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Association of nutrition knowledge level, sugar, salt, and fat (SSF) intake with blood pressure: case of university students

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ABSTRAK

Latar Belakang: *Hipertensi tidak lagi menjadi kondisi yang hanya dialami oleh orang tua, tetapi semakin sering ditemukan pada individu usia produktif, termasuk mahasiswa. Salah satu faktor yang dapat memengaruhi tekanan darah adalah pola makan, khususnya asupan gula, garam, dan lemak (SSF), serta pengetahuan gizi seseorang.*
Tujuan: *Menentukan hubungan antara pengetahuan gizi, asupan SSF, dan tekanan darah mahasiswa di Universitas Sriwijaya.*
Metode: *Penelitian menggunakan desain cross-sectional dan melibatkan 120 mahasiswa aktif dari Fakultas Kesehatan Masyarakat dan Fakultas Pendidikan dan Pelatihan Guru Universitas Sriwijaya, yang dipilih melalui sampling purposif. Pengumpulan data meliputi kuesioner pengetahuan gizi, wawancara 2x24 jam pengingatan makanan, dan pengukuran tekanan darah menggunakan sphygmomanometer digital.*
Hasil: *Hasil univariat menunjukkan bahwa 47,5% responden berusia 20 tahun, 90,8% perempuan, 74,2% memiliki pengetahuan gizi yang baik, dan 94,2% memiliki tekanan darah normal. Rata-rata konsumsi gula, garam, dan lemak dari makanan dan minuman yang dikonsumsi di kantin kampus masing-masing sebesar 5,9 gram, 670,75 miligram, dan 21,9 gram. Analisis bivariat menggunakan uji Chi-Square pada tingkat kepercayaan 95% menunjukkan hubungan yang signifikan antara asupan garam (P = 0,036) dan asupan lemak (P = 0,004) dengan tekanan darah. Sebaliknya, tidak ada hubungan yang signifikan antara pengetahuan gizi (P = 0,373) atau asupan gula (P = 0,166) dengan tekanan darah.*
Kesimpulan: *Secara keseluruhan, tekanan darah pada mahasiswa Universitas Sriwijaya lebih dipengaruhi oleh asupan garam dan lemak daripada pengetahuan gizi atau asupan gula.*

KATA KUNCI*: garam; gula; lemak; tekanan darah*

ABSTRACT

Background: *Hypertension is no longer a condition that only affects older people, but is increasingly found in individuals of productive age, including students. One factor that can affect blood pressure is diet, particularly sugar, salt, and fat (SSF) intake, as well as an individual's nutritional knowledge.*

Objectives*: To analyze the relationship between breakfast habits and cognitive performance and academic achievement among adolescents in Bogor Regency.*

Methods: *This cross-sectional study involved 120 active students from the Faculty of Public Health and the Faculty of Teacher Education and Training at Sriwijaya University, who were selected through purposive sampling. Data collection included a nutritional knowledge questionnaire, a 2x24-hour dietary recall interview, and blood pressure measurement using a digital sphygmomanometer.*

Results: *Univariate results showed that 47.5% of respondents were 20 years old, 90.8% were female, 74.2% had good nutritional knowledge, and 94.2% had normal blood pressure. The average consumption of sugar, salt, and fat from food and beverages consumed in the campus cafeteria was 5.9 grams, 670.75 milligrams, and 21.9 grams, respectively. Bivariate analysis using the Chi-Square test at a 95% confidence level showed a significant relationship between salt intake (P = 0.036) and fat intake (P = 0.004) with blood pressure. Conversely, there was no significant relationship between nutritional knowledge or sugar intake and blood pressure.*

Conclusions: *Blood pressure among students at Sriwijaya University is significantly associated with salt and fat intake, while nutritional knowledge and sugar intake show no significant relationship.*

KEYWORDS*: blood pressure; fat; salt, sugar*

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INTRODUCTION

Lifestyle changes in the era of globalization have influenced many aspects of daily life, including dietary patterns, with an increasing tendency toward unhealthy food choices. Poor eating habits contribute substantially to the development of Non-Communicable Diseases (NCDs), which remain the leading causes of death worldwide. The World Health Organization (WHO, 2023) reported that NCDs account for approximately 41 million deaths annually, representing 74% of global mortality, with most deaths occurring in low- and middle-income countries (1). Hypertension is one of the most prevalent NCDs and a key modifiable risk factor for cardiovascular disease (2). Defined by the WHO as blood pressure ≥140/90 mmHg, hypertension affects more than one billion people globally and is increasingly observed among younger populations. Rising prevalence has been reported among young adults in several regions, including the United States and low- and middle-income countries, indicating that hypertension is no longer limited to older age groups (3,4). In Indonesia, this trend is also evident. The 2023 Indonesian Health Survey reported a hypertension prevalence of 9.3% among individuals aged 15–24 years (5). At the regional level, the burden of hypertension in South Sumatra has increased substantially, with reported cases rising from 987,295 in 2021 to 1,951,068 in 2023 (6). These findings highlight the growing public health concern of hypertension among individuals of productive age, including university students.

Dietary behavior plays a crucial role in the development of hypertension. Nutritional knowledge is considered an important determinant of dietary choices, as understanding nutrient content, portion size, consumption frequency, and healthy food preparation methods may encourage healthier eating behaviors (7). However, knowledge alone may not always translate into appropriate dietary practices, particularly when environmental factors influence food availability and preference.

Consumption of processed foods, sugar-sweetened beverages, and foods high in sugar, salt, and fat (SSF) has been consistently associated with increased blood pressure (8–11). A study by Ferencia, Rahayu, and Purwaningtyas (2023) reported higher blood pressure among

individuals with excessive SSF intake compared to those consuming within recommended limits (12). In South Sumatra, 43.7% of individuals aged ≥5 years reported consuming sweet foods more than once per day, exceeding the national average. Excessive sugar intake contributes to energy surplus and fat accumulation, increasing the risk of obesity, a major risk factor for hypertension (13).

High salt and fat consumption further exacerbate hypertension risk. Salt intake in South Sumatra reached 33.3% among individuals aged ≥3 years, higher than the national average (14). Excess sodium intake promotes fluid retention and increases blood pressure. In addition, the 2023 Indonesian Health Survey reported an increase in fat and oil consumption from 41.7% in 2018 to 50.4% in 2023 (14). Diets high in saturated fat elevate LDL cholesterol levels, promoting atherosclerosis and contributing to hypertension (15). University students, typically aged 18–25 years, represent a vulnerable population undergoing a transitional phase characterized by increased independence in food selection (16). Students often skip breakfast, follow irregular eating patterns, and consume energy-dense foods low in fiber, vitamins, and minerals (17). Food choices are frequently influenced by availability, affordability, and convenience rather than nutritional value (18). A study at Tadulako University found that commonly consumed foods included instant noodles, fried rice, siomay, and sugar-sweetened beverages (19).

At Sriwijaya University, campus canteens provide a wide range of staple foods, side dishes, fried snacks, and packaged foods and beverages. However, healthier food options are often limited and relatively more expensive, leading many students to prefer SSF-rich foods. Previous research at Sriwijaya University has shown a significant relationship between fat intake and nutritional status among students (20). Additionally, many students live in boarding houses without parental supervision, making their dietary intake strongly influenced by the campus food environment (21). Given the high prevalence of SSF consumption among university students and the increasing burden of hypertension in young adults, it is important to examine the relationship between nutritional knowledge, dietary intake, and blood pressure. Understanding these associations may provide evidence to support targeted campus-based nutrition and food environment interventions aimed at preventing hypertension at an early age.

MATERIALS AND METHODS

Type and Study Design

This research was an analytical quantitative study using a cross-sectional design, aiming to determine the relationship between nutrition knowledge, (SSF) intake, and blood pressure among students of Sriwijaya University. The data were collected at a single point in time.

Location and Time of Study

The study was conducted at Sriwijaya University, Indralaya Campus. The research start from October 2024 to May 2025.

Methods and Procedures

Samples were selected using purposive sampling, where participants were chosen based on specific characteristics considered to be strongly related to the predetermined population criteria. Inclusion criteria: Active students of the Faculty of Public Health and the Faculty of Teacher Training and Education at Sriwijaya University, purchased lunch at the Faculty of Public Health or Faculty of Teacher Training and Education canteen at least one a week,willing to participate as respondents. Exclusion criteria:were ill during the study, were on a diet, were absent during data collection, were taking antihypertensive medication.

The sample size was calculated using the formula for hypothesis testing of two proportions as described by Lemeshow (1991) with 80% power of test and 95% confidence Interval (22). A total of 117 samples was obtained and rounded up to 120. Sampling was carried out by submitting a research permit and ethical approval request to the academic authority of the Faculty of Public Health, Sriwijaya University. After receiving approval, the researcher selected respondents using purposive sampling based on the defined criteria. Direct approach was made to eligible participants, and those who agreed to participate signed an informed consent form voluntarily and completed a demographic questionnaire. Next,

the researcher verified whether the respondents were taking antihypertensive medication or following a specific diet. If the respondent answered "no," blood pressure measurements were conducted; if "yes," the respondent was excluded from the study.

Data collection included the administration of respondent's characteristic quesionnaire such as age, gender, entry year university,pocket money,parents occupation.Pocket money was classified using the average value as the cutoff. a nutrition knowledge questionnaire, there are 15 questions,good knowledge is total score ≥ 75 % and less knowledge if total score < 75 %. The quisionnaire are modified from prior study. Two non-consecutive 24-hour food recall interviews on week days, and direct blood pressure measurement using a TensiOne digital sphygmomanometer. The 2x24-hour food recall was conducted over two non-consecutive days to provide a more representative picture of dietary intake. Sugar intake classified adequate if it intake ≤ 20 gr/ day, excessive if intake > 20 g/day. Salt intake classified adequate if it intake ≤ 800 mg/day, excessive if intake > 800 mg/day. Fat intake classified adequate if it intake ≤ 26,8 g/day, excessive if intake > 26,8 g/day. Blood pressure was measured on the upper arm, positioned at heart level, with the respondent in a seated position and having refrained from physical activity for at least 30 minutes. Blood pressure was measured twice, with a 10-minute interval between measurements, to ensure accuracy. Blood pressure was measured twice, with a 10-minute interval between measurements, to ensure accuracy.Normal blood pressure is defined as systolic blood pressure <140 mmHg and diastolic blood pressure <90 mmHg.High blood pressure is defined as systolic blood pressure ≥140 mmHg and diastolic blood pressure ≥90 mmHg (23).

Data Analysis

The questionnaire used in the study had been tested for validity and reliability prior to data collection.The validity test was performed using the Bivariate Pearson correlation. The reliability of the instrument was tested using Cronbach's alpha, with acceptable values defined as greater than 0.7 and less than 0.9(24). Univariate analysis was used to describe the frequency and percentage distribution of variables such as age, gender, nutrition knowledge level, SSF intake, and blood pressure measurements. Bivariate analysis was performed using the Chi-Square test to determine the relationships between nutrition knowledge and SSF intake with blood pressure. The level of significance was set at $P < 0.05$. Data was analysis with statistic analysis software. Sugar,salt and fat consumption were calculated by nutrition analysis software.

Ethical Consideration

This study was approved by the Health Research Ethics Committee of the Faculty of Public Health, Sriwijaya University, with approval number 416/UN.FKM/TU.KKE/2024.

RESULTS AND DISCUSSIONS

Characteristics of Subjects

Respondent Characteristics can be seen on **Table 1**. The respondents in this study were predominantly aged 18–22 years, representing early adulthood, a developmental phase characterized by increasing independence in lifestyle and dietary decision-making (25). This transition is often associated with changes in eating behavior, including greater autonomy in food selection and reduced parental oversight (26). The sample was largely composed of female students, reflecting enrollment patterns in the Faculty of Public Health and the Faculty of Teacher Training and Education at Sriwijaya University. Although estrogen is known to have a protective effect against hypertension in premenopausal women (27).), lifestyle-related factors remain central determinants of blood pressure regulation in young adults of both sexes (28).

Economic factors appeared to influence dietary behaviors among respondents. Over one-third of students reported a relatively higher daily allowance, which was primarily used to purchase food and beverages on campus. Previous studies have shown that greater pocket money is associated with increased food purchasing frequency and a higher likelihood of consuming energy-dense foods (29). In addition, most respondents lived in boarding houses rather than with their parents, a living arrangement commonly linked to more frequent eating outside the home

and increased consumption of fast or convenience foods (30). These findings highlight the combined influence of financial autonomy and living environment on students' dietary patterns.

Table 1. Respondent characteristics

Respondent Characteristics	n	%
Respondent's Age		
17	1	0.80
18	8	6.70
19	41	34.20
20	57	47.50
21	12	10.00
22	1	0.80
Total	120	100.00
Gender		
Man	11	9.20
Woman	109	90.80
Total	120	100.00
Entry year		
2022	61	50.80
2023	52	43.30
2024	7	5.80
Total	120	100.00
Pocket money		
<Rp33.383/day	76	63.30
≥Rp33.383/day	44	36.70
Total	120	100.00
Frequency of Food and Drink Purchases at cantin		
<3 times per week	34	28.30
3 times per week	48	40.00
Every day	38	31.70
Total	120	100.00
Father's Occupation		
Not Working	7	5.80
Private Sector	11	9.20
Civil Servant/Military/Police	15	1.50
Self-Employed	34	28.30
Laborer	49	40.80
Retired	4	3.30
Total	120	100.00
Mother's Occupation		
Not Working	85	70.80
Private Sector	4	3.30
Civil Servant/Military/Police	19	15.80
Self-Employed	3	2.50
Laborer	8	6.70
Retired	1	0.80
Total	120	100.00

Nutrition Knowledge, SSF Intake,Blood Pressure

The description of respondents' nutritional knowledge in this study can be seen at **Table 2**. Most respondents demonstrated a good level of nutrition knowledge; however, gaps were evident, particularly regarding recommended daily limits for sugar and fat intake. Similar findings have been reported in studies among university students, where general nutrition awareness does not always extend to knowledge of quantitative dietary guidelines (31). Students from the Faculty of Public Health appeared to have better nutrition knowledge than those from the Faculty of Teacher Training and Education, likely due to differences in academic exposure.

As no statistical testing was conducted, these faculty-based differences should be interpreted descriptively rather than inferentially. Dietary assessment indicated frequent consumption of foods high in fat and sodium, largely obtained from campus canteens and surrounding food outlets. Fried foods, packaged snacks, and salty prepared foods are commonly consumed by university students due to their affordability and accessibility (32). The campus food environment has been widely recognized as a key determinant of dietary behavior, often promoting excessive intake of sugar, salt, and fat (33). Although differences in SSF intake between faculties were observed, these findings should be viewed cautiously in the absence of formal statistical comparison.

Table 2. Distribution of Nutrition Knowledge, SSF Intake and Blood Pressure

	n	%
Nutrition Knowledge		
Good	90	75.00
Less	30	25.00
Total	120	100.00
SSF Intake		
Sugar		
Adequate	117	97.50
Excessive	3	2.50
Salt		
Adequate	81	67.50
Excessive	39	32.50
Fat		
Adequate	82	70.80
Excessive	38	29.20
Total	120	100.00
Blood Pressure		
Normal	113	94.20
High	7	5.80
Total	120	100.00

Blood pressure measurements showed that most students had values within the normal range, which aligns with patterns commonly observed among young adults. Despite this, a small proportion of respondents already exhibited elevated blood pressure, indicating that hypertension risk may emerge earlier in life. The absence of parental supervision and increased consumption of convenience foods may contribute to this trend. Regular academic and extracurricular activities may partially explain the generally normal blood pressure levels, although these activities may not fully offset the effects of unhealthy dietary intake. Blood pressure measurements showed that most respondents had values within the normal range, which is consistent with previous findings among adolescents and young adults (34). Nevertheless, a small proportion of students already exhibited elevated blood pressure, indicating that hypertension risk may begin earlier in life. Early exposure to unhealthy dietary patterns may contribute to this trend, particularly in settings where convenience foods dominate (35). Regular academic and extracurricular activities may help maintain normal blood pressure levels, although

such activity may not fully offset the adverse effects of poor dietary intake (36).

Bivariate analysis revealed no significant association between nutrition knowledge and blood pressure. This finding supports previous research indicating that knowledge alone is insufficient to induce sustained behavioral change or improve cardiometabolic outcomes (37). Dietary behavior is influenced by multiple interacting factors, including food availability, social norms, personal preferences, and motivation (38). As a result, individuals may understand dietary recommendations but fail to implement them consistently in daily life

Table 3. Association between nutritional knowledge, sugar, salt, and fat intake with blood pressure

Variables	Blood Pressure		Total	*P-value*
	Normal n (%)	High n (%)		
Nutritional Knowledge				
Good	85 (95.50)	4 (4.50)	89 (100)	0.37
Low	28 (90.30)	3 (9.70)	31 (100)	
Sugar Intake				
Normal	111 (94.90)	6 (5.10)	117 (100)	0.17
Excess	2 (66.70)	1 (33.30)	3 (100)	
Salt Intake				
Normal	79 (97.50)	2 (2.50)	81 (100)	0.04
Excess	34 (87.20)	5 (12.80)	39 (100)	
Fat Intake				
Normal	81 (98.80)	1 (1.20)	82 (100)	0.00
Excess	32 (84.20)	6 (15.80)	38 (100)	

Sugar intake was also not significantly associated with blood pressure in this study. Individual metabolic differences, including genetic predisposition and insulin sensitivity, may moderate the physiological effects of sugar consumption on blood pressure regulation (39). In young adults with normal metabolic function, compensatory mechanisms may help maintain blood pressure homeostasis despite variations in sugar intake. In contrast, salt and fat intake showed significant associations with blood pressure. Excessive sodium intake increases extracellular fluid volume and vascular resistance, leading to elevated blood pressure (40). Similarly, high intake of saturated and trans fats contributes to dyslipidemia, endothelial dysfunction, and increased cardiovascular risk (41). These findings are consistent with extensive evidence identifying salt and fat consumption as critical dietary determinants of hypertension, even among young populations (42).

This cross-sectional study cannot establish causal relationships between nutritional knowledge, sugar, salt, and fat intake, and blood pressure. Dietary intake was assessed using food recall data limited to foods purchased at the campus canteen, which may not reflect total daily intake and is subject to recall bias. Sodium intake may also be underestimated because discretionary salt use was not measured. The sample was selected using purposive sampling and drawn from two faculties at a single university and was predominantly female, limiting generalizability. In addition, faculty-based differences were descriptive only, as no statistical comparisons were conducted. Potential confounders such as physical activity, stress, sleep patterns, and family history of hypertension were not fully assessed and should be addressed in future studies.

CONCLUSION AND RECOMMENDATION

Blood pressure of Universitas Sriwijaya students is more influenced by salt and fat intake than by nutritional knowledge or sugar intake. It is need for dietary control efforts through practical education and the provision of healthy food options within the campus environment.

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