih, A. (2021). The relationship between body mass index and blood pressure among adolescents at SMK NU Ungaran. *Indonesian Journal of Midwifery*, 4(1).
14. Sudikno, S., Mubasyiroh, R., Rachmalina, R., Arfines, P. P., & Puspita, T. (2023). Prevalence and associated factors for prehypertension and hypertension among Indonesian adolescents: A cross-sectional community survey. *BMJ Open*, 13(3), e065056. <https://doi.org/10.1136/bmjopen-2022-065056>
15. Ministry of Health of the Republic of Indonesia. (2024). Circular letter on World Heart Day 2024. Ministry of Health of the Republic of Indonesia.
16. Hall, J. E., Hall, M. E., and do Carmo, J. A. M. (2022). Mechanisms of obesity-induced hypertension. *Circulation Research*, 130(11), 1748–1766. <https://doi.org/10.1161/CIRCRESAHA.121.319308>
17. World Health Organization. (2023). Guideline for the pharmacological treatment of hypertension in adults. Geneva: World Health Organization.
18. Aburto, N. J., Hanson, S., Gutierrez, H., Hooper, L., Elliott, P., & Cappuccio, F. P. (2013). Effect of increased potassium intake on cardiovascular risk factors and disease: systematic review and meta-analyses. *BMJ*, 346, f1378
19. Bandung City Health Office. (2023). Number of patients with hypertension, diabetes mellitus, and mental disorders in Bandung City. Bandung City Health Office.
20. Ministry of Health of the Republic of Indonesia. (2019). Recommended dietary allowances for the Indonesian population. Ministry of Health of the Republic of Indonesia.