

The Relationship Between Sodium Intake, Stress Levels, and Blood Pressure Among Production Employees at PT Eurochair Internusa

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Abstract

Hypertension is one of the most prevalent non-communicable diseases and remains a major public health concern among productive-age populations. Sodium intake and psychological stress are considered important modifiable factors associated with blood pressure changes. This study aimed to analyze the relationship between sodium intake and stress level with blood pressure among production employees at PT Eurochair Internusa. An analytical observational study with a cross-sectional design was conducted involving 74 production employees selected through purposive sampling. Sodium intake was assessed using a Semi Quantitative Food Frequency Questionnaire (SQ-FFQ), stress level was measured using the Depression Anxiety Stress Scale (DASS-21), and blood pressure was measured using an Omron JPN600 digital sphygmomanometer. Data were analyzed using the Spearman Rank correlation test with a significance level of $p < 0.05$. The results showed a significant positive relationship between sodium intake and systolic blood pressure ($p = 0.003$; $r = 0.344$), while no significant relationship was found between sodium intake and diastolic blood pressure ($p = 0.379$). Stress level was not significantly associated with systolic blood pressure ($p = 0.336$), but showed a significant positive relationship with diastolic blood pressure ($p < 0.001$; $r = 0.407$). The novelty of this study lies in examining the combined influence of sodium intake and stress level on blood pressure among manufacturing production employees, a population that has received limited attention in previous studies. These findings suggest that controlling sodium consumption and implementing workplace stress management programs may contribute to maintaining normal blood pressure and preventing hypertension among employees.

Keywords: blood pressure; hypertension; sodium intake; stress level; production employees



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INTRODUCTION

Blood pressure is the pressure exerted by blood flow against the walls of the arteries as a result of the heart's pumping action (Basruddin et al., 2021). According to the American Heart Association (AHA) guidelines, blood pressure is considered normal if the systolic pressure is below 120 mmHg and the diastolic pressure is below 80 mmHg (Whelton et al., 2017). Meanwhile, according to the Ministry of Health of the Republic of Indonesia (2021) and the European Society of Hypertension (ESH), normal blood pressure in the working-age group (18–64 years) falls within the range of 120–129 mmHg for systolic pressure and 80–84 mmHg for diastolic pressure (Kemenkes, 2021; Whelton et al., 2022). If blood pressure exceeds this range, the condition may be classified as high blood pressure (hypertension).

Hypertension, or high blood pressure, is a global health issue that has become a major concern among the public. This condition is known as a “silent killer” because it often does not present specific symptoms but can lead to serious complications such as heart disease, stroke, and kidney damage (Ayu Muthia et al., 2024). Globally, hypertension is one of the leading causes of premature death. According to data from the World Health Organization (WHO), in 2024, an estimated 1.4 billion adults aged 30 to 79 worldwide had hypertension; approximately 46% were unaware they had the condition; and about 21% or 1 in 5 adults with hypertension were able to effectively control their blood pressure (WHO, 2025).

According to data from the WHO, approximately 33% of adults worldwide have hypertension (WHO, 2025). Meanwhile, results from the 2023 Indonesian Health Survey (SKI) show that 34.1% of Indonesia's population has hypertension or high blood pressure. This indicates that the prevalence of hypertension in Indonesia is relatively high and slightly higher than the global average. This percentage ranks Indonesia fifth globally among countries with the highest number of people with hypertension. East Java Province has the highest prevalence of hypertension on the island of Java at 32.8%, followed by Central Java (31.3%) and West Java (32.6%). The majority of employees in the production department at PT. At Eurochair Internusa, 82% are male, and 18% are female. According to SKI 2023 data, the prevalence of hypertension is high among the productive age group (25–44 years), at 44.6%, and among pre-elderly individuals who are still actively working (45–54 years), at 39.1%. Meanwhile, the prevalence of hypertension is also higher among women (34.7%) than among men (26.9%) (SKI, 2023).

The productive age is the period of life when individuals experience higher levels of activity and are responsible for coping with more complex social, economic, and work-related demands (Hardin & Manao, 2024). The high demands and work-related stress during this phase can increase the risk of work-related stress, which can lead to health problems if not accompanied by a healthy lifestyle (Marlita et al., 2022). Low adoption of healthy lifestyle behaviors, such as insufficient physical activity, low consumption of fruits and vegetables, smoking, alcohol consumption, and poor dietary habits, including frequent consumption of high-sodium fast food, are the primary contributing factors to hypertension among working-age individuals (Rahmi et al., 2024). According to SKI data, 30.13% of individuals aged ≥ 15 years with risky dietary behaviors were found to prefer high-sodium foods, consuming more than 2,000 mg of sodium per day, equivalent to >5 grams of salt more than once a day. In addition, 75.08% of adults aged 15 years and older were found to frequently consume flavor enhancers more than once a day (SKI, 2023).

Elevated blood pressure among workers of working age not only affects their health but can also reduce work productivity, increase the risk of errors and workplace accidents, and

trigger work-related stress. Production workers are one of the groups most at risk of developing hypertension due to physical and psychological workloads, as well as unhealthy lifestyles, such as strenuous activities, long working hours, strict targets, pressure from supervisors, and monotonous work that demands high concentration. These conditions can trigger stress, raise blood pressure, and affect attendance and punctuality at work (Hartono et al., 2023).

The association between excessive sodium intake and the incidence of hypertension tends to be higher among those of working age. This is supported by previous research indicating that 76.7% of respondents in the working age population consume excessive amounts of sodium (Agustina, Anggi Putri et al., 2025). This habit is considered risky because, according to the WHO, sodium intake exceeding recommended limits has been proven to raise blood pressure. Excessive sodium intake can significantly increase the risk of high blood pressure and is associated with the onset of hypertension and cardiovascular complications (Juliana et al., 2024).

Excessive sodium intake is associated with increased blood pressure due to fluid retention, which increases blood volume and arterial blood pressure. Furthermore, excess sodium can activate the sympathetic nervous system and the renin-angiotensin-aldosterone system (RAAS), and even accumulate in tissues, particularly the skin, thereby impairing blood pressure regulation and vascular function (Grillo et al., 2019). A previous study demonstrated a significant association between sodium intake and systolic blood pressure (Juliansie et al., 2025). These findings are consistent with the study by Melianus Duly et al. (2018), whose bivariate analysis results indicated a significant association between a high-sodium diet and the incidence of hypertension, with an OR of 2.399 (Duly, 2018).

In addition to dietary factors, stress levels can also potentially increase the risk of hypertension. Stress is a form of psychological pressure that arises from the high demands of life and work. As stress increases, so does the risk of hypertension (Indriyani & Kamil, 2022). Several factors can influence a person's blood pressure through stress, such as an excessively heavy workload, workplace pressures, cultural differences, social conditions, and emotional stress (Basruddin et al., 2021). Individuals of working age with an average workweek of 40–50 hours may experience stress that leads to elevated blood pressure (Jingga & Indarjo, 2022). This stress can stimulate the sympathetic nervous system, causing it to release stress hormones such as adrenaline and cortisol, which lead to blood vessel constriction (vasoconstriction) and an increased heart rate, both of which can cause blood pressure to rise (Hidayati et al., 2022). Workers with hypertension tend to experience reduced productivity and an increased risk of workplace accidents (Safitri & Gilang, 2020). Based on the results of a study by Cut Saura Salmira (2020), the higher the level of stress experienced, the more diastolic blood pressure tends to increase (Salmira, 2020). These findings are consistent with a study by Rusnoto (2018) on factory workers in the Kaliwungu Community Health Center's service area, which found that 44.1% experienced stress and 70.96% had hypertension (Hermawan et al., 2018). Additionally, a study by Halawa et al., (2023) also revealed that individuals experiencing high stress levels are more likely to develop hypertension compared to those with lower stress levels.

Various studies have shown a significant association between high sodium intake, work-related stress, and elevated blood pressure among the working population. A study by Nabila Nurul Fitriyani (2025) demonstrated a significant association between sodium intake, work-related stress, and hypertension among online motorcycle taxi drivers; 64.5% of respondents had high sodium intake, and 92.5% of that group had hypertension. Furthermore, 62.9% of them experienced high work-related stress, and 87.2% of that group were diagnosed with

hypertension. This indicates a very strong correlation between these two factors and elevated blood pressure (Fitriyani et al., 2025). These results are consistent with a study conducted by Duly (2018), which showed a significant association between work-related stress and the incidence of hypertension among men employed in government agencies in Bantul Regency. In a study by Astuti (2025), it was also found that these two factors are significantly associated with increased blood pressure among production department employees at PT. X in South Jakarta.

PT Eurochair Internusa is a manufacturing company that produces and exports furniture made from natural materials such as wood and rattan. The company has approximately 220 employees, 90% of whom work in production, while the remainder hold administrative and other support positions. Given this distribution, production department employees were selected as the study subjects because they constitute the dominant group in the company and have a relatively higher physical workload and level of job stress than employees in other departments. Field observations revealed that the company does not provide meals for its employees. Consequently, employees tend to buy food outside the workplace, often high in sodium, such as chicken noodle soup, meatballs, and similar items. It is highly unlikely that employees would refrain from purchasing and consuming such foods. Aside from dietary factors, one risk in the work environment is job stress.

Interview results indicate that employees in the production department work 7–8 hours per day, Monday through Friday. The target is to achieve 20% of the total container capacity of 350 units (100%) in a single day, with a work system that involves close collaboration among workers. Working under pressure can trigger work-related stress, which can ultimately reduce productivity levels and cause physical and mental fatigue among workers (Saputri et al., 2024). Preliminary research findings in the production department involving 22 respondents, comprising 18 male employees and 4 female employees, revealed that 15 individuals (68.18%) had high blood pressure. Furthermore, field interviews revealed that 9 individuals (40.91%) had a family history of hypertension, while the remaining 13 (59.01%) either had no such history or were unaware of it.

The conditions experienced by production employees at PT Eurochair Internusa may increase the risk of elevated blood pressure due to factors such as excessive sodium intake and psychological stress. Research on the relationship between sodium intake, stress levels, and blood pressure among employees remains limited. Understanding this relationship is important for developing health promotion programs and hypertension prevention efforts in the workplace. Therefore, this study aims to analyze the relationship between sodium intake and stress levels, as well as systolic and diastolic blood pressure, among production employees at PT Eurochair Internusa. The results of this study are expected to provide a deeper understanding of hypertension and serve as an initial intervention to support healthier lifestyle changes, prevent disease, and enable earlier detection of the condition.

RESEARCH METHOD

Research Design

This study employed an analytical observational design with a cross-sectional approach. The study aimed to analyze the relationship between sodium intake, stress levels, and blood pressure among production employees at PT Eurochair Internusa. Data on sodium intake, stress levels, and blood pressure were collected simultaneously at a single time point.

Time and Place of Research

The study was conducted at PT Eurochair Internusa. Data collection was carried out from January to February 2026. The research location was selected because the company employs a large number of production workers who may be exposed to occupational stress and dietary factors that could influence blood pressure.

Research Target

The target population for this study comprised all production employees at PT Eurochair Internusa. The study sample comprised 74 production employees who met the inclusion and exclusion criteria established by the researcher. Respondents were selected using a purposive sampling technique.

The inclusion criteria were production employees aged > 18 years who were willing to participate in the study and actively working during the data collection period. Employees who were absent during data collection or had incomplete data were excluded from the study.

The sample size was determined based on the minimum sample requirement for analytical observational studies and adjusted to the number of eligible employees available during the research period. The purposive sampling technique was used to ensure that the selected respondents met the research objectives and represented the characteristics of the target population.

Research Procedure

This study employed an analytical observational design with a cross-sectional approach. The research was conducted among production employees at PT Eurochair Internusa. Prior to data collection, ethical approval was obtained from the Health Research Ethics Committee of Universitas Negeri Surabaya (No. 009/UN38.16/KEP/EC/2026), and permission to conduct the study was obtained from PT Eurochair Internusa.

Respondents were selected using purposive sampling based on the established inclusion and exclusion criteria. Eligible respondents were informed about the study's objectives and procedures and asked to sign an informed consent form before participating.

Data collection was carried out through interviews and direct measurements. Respondent characteristics were obtained using a structured questionnaire. Sodium intake data were collected using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), while stress levels were assessed using the Depression Anxiety Stress Scale (DASS-21). Blood pressure measurements were performed using an Omron JPN600 digital sphygmomanometer according to standard measurement procedures.

After data collection, all data underwent editing, coding, data entry, and cleaning processes. The collected data were then analyzed using univariate and bivariate statistical analyses. The relationship between sodium intake, stress level, and blood pressure was examined using the Spearman Rank correlation test with a significance level of $p < 0.05$.

Instruments and Data Collection Techniques

The study used primary data collected directly from respondents. Data collected included respondent characteristics, sodium intake, stress level, and blood pressure. Respondent characteristics, such as age, sex, educational level, and length of employment, were obtained through interviews administered using a structured questionnaire.

Sodium intake data were collected using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) to assess the frequency and amount of sodium-containing foods consumed by respondents. Stress levels were measured using the Depression Anxiety Stress Scale (DASS-21)

questionnaire. Blood pressure measurements were performed directly with an Omron JPN600 digital sphygmomanometer, following standard procedures.

The data collection procedure consisted of several stages: (1) obtaining research permission from PT Eurochair Internusa and ethical approval from the Health Research Ethics Committee of Universitas Negeri Surabaya; (2) recruiting respondents who met the inclusion criteria; (3) providing information regarding the study and obtaining informed consent from respondents; (4) conducting interviews using questionnaires to collect respondent characteristics, sodium intake, and stress level data; and (5) measuring systolic and diastolic blood pressure. All collected data were checked, coded, entered, and statistically analyzed using the Spearman Rank correlation test at a significance level of $p < 0.05$.

Statistical Methods

The data were analyzed using IBM SPSS Statistics 27 software. Univariate analysis was conducted to describe the distributions of respondent characteristics, sodium intake levels, stress levels, and blood pressure, with results presented as frequencies and percentages. Bivariate analysis used Spearman's rank correlation test to assess the relationships between sodium intake and blood pressure, and between stress levels and blood pressure, among production department employees at PT Eurochair Internusa. The analysis was conducted with a significance level of 5% ($\alpha = 0.05$). The strength of the correlation was interpreted based on the correlation coefficient (r).

RESULTS

Respondent Characteristics

The characteristics of the respondents examined in this study include age, gender, highest level of education, frequency of physical activity, medical history, and smoking history. Information regarding these characteristics was obtained through questionnaires and interviews. An overview of the respondents' characteristics is presented in the following table:

Table 1. Respondent Characteristics

Respondent Characteristics		n(%)	Mean $\pm$ SD	Min-Max
Age	19 – 29	25 (33,8)	38,5	19 - 64
	30 – 49	44 (59,5)		
	50 – 64	9 (6,8)		
	Total	74 (100)		
Gender	Female	28 (37,8)		
	Male	46 (62,2)		
	Total	74 (100)		
Highest Level of Education	High School/Vocational School	66 (89,2)		
	Bachelor's Degree/Diploma	8 (10,8)		
	Total	74 (100)		
Frequency of Physical Activity	Exercise <3 times per week	59 (79,7)		
	Exercise >3 times per week	15 (20,3)		
	Total	74 (100)		
Medical History	Yes	9 (12,2)		
	None	65 (87,8)		
	Total	74 (100)		
Smoking	Yes	41 (55,4)		
	No	33 (44,6)		
	Total	74 (100)		

Correlation Test of the Relationship Between Sodium Intake and Blood Pressure

The relationship between sodium intake and blood pressure was tested using Spearman's rank correlation test. The statistical results for the relationship between sodium intake and blood pressure in the following table:

Table 2. Correlation Test of the Relationship Between Sodium Intake and Blood Pressure

Sodium Intake Level	Blood Pressure								P-value		OR	
	Normal		Pre-hypertension		Hypertension 1		Hypertension 2		Systolic	Diastolic	Systolic	Diastolic
	n	%	n	%	n	%	n	%				
Moderate	0	0	3	4,1	0	0	0	0	0,003	0,379	0,344	0,104
High	3	4,1	43	58,1	12	16,2	13	17,6				
Total	3	4,1	46	62,2	12	16,2	13	17,6				

Table 2 shows that among respondents with adequate sodium intake. The results of the Spearman rank correlation test indicate a significant association between sodium intake levels and systolic blood pressure among production department employees at PT Eurochair Internusa ($p = 0.003$; $p < 0.05$). The correlation coefficient ($r = 0.344$) indicates a positive relationship with a low correlation strength. This suggests that as sodium intake increases, systolic blood pressure tends to rise, although the relationship is not very strong. Regarding diastolic blood pressure, no significant relationship was found ($p = 0.379$; $p > 0.05$), and the correlation coefficient (r) of 0.104 indicates a very weak relationship; thus, it can be concluded that sodium intake is not significantly associated with diastolic blood pressure among the respondents.

Correlation Test of the Relationship Between Stress Levels and Blood Pressure

The relationship between stress levels and blood pressure was tested using Spearman's rank correlation test. The statistical results for the relationship between stress levels and blood pressure are presented in the following table:

Table 3. Correlation Test of the Relationship Between Stress Levels and Blood Pressure

Stress Level	Blood Pressure								P-value		OR	
	Normal		Pre-hypertension		Hypertension 1		Hypertension 2		Systolic	Diastolic	Systolic	Diastolic
	n	%	n	%	n	%	n	%				
Normal	2	2,7	15	20,3	4	5,4	5	6,8	0,336	<,001	0,113	0,407
Mild Stress	1	1,4	12	16,2	2	2,7	1	1,4				
Moderate Stress	0	0	7	9,5	2	2,7	5	6,8				
Severe Stress	0	0	6	8,1	1	1,4	1	1,4				
Extreme Stress	0	0	6	8,1	1	1,4	1	1,4				
Total	3	4,1	46	62,2	12	16,2	13	17,6				

Table 3 shows that among respondents with normal stress levels. The results of the Spearman rank correlation test showed no significant relationship between stress levels and systolic blood pressure among production department employees at PT Eurochair Internusa ($p = 0.336$; $p > 0.05$), with a correlation coefficient ($r = 0.113$) indicating a very weak relationship. For diastolic blood pressure, a p-value of < 0.001 ($p < 0.05$) was obtained, indicating a significant relationship between stress levels and diastolic blood pressure. The correlation

coefficient ($r = 0.407$) indicates a moderate, positive relationship. This suggests that as stress levels increase, diastolic blood pressure also rises. It can be concluded that stress levels are not significantly associated with systolic blood pressure but are significantly associated with diastolic blood pressure among production department employees at PT Eurochair Internusa.

DISCUSSION

The results of the Spearman's rank correlation analysis showed a significant relationship between sodium intake and systolic blood pressure among production department employees at PT Eurochair Internusa. The relationship was positive, with a low correlation, indicating that higher sodium intake was associated with higher respondents' systolic blood pressure. However, this study did not find a significant relationship between sodium intake levels and diastolic blood pressure. Excessive sodium intake can increase blood volume and the heart's workload, thereby contributing to elevated blood pressure. Additionally, high sodium intake can disrupt blood vessel function and the regulation of the renin-angiotensin-aldosterone system (RAAS), which plays a role in blood pressure regulation (Sry, 2025). These findings are consistent with a study by Jingga & Indarjo (2022) which showed that individuals with high salt intake have a 2.470 times greater risk of hypertension compared to those with sodium intake within recommended levels.

The results of the study show that respondents with lower sodium intake tend to have more normal blood pressure. These findings are consistent with several studies indicating that high sodium consumption is associated with an increased risk of hypertension and cardiovascular disease (Juliana et al., 2024; Jumara et al., 2025; Ramdasari Aksan et al., 2020). Furthermore, the respondents' average potassium intake remained below the recommended adequate intake level. Low potassium intake can exacerbate sodium's effect on blood pressure elevation because potassium plays a role in facilitating sodium excretion, maintaining fluid balance, and supporting vasodilation (Sadikin et al., 2025). Adequate potassium intake combined with sodium restriction plays a crucial role in lowering blood pressure and reducing the risk of hypertension (Hadi, 2025).

Regarding stress levels, the research results indicate that they are not significantly related to systolic blood pressure among production department employees at PT Eurochair Internusa. These findings suggest that respondents with higher stress levels do not necessarily have higher systolic blood pressure than those with lower stress levels. These results are consistent with the study by Frisca, Santoso et al. (2023), which states that systolic blood pressure does not always increase as a person's stress levels rise. This suggests that changes in systolic blood pressure are complex and can be influenced by factors beyond psychological ones (Frisca, Santoso et al., 2023). An unhealthy diet, low physical activity, smoking, poor nutritional status, and low consumption of fruits and vegetables are among the factors that can contribute to elevated blood pressure in individuals (Istiqomah & Musniati, 2025).

Regarding stress levels, the study results show that stress is not significantly associated with systolic blood pressure but is significantly associated with diastolic blood pressure. These findings indicate that as respondents' stress levels increase, diastolic blood pressure tends to rise as well. Stress can activate the sympathetic nervous system, which triggers the release of the hormone adrenaline, leading to vasoconstriction and increased peripheral vascular resistance—both of which contribute to elevated diastolic blood pressure (Devora et al., 2025). These results are supported by a study by Simalango (2021), which reports that increases in

diastolic blood pressure occur more frequently in younger adults because their blood vessel elasticity is still relatively high. Each individual responds differently to stress. These differences are influenced by their ability to manage stress, social support, and work experience (Wahyuni et al., 2023).

The absence of a significant association between stress levels and systolic blood pressure in this study may be influenced by the respondents' ability to manage stress and the presence of adequate social support in the workplace. Individuals with effective coping strategies tend to handle work-related pressures more effectively, thereby reducing their perceived stress levels. Social support from the surrounding environment, particularly coworkers, also helps workers cope with various job demands and reduce stress levels (Rizqi & Nurfi, 2024). These findings are consistent with Permatasari (2025) results showing that social support from coworkers influences the reduction of work-related stress. In addition to psychological factors, blood pressure is also influenced by various other factors, such as physical activity, diet, salt intake, sleep quality, and an individual's health status (Darmawan et al., 2025). Various stress management methods, such as exercise, meditation, relaxation techniques, and adequate sleep, are known to help reduce stress while keeping blood pressure within normal limits (Putri & Sosialita, 2025). Furthermore, the lack of a significant effect on this variable may be due to other factors not examined in this study, such as sleep quality, physical condition, mental or emotional state, or the work environment.

CONCLUSION

The findings of this study indicate that both dietary sodium intake and psychological stress are distinct, measurable determinants of blood pressure regulation among industrial workers. Specifically, elevated sodium consumption is positively associated with systolic blood pressure, whereas increased stress levels are positively associated with diastolic blood pressure.

These results underscore the necessity of addressing both nutritional and psychosocial factors as critical components of workplace health promotion programs. Implementing targeted interventions, such as dietary sodium reduction strategies and stress management initiatives, may serve as effective preventive measures to mitigate the risk of hypertension in this occupational demographic. To further elucidate the complex etiology of hypertension in workforce populations, future research should adopt longitudinal designs and incorporate a broader array of confounding variables, including physical activity, sleep hygiene, lifestyle factors, and genetic predisposition.

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AUTHOR CONTRIBUTIONS

The author contributed to the preparation of this manuscript and is responsible for its content. Specifically designed and conducted the research, collected and analyzed the data, interpreted the results, and prepared the draft manuscript.

CONFLICTS OF INTEREST

The author declares that there are no conflicts of interest regarding the publication of this article. This study received no external funding, and no sponsors were involved in the study design, data collection, data analysis, interpretation of findings, manuscript preparation, or the decision to publish the results.

DECLARATION OF ARTIFICIAL INTELLIGENCE USE

This study utilizes artificial intelligence (AI) tools solely to support the manuscript drafting process. AI tools were employed to assist with language refinement, including improvements in grammar, sentence structure, readability, paraphrasing, and technical writing. All AI-generated outputs were critically reviewed, edited, and validated by the authors. The authors take full responsibility for the accuracy, integrity, and originality of the manuscript. AI tools were not used for data collection, data analysis, interpretation of results, generation of scientific findings, or formulation of research conclusions

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