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RELATIONSHIP BETWEEN STRESS LEVELS AND UPF CONSUMPTION ON BLOOD PRESSURE IN OBESE ADOLESCENTS

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ABSTRACT
Adolescent obesity is a growing global health problem, with the risk of developing hypertension due to activation of the sympathetic nervous system (SNS) and sodium regulation. Psychosocial stress and unhealthy diets, including consumption of Ultra-Processed Foods (UPF), contribute to increased blood pressure. UPF high in sodium, fat, and sugar are associated with hypertension, while stress can trigger emotional eating, increasing consumption of high-calorie foods. Adolescent diets tend to be low in fiber and high in UPF, supported by the school environment. This study aims to analyze the relationship between stress levels and UPF consumption on blood pressure in obese adolescents to understand the risk factors for hypertension in this group. This study used an analytical observational design with a cross-sectional approach. A sample of 75 students was selected by purposive sampling. Data were collected through interviews and measurements, then analyzed using SPSS version 29 statistically. The majority of respondents were 16 years old, male, with high UPF consumption. UPF consumption was significantly associated with diastolic blood pressure ($p=0.036$, $r=0.255$). Stress level was not significantly associated with blood pressure ($p>0.05$, $r=0.1–0.2$). Stress levels did not have a significant relationship with either systolic or diastolic blood pressure. UPF consumption was not significantly related to systolic blood pressure, but UPF consumption was significantly related to diastolic blood pressure.

Keywords: adolescent; hypertension; obesity; stress level; ultra-processed food

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INTRODUCTION

Obesity that occurs in adolescence and children is one of the health problems that must be considered. The increasing prevalence of obesity that occurs in various countries and regions in the world (Zhang et al., 2024). Data from the World Obesity Federation shows an increasing trend in obesity in children. It is estimated that children and adolescents aged 5-19 years who are obese in 2025 will be around 206 million and will increase to 254 million in 2030 (Hu & Staiano, 2022). Obesity is a risk factor for various health problems, one of which is cardiovascular disorders, namely hypertension (Jeong & Kim, 2024). The prevalence of hypertension in adolescents in Indonesia in 2013 was 10% and increased to 14% in 2018 (Basile & Bloch, 2023).

Obesity can affect blood pressure through various pathways. One component that plays an important role in the mechanism of hypertension in obesity is increased activity of the sympathetic nervous system (SNS) (Jeong & Kim, 2024). The central nervous system plays a role in regulating and controlling the activity of the sympathetic nervous system (SNS), which can play a role in increasing sodium absorption in the kidneys and the release of the hormone renin, which plays a role in regulating blood pressure. Increased SNS in obese individuals is

associated with increased leptin hormone, fat accumulation in the kidneys, and excessive RAAS activation. These factors can increase the risk of increased blood pressure to hypertension (Sumarni et al., 2024). Previous studies have shown that psychosocial stress factors and unhealthy diets are some of the factors that can cause hypertension. Stress can cause hypertension through increased SNS activity. Stressful conditions can also cause someone to tend to prefer consuming foods that are high in calories, fat, sodium, and sugar, this can cause individuals to have unhealthy diets, so they are at risk of obesity and hypertension (Lopes, H.F., 2019).

Indonesian teenagers generally have unhealthy eating patterns, this is indicated by low fruit and vegetable intake, as well as high consumption of foods and drinks that are high in sugar, fat and alcohol (Colozza & Padmita, 2022). Unhealthy diet also contributes to the risk of hypertension. Ultra-Processed Food (UPF) is closely related to increased risk of cardiovascular disease. UPF has a high sodium content, this can cause hypertension. Previous research showed that an increase in UPF intake of 100 grams in obese adolescents caused an increase in diastolic blood pressure of 0.28 mmHg (Cortes et al., 2023). Not only in adolescent and adult groups, UPF consumption can also play a role in increasing systolic and diastolic blood pressure in children's age groups, from 3 to 6 years ($P=0.05$ and $P<0.01$) (Valmorbida et al., 2023).

UPF is a food produced by industry consisting of sugar, oil, fat, and starch. UPF products do not contain whole food components and contain flavorings, colorings, emulsifiers, and various other additives that aim to add a good taste to the product (Cortes et al., 2023). UPF products were initially consumed as snacks, but over time UPF products are currently consumed as primary needs and can even replace primary foods. Changes in UPF consumption patterns can lead to inappropriate eating behavior, such as frequent consumption of junk food, soft drinks, and fast food. UPF consumption contributes 55% to daily energy consumption. Higher UPF intake is associated with a higher percentage of body fat in this population (2.08 higher) (Liu et al., 2023). UPF products that are widely consumed by Indonesian people are partly driven by the presence and development of the food and beverage industry in Indonesia. The increase in the number of developments and presence of the food and beverage industry in Indonesia increased from 8.46% in 2016 and increased to 9.23% in 2017 (Pratiwi et al., 2022).

Teenagers are one of the age groups that have high levels of UPF consumption (Reales-Moreno et al., 2022). In the adolescent group, 33.9% of females and 69.9% of males were reported to consume sweetened drinks and unhealthy snacks at least once a day. The high rate of UPF consumption among adolescents is also influenced by the school environment which provides various types of food, snacks, and drinks at affordable prices. Most of the snacks sold around schools consist of fried foods and various UPF products, which generally contain high levels of sugar, salt, saturated fat, and food additives (Parnham et al., 2022).

Currently, adolescents' eating patterns are changing, marked by increased consumption of foods high in fat and cholesterol, but low in fiber, such as UPF, junk food, and carbonated drinks. As many as 49.9% of adolescents do not consume fruit, while 22.3% do not consume vegetables at all. In addition, 54.8% of adolescents consume fast food more than once a week. This unbalanced diet, if not accompanied by sufficient physical activity, can increase the risk of obesity and various cardiovascular diseases in adolescents (Telisa et al., 2020).

Teenagers experience a lot of psychological stress, this is because of physical, psychological, hormonal, and social changes in adolescents. Stressful conditions can cause changes in eating patterns, which are called emotional eating. Emotional eating can be in the form of over-eating or under-eating. The majority of teenagers who are stressed experience over-eating and tend to choose comfort food for teenagers, namely foods with high fat and sugar content (Wiciyuhelma, 2021). Based on the background description above, the aim of this study was to analyze the relationship between stress levels and UPF consumption on blood pressure in obese adolescents.

METHOD

The design of this study is observational analytic with cross-sectional approach study. The population in this study were all students of grade X and XI in SMA Negeri 1 and 7 Surakarta City. The sample size involved in this study was 75 respondents, with purposive sampling technique according to the specified inclusion and exclusion criteria. The inclusion criteria in this study were, students in grades X and XI with obesity nutritional status (>+2 SD) and were willing to participate in the study from beginning to end. The exclusion criteria in this study were, students who were sick (cough, flu, fever, etc.), students aged > 18 years, and students who were undergoing drug therapy.

The independent variables in this study were stress levels using the DASS 42 questionnaire and UPF consumption history using the FFQ UPF questionnaire by Khomilah DA, 2023. The validity test of the DASS 42 stress questionnaire was not carried out because many validity tests have been carried out in other studies. Muttaqin's (2021) study conducted a validity and reliability test of the DASS 42 stress questionnaire. The results of the validity test on the sub-depression were r = 0.872, the sub-anxiety obtained a value of r = 0.782; sub-variable stress r = 0.79; reliability value on depression = 0.872, anxiety = 0.806 and stress = 0.816. The results of the reliability test of the DASS 42 stress questionnaire obtained a Cronbach's alpha value of 0.981 (Muttaqin & Ripa, 2021). This shows that the DASS 42 questionnaire is valid and reliable for use in this study. The UPF questionnaire was created and compiled by Khomilah, 2023. After filling out the questionnaire, there were 13 questions that met the reliability requirements. Based on this, the question items above can be used as observed and manifest variables for measuring variables. This result shows that the Cronbach's alpha value is above 0.6 where the questionnaire is suitable for use (Khomilah, 2023). The dependent variable in this study was blood pressure using a digital sphygmomanometer with the Omron HEM-7120 brand. Research data were collected through interviews and direct data measurements by researchers and the enumerator team. This study has obtained an ethical feasibility letter from the Ethics Assessment Committee of the Faculty of Medicine, Sebelas Maret University at number 250/UN27.06.11/KEP/EC/2024. The research data that has been collected is re-examined for completeness. The data is processed using the SPSS version 29 program to be analyzed and interpreted statistically.

RESULT

Based on the characteristics of the respondents in table 1, the age range is 15 to 17 years with the majority being 16 years old (49.3%). The majority of teenagers are male, namely 42 people. The majority of respondents are at normal stress levels (45.3%). The history of UPF consumption of the majority of respondents is high (50.7%). As many as 46.7% or 35 respondents have hypertension or blood pressure above 120/80 mmHg, while the other 40 respondents have normal blood pressure (53.3%).

Table 1.
Characteritics of Respondense (n= 75)

Respondent characteristics	f	%
Age		
15	16	21.3
16	37	49.3
17	22	29.3
Gender		
Male	42	56
Female	33	44
Stress Level		
Severe	5	6.7
Moderate	5	6.7
Mild	31	41.3
Normal	34	45.3
Consumpption UPF		
High	38	50.7
Low	37	49.3
Blood Pressure		
Hypertension	40	53.3
Normal	35	46.7

Table 2.
Pearson Coreelation of Stress Levels and Blood Pressure in Obese Adolescents (n= 75)

Variable	Total	r	p-value
Systolic Blood Pressure	75	0.129	0.127
Diastolic Blood Pressure	75	0.271	0.278

Based on the results of the Pearson correlation analysis in Table 2, it shows that there is no significant relationship between stress levels and systolic and diastolic blood pressure in obese adolescent subjects, with a p-value > 0.05. The direction of the correlation shows a positive direction with a very weak and weak correlation strength between stress levels and systolic and diastolic blood pressure (r = 0.1 - 0.2).

Table 3.
Pearson Coreelation of UPF Consumption and Blood Pressure in Obese Adolescents (n= 75)

Variable	Total	r	p-value
Systolic Blood Pressure	75	0.112	0.340
Diastolic Blood Pressure	75	0.255	0.027*

Based on the results of the Pearson correlation analysis in Table 3, it shows that there is a significant relationship between UPF consumption and diastolic blood pressure in obese adolescent subjects, p-value <0.05 and a positive correlation direction with a weak correlation strength (r = 0.255). The results of the analysis of the relationship between UPF consumption and systolic blood pressure showed no significant relationship (p <0.05), with a positive correlation direction and a very weak correlation strength (r = 0.1).

DISCUSSION

Relationship between Stress Levels and Blood Pressure in Obese Adolescents

The results of the statistical test analysis that can be seen in table 2, show that there is no significant relationship between stress levels and systolic blood pressure (p-value = 0.127) and diastolic blood pressure (p-value = 0.278). The correlation coefficient value shows 0.129 for systolic blood pressure and 0.271 for diastolic blood pressure, where there is a positive correlation direction with a weak to very weak correlation strength. The results of this study are in line with the results of previous research, namely that previous research showed that there was no significant relationship between stress levels and blood pressure in high school

adolescents. The majority of teenagers in this study had normal stress levels, where blood pressure above normal or hypertension was not caused by stress factors, but could be caused by other risk factors such as nutritional status (Binti Abdul Malik & Syahrul, 2022). The causes of teenagers being vulnerable to stress include having busy learning activities, extracurricular activities, problems with family, and close friends. Teenagers tend to have difficulty dividing their time between school activities and other activities. These various problems can cause feelings of restlessness, sadness, anxiety, worry, becoming easily angered, having difficulty concentrating, and easily losing patience (Ankhofiya et al., 2021).

Stress levels in individuals can be one of the causes of increased blood pressure, this is caused by the adrenaline hormone being released and increasing blood pressure through arterial contraction (vasoconstriction) and increased heart rate. Individuals who experience continued stress, then blood pressure will continue to increase and cause hypertension (Octavia Lingga et al., 2024). The mechanism of stress can affect blood pressure through activation of the autonomic nervous system, the hypothalamic-pituitary-adrenal (HPA) axis, and the hematopoietic-arterial nervous pathway. These mechanisms cause pathophysiological effects in the body that are at risk of increasing sympathetic nervous system activity, decreasing parasympathetic nervous system activity, and causing stimulation of neurohormonal production (Reshawn et al., 2021).

Individuals who experience stress, the hypothalamus will be activated to synthesize corticotropin releasing factor (CRF) and vasopressin. CRF stimulates the anterior pituitary gland to release adrenocortitropin hormone (ACTH), which can trigger the adrenal cortex to produce glucocorticoids, namely cortisol. Cortisol levels that increase and exceed the capacity of the HSD2 enzyme that plays a role in changing cortisol into cortisone, cortisol begins to interact with mineralocorticoid receptors (MR) with an affinity equivalent to aldosterone. This process causes increased sodium absorption and potassium excretion in the kidneys, which leads to increased blood volume and increased blood pressure (Barbot et al., 2019). In addition, cortisol plays a role in activating the renin-angiotensin system (RAS) by increasing the production of angiotensin II, which can cause persistent hypertension (Anriyani et al., 2024).

Relationship between UPF Consumption and Blood Pressure in Obese Adolescents

The results of the statistical test analysis which can be seen in table 3, show that there is a significant relationship between UPF consumption and diastolic blood pressure ($p>0.05$) and there is no significant relationship between UPF consumption and systolic blood pressure ($p<0.005$). Respondents' blood pressure characteristics data show that the majority of respondents have hypertension or above normal blood pressure (≥120/80 mmHg) and the majority of respondents are classified as having a high level of UPF consumption or above the median consumption score. As many as 53.3% of respondents have hypertension and 50.7% are classified as having a high level of UPF consumption. Previous studies have shown that UPF consumption can increase the risk of hypertension. Individuals who consume UPF in the highest quartile have a risk of hypertension of 23% (Octavia Lingga et al., 2024). Ultra-Processed Food (UPF) is a food or beverage product produced by industry. UPF has characteristics of high sodium, high sugar, high saturated fat, dense calories, and low nutrients. The composition of UPF has a high sodium and fat content, but is low in potassium, calcium, and magnesium which play a role as the main risk factors for hypertension (da Silva et al., 2021).

Excessive sodium intake can increase systolic and diastolic blood pressure to hypertension, this mostly occurs in children and adults with overweight and obesity conditions (Cortes et al., 2023). The mechanism of hypertension in obese individuals is through increased activity of the sympathetic nervous system (SNS), higher activation of the renin-angiotensin-aldosterone system (RAAS), and pressure on the kidneys due to fat accumulation. One of the triggers for increased SNS activity is higher levels of angiotensin II (Jeong & Kim, 2024). Excessive calorie intake causes increased energy storage in adipose tissue in the body. Adipose tissue can secrete adipokine compounds and proinflammatory cytokines. These compounds play a role in chronic inflammation that often occurs in obese individuals. Chronic inflammation that occurs in the body can trigger the activation of RAAS, which is a system that regulates fluid balance and blood pressure. Excessive RAAS activity can increase angiotensin II levels, which can have an impact on blood vessel constriction and higher sodium retention, which can increase blood pressure and potentially cause hypertension (Shariq & Mckenzie, 2020).

CONCLUSION

The results of this study indicate that stress levels do not have a significant relationship with systolic or diastolic blood pressure. UPF consumption is not significantly related to systolic blood pressure, but UPF consumption has a significant relationship with diastolic blood pressure.

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