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The Relationship between Nutritional Status and Physical Activity with Blood Pressure in Children Aged 16-18 Years at SMA Negeri 7 Samarinda

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A B S T R A C T

High blood pressure is often seen as a common health problem in the elderly. However, recent findings suggest that adolescents can also experience hypertension. Hypertension that occurs in adolescence tends to continue into adulthood. This study aims to determine the relationship between nutritional status and physical activity and blood pressure in students aged 16-18 years at SMA Negeri 7 Samarinda. This study uses a quantitative approach with a cross-sectional design, conducted in February 2024 involving 56 respondents. The results of the analysis using the Pearson Chi-Square Test showed a significant relationship between nutritional status (p=0.032) and physical activity (p=0.011) and blood pressure in this age group. Thus, it is important to pay attention to diet and physical activity to reduce the risk of hypertension and health complications in adulthood.

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INTRODUCTION

The nutritional problem found in adolescents is hypertension. The prevalence of hypertension at the age of ≥ 18 years in Indonesia is 34.1%, this figure shows an increase in the incidence of hypertension when compared to 2013 which is 25.8%. However, the prevalence of non-communicable diseases has increased when compared to Riskesdas 2013, including cancer, stroke, chronic kidney disease, diabetes mellitus, and hypertension. The prevalence of hypertension for the East Kalimantan region from the results of the measurement of the population ≥ the age of 18 years is 39.30%.

The above blood pressure and hypertension conditions are very informative. Normal blood pressure is usually considered to be in the range of 120/80 mmHg. However, if blood pressure persistently exceeds 140/90 mmHg, this is considered hypertension, especially in adults over the age of 18. The data you provide also shows how prevalent and important the problem of high blood pressure is globally. With an estimated 1.13 billion people worldwide having high blood pressure, especially in low- and middle-income countries, this shows the importance of awareness of the disease and its prevention and management efforts (WHO, 2021).

High blood pressure is a serious global health problem because it is the leading cause of cardiovascular diseases such as heart disease, stroke, and kidney problems. In 2016, heart disease and stroke have become the leading cause of death worldwide, according to research by (Siswanto et al., 2020). High blood pressure is one of the main risk factors for heart disorders and often leads to complications that threaten vital organs. (Larasati & Husna, 2020). The national prevalence of hypertension in the age group of 15-18 years reaches 5.3%, consisting of 6% of men and 4.7% of women, according to the report of Riskesdas East Kalimantan (2018). In Indonesia, the prevalence of hypertension at the age of ≥18 years reaches 34.1%, which shows an increase from 2013 which was 25.8%. The prevalence of non-communicable diseases, such as cancer, stroke, chronic kidney disease, diabetes mellitus, and hypertension, has also increased according to the 2018 Riskesdas report

The high prevalence rate of obesity among adolescents, as shown by RISKESDAS 2018 and research conducted by Setiawati and colleagues in 2019, indicates the need for greater preventive measures to address this overnutrition problem. Obesity in adolescence can have a serious impact on health both in adolescence and in adulthood, because it tends to continue into adulthood and increases the risk of various serious diseases such as diabetes, heart disease, and stroke (Simbolon, Tafrieani and Dahrizal, 2018).

Physical activity in adolescents can be subdued (Praditasari and Sumarmi, 2018). Up to 57.3% of young people are involved in physical activity. This increases the risk of degenerative diseases such as overeating and hypertension. Poor nutritional status Physical activity is also a risk factor for hypertension in adolescents. Adolescents with better nutrition have a relative risk of developing hypertension 4.85 times higher than adolescents with good nutrition (Shaumi and Achmad, 2019). Lack of physical activity is also one of the factors. The risk of developing hypertension is 7.86 times compared to

adolescents who suffer from hypertension. Be physically active. Hypertension can appear during puberty and the prevalence increases from year to year (Shaumi and Achmad, 2019).

Given the importance of nutrition and physical activity issues in adolescent health, as well as their potential long-term impact on blood pressure and cardiovascular health, this study could provide valuable insights. By focusing on the relationship between nutritional status, physical activity, and the incidence of hypertension in children aged 16-18 years, your study has the potential to provide a better understanding of the risk factors associated with high blood pressure in this age group. In addition, extending the age range of the study to late teens aged 16-18 will provide a more complete picture of the relationship, as well as help identify patterns that may occur as the transition from adolescence to adulthood occurs.

THEORETICAL REVIEW

Hypertensiom

Hypertension is a condition in which blood pressure exceeds the normal limit, namely systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg when measured periodically. Hypertension occurs when there is a disorder in the blood vessels that obstructs the blood flow that carries oxygen and nutrients to the body's tissues. This can result in a variety of serious health complications if not treated appropriately. (Hastuti, 2020).

Nutritional Status

Nutritional status is the state of the body that is affected by nutrients Naturally, it occurs as a result of food consumption. Nutritional status is also the result of fulfilling nutritional needs and intake expressed in terms of weight and height (Hafiza et al., 2020).

Research conducted by Wijayanti (2019) stated that over-nutritional status, both overweight or obese has the same proportion, which is 20% and less than normal nutritional status as much as 49.33%. H_{a1} is there a relationship between nutritional status and blood pressure in children aged 16-18 years at SMA Negeri 7 Samarinda and H_{o1} There is no relationship between nutritional status and blood pressure in children aged 16-18 years at SMA Negeri 7 Samarinda.

Physical Activity

Physical activity is any movement of the body that the skeletal muscles work, increasing energy and energy expenditure. This activity includes activities carried out at school locations Work, family/household activities, household activities, tours and other leisure activities in free time every day (Ministry of Health, 2019). The World Health Organization (WHO) is a physical activity as a movement of skeletal muscles that requires energy expenditure. Also, exercise in your free time when traveling, or when doing activities. This habit is very important for a person's physical and mental health to achieve a normal and healthy weight (WHO, 2020).

Physical activity has an important role in reducing the risk of hypertension. Any increase in the duration of physical activity for 30, 60, 90, or 120 minutes each week can reduce the risk of hypertension. Based on the research of Chandra Tri Wahyudi (2021), the relationship between physical activity and the occurrence of hypertension above also explains where a weak and negative relationship was found between physical activity and the incidence of hypertension, both systolic and diastolic blood pressure, which can be interpreted as the higher the physical activity of adolescents, the lower the incidence of hypertension in adolescents based on a pvalue < alpha (0.05). H_{a2} is there a relationship between nutritional status and blood pressure in children aged 16-18 years at SMA Negeri 7 Samarinda and H_{o2} There is no relationship between nutritional status and blood pressure in children aged 16-18 years at SMA Negeri 7 Samarinda.

Adolescent

Adolescence is when humans are in their teens. A teenager is not an adult or a child. Puberty can also be biologically interpreted as physical changes marked by the onset of puberty and the end of physical growth. (National Children's Forum (FAN), 2021). According to some experts, the age group of young people is between 10 to 21 years old. Adolescent development coincides with physical, creative, cognitive, social, and linguistic development. In each phase of a child's development, the response sometimes varies depending on the child's environment, his environment, the reactions of others, and parental guidance (Diananda, 2019)

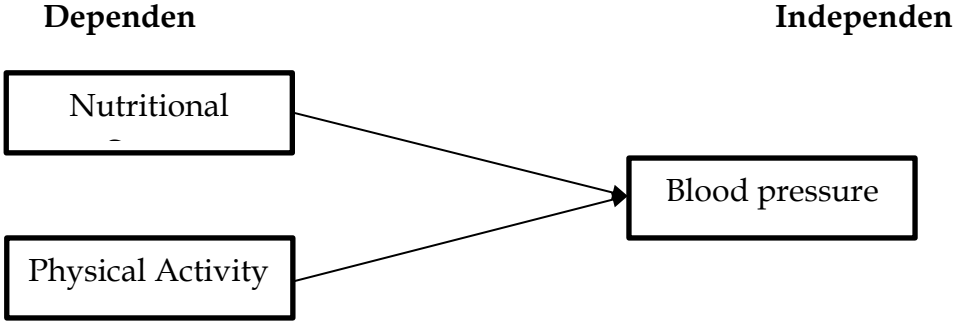

Figure 1. Research Conceptual Framework

METHODOLOGY

The type of research conducted in this study is quantitative research. The observational analytical method uses a cross sectional research design, because in this design all independent variables and dependent variables can be measured and observed at the same time. The research population was 105 students of SMAN 7 Samarinda grades X, XI, and XII. The sampling technique uses the Random *Sampling* Technique. The criteria for sample inclusion in this research include; students who are 16-18 years old, willing students, students in

physical and spiritual health, students in grades X, XI and XII. The research was conducted in February 2024 at SMAN 7 Samarinda for 2 days, with a total of 56 respondents. Nutritional status and blood pressure data were obtained by anthropometric measurements and using a sphygmomanometer while physical activity data was obtained using the Physical Activity Questionnaire For Adolescents (PAQ-A).

Univariate analysis was carried out to analyze each variable in each research result to produce the frequency distribution and percentage of each variable.

Bivariate analysis was used in this study to determine the relationship between nutritional status and physical activity with blood pressure in children aged 16-18 years at SMAN 7 Samarinda.

This researcher used a statistical analysis application where this study used *the Pearson Chi-Square test*.

RESULTS

Univariate Analysis

Student Characteristics

Table 1 Distribution of Characteristics of Adolescents at SMA Negeri 7 Samarinda

Karakteristik	Frekuensi(N)	Persentase(%)
Gender		
Man	19	33,9
Woman	37	66,1
Class		
Grade 10	21	37,5
Grade 11	17	30,4
Grade 12	18	32,1
Age		
16 Years	31	55,4
17 Years	18	32,1
18 Years	7	12,5
Total	**56**	**100**

Source : Primary Data, 2024

Based on table 1, of the distribution of characteristics in children aged 16-18 years at SMA Negeri 7 Samarinda, it was found that the majority of respondents were women, namely 66.1% (37 people), while male respondents amounted to 33.9% (19 people). The class with the highest number of respondents was class 10, reaching 37.5% (21 people), while the class with the lowest number of respondents was class 11, which was 30.4% (17 people). A total of 55.4% (31 people) of the respondents were 16 years old, while only 12.5% (7 people) were 18 years old.

Nutritional Status

Nutritional status in adolescents is obtained by conducting anthropometric measurements, namely weight measurement and height measurement. Then calculations are carried out to get the BMI/U (Body Mass Index According to Age) value to find out the nutritional status of adolescents.

Table 2 Distribution of Adolescents Based on Nutritional Status

Classification of Nutritional Status	N	%
Lack of Nutrition (Thinness)	5	8.9
Good Nutrition (Normal)	33	58,9
More Nutrition	8	14.3
Obesity	10	17.9
Total	**56**	**100**

Source : Primary Data, 2024

Based on the results of the study in Table 2, the distribution of data in children aged 16-18 years based on their nutritional status shows that the normal category has the highest percentage, which is 58.9% (33 people). Meanwhile, the obesity category reached 17.9% (10 people), the overnutrition category was 14.3% (8 people), and the undernutrition category had the lowest percentage, which was 8.9% (5 people).

Physical Activity

Physical activity is measured using a questionnaire including activities or activities that are usually done from waking up to returning to sleep within the past week. Physical activity is expressed in a score, which is the number of activities per minute.

Table 3 Distribution of Adolescents Based on Physical Activity

Physical Activity Classification	N	%
Very Low	3	5.4
Low	16	28.6
Keep	18	32.1
Tall	19	33.9
Total	**56**	**100**

Source : Primary Data, 2024

Based on Table 3, out of a total of 56 respondents aged 16-18 years, the data shows that the highest physical activity is in the high category, which is 33.9% (19 people), followed by the medium category as much as 32.1% (18 people), and the low category as much as 28.6% (16 people). As for very low physical activity, there is the lowest percentage, which is

5.4% (3 people). This shows that most students have a high level of physical activity.

Blood pressure

The respondent's hypertensive status is blood pressure consisting of systolic pressure measured through a sphygmomanometer. Based on the blood pressure of the respondents, the results were obtained that most of the respondents experienced pre-hypertension (TD 120–139 mmHg) as much as 42.9%.

Table 4 Distribution of Adolescents Based on Blood Pressure

Blood Pressure Classification	N	%
Usual	22	39.3
Pre-Hypertension	24	42.9
Grade 1 hypertension	10	17.9
Total	**56**	**100**

Source : Primary Data, 2024

Based on Table 4, the researcher used a double sphygmomanometer to measure blood pressure, with a ten-minute time interval for each measurement. Systolic and diastolic blood pressure were used to determine the incidence category of hypertension, which was then divided into four categories: normal, pre-hypertensive, and grade I hypertension. The highest incidence of blood pressure occurred in the pre-hypertension category, reaching 42.9% (24 people), followed by the normal category of 39.3% (22 people), and the lowest incidence of blood pressure occurred in grade I hypertension of 17.9% (10 people)

Bivariate Analysis

Table 5 Relationship between Nutritional Status and Blood Pressure at the Age of 16-18 Years at SMAN 7 Samarinda

Status Gizi	Blood Pressure Events						P-Value
	Normal		Pre-Hypertension		Grade 1 Hypertension		
	N	%	N	%	N	%	
Lack Of Nutrition (Thinness)	3	14	1	4	1	10	
Good Nutrition (normal)	16	73	15	63	2	20	0.032
More Nutrition	2	9	2	9	4	40	
Obesity	1	4	6	6	3	30	

Total	**22**	**100**	**24**	**100**	**10**	**100**

Source : Primary Data, 2024

Based on Table 5, In children aged 16-18 years, the group with good nutritional status has the highest number with 16 people in the normal blood pressure category, 15 people with pre-hypertension, and 2 people with grade 1 hypertension. And in the group with poor nutritional status, there were only 3 people in each category of normal, pre-hypertensive, and grade 1 hypertension. The results of the Pearson chi-square statistical test are tests conducted in this study, it is said that there is a significant correlation if the p-value <0.05. In this study, a p-value of 0.032 was obtained, which means that there is a significant correlation between nutritional status and blood pressure at the age of 16-18 years.

Table 6 Relationship between Physical Activity and Blood Pressure at the Age of 16-18 Years at SMAN 7 Samarinda

Blood Pressure Events							
Aktivitas Fisik	Normal		Pre-Hypertension		Grade 1 Hypertension		P-Value
	N	%	N	%	N	%	
Very Low	1	5	1	4	1	10	
Low	5	23	8	33	3	30	0.011
Keep	2	9	11	46	5	50	
Tall	14	63	4	17	1	10	
Total	**22**	**100**	**24**	**100**	**10**	**100**	

Source : Primary Data, 2024

Based on Table 6, In children aged 16-18 years, the group with high physical activity had the highest number with 14 people in the normal blood pressure category, 4 people with pre-hypertension, and 1 person with grade 1 hypertension. And in the group with very low physical activity, there was only 1 person in each category of normal, pre-hypertensive, and grade 1 hypertension. The results of the Pearson chi-square statistical test were carried out in this study to find correlations between variables. The correlation is considered significant if the p-value < 0.05. In this study, it was found that the p-value was 0.011, which indicates a significant correlation between physical activity and blood pressure at the age of 16-18 years

DISCUSSION

Relationship between Nutritional Status and Blood Pressure

The relationship between nutritional status and blood pressure incidence can be analyzed using SPSS. In this study, a bivariate statistical test was carried out using the *Pearson chi-square* Statistical Test. This test aims to find a correlation between the two variables, and the results are considered significant if the p-value < 0.05. Based on the results of the analysis, a p-value of 0.032 was obtained, which shows a significant correlation between nutritional status and blood pressure at the age of 16-18 years.

The results of this study are in line with the findings of the study (Sri Wahyu Nurkhofifah, 2022), which found a significant relationship between nutritional status and the incidence of hypertension in adolescents at SMA Negeri 3 Semarang, with a value of p=0.047 using the chi-square statistical test. The findings are also consistent with research conducted by (Romadhiyana K.P. et al., 2021), which showed a strong association between nutritional status and hypertension in adolescents. In addition, the results of the study also support other studies that show a positive correlation between body mass index (BMI) and blood pressure in adolescents.

The results of this study are in line with the findings of the Hidayatullah (2019) study, which also shows a significant relationship between nutritional status and blood pressure in adolescents. The research was conducted in Mataram in adolescents aged 15-19 years. According to (Hidayatullah and Pratama, 2019), adolescents who have nutritional status are more likely to have more fat deposits in the body. This can lead to narrowing of blood vessels and increased blood pressure. Therefore, the findings from this study support the same concept that unhealthy nutritional status can contribute to increased blood pressure in adolescents.

This researcher determined that confirming the results reported by (Batara et al., 2016) regarding the relationship between obesity nutritional status and blood pressure in students in several secondary schools in Bitung City in 2016. Another study conducted by Ratulangi in North Bolaang Mongondow Regency in the same year showed that there was no significant correlation between nutritional status and systolic and diastolic blood pressure in adolescents, with p = 0.413 and p = 0.938 values respectively. One of the factors that may lead to poor nutritional status is excessive weight gain, especially if the increase is accompanied by an increase in visceral adiposity, which can increase the risk of hypertension by up to 65-75%. The mechanisms behind the link between obesity and hypertension include sodium retention, increased activity of the sympathetic nervous system, and activation of other components discussed by (Mauliza, 2018.)

According to the results of the study and the supporting theory, the researcher concluded that there is a relationship between nutritional status and blood pressure. One of the causes of poor nutritional status or obesity is excessive weight gain, especially if accompanied by an increase in body fat, which can be a risk factor for hypertension by 65-75%. Hypertension in adolescents often starts from obesity or obesity related to lifestyle. Insulin resistance is the cause of hypertension in obesity. Nutritional status is one of the factors that can affect blood pressure. However, it is important to remember that hypertension is not only caused by nutritional status, but also influenced by other factors such as a diet rich in sodium and fat, family history of hypertension, physical activity levels, and smoking habits.

The Relationship Between Physical Activity and Blood Pressure

This study used bivariate analysis with the Pearson chi-square Statistical Test to check whether there was a correlation between physical activity and blood pressure events, This study used bivariate analysis using the Pearson chi-square Statistical Test. The goal is to find out if there is a significant correlation if the p value < 0.05. The results of the calculation showed that the p-value was 0.011 which showed that there was a significant correlation between physical activity and blood pressure events.

This research is in line with the findings reported by (Ferdy Hendrianus Muha, 2019). The results of the statistical test showed that the p-value was 0.000 ≤ α (0.05), which showed that there was a significant relationship between physical activity and blood pressure in adolescents with hypertension in the Assisted Area of the Srondol Health Center, Semarang City. Based on the results of the ChiSquare test, it was found that the Odds Ratio (OR) value was 3,667 with a Confidence Interval (CI 95%) between 1,193-11,271. This shows that adolescents with hypertension in the Srondol Health Center Assisted Area of Semarang City who have low physical activity have a 3,667 times higher risk of having moderate blood pressure compared to those who have moderate physical activity. Thus, it can be concluded that physical activity has an important role in regulating blood pressure in adolescents with hypertension in the region.

The results of this study are in line with the results of previous research (Iswahyuni, 2017), which showed that nutritional status and physical activity have a strong correlation with hypertension, both in systolic and diastolic blood pressure. Physical activity can lower blood pressure in several ways, one of which is by changing the response of blood vessels and the sympathetic nervous system so as to reduce peripheral resistance. In addition, physical activity can also make the sympathetic nerve work harder and the parasympathetic nerve less, resulting in vasodilation of blood vessels and a decrease in overall blood pressure. As a result, maintaining cardiovascular health and controlling blood pressure is essential.

The results of this study are in line with the findings reported by (Chandra Tri Wahyudi, 2021). The analysis of the relationship between physical activity and the occurrence of hypertension used the Spearman Correlation test, because the data did not have a normal distribution. The Spearman's rho coefficient obtained was -0.137 for systolic blood pressure and -0.202 for diastolic blood pressure. These values illustrate the existence of a weak and negative relationship between physical activity and the incidence of hypertension, both in systolic and diastolic blood pressure. In essence, the higher the level of physical activity of adolescents, the lower the likelihood of hypertension in them. Taking into account the p-value smaller than alpha (0.05), it can be concluded that the null hypothesis (H0) is rejected, while the alternative hypothesis (Ha) cannot be rejected. This means that there is a significant relationship between physical activity and the incidence of hypertension in adolescents. Thus, the results of the analysis show that physical activity plays a role in lowering the risk of hypertension in the adolescent population.

However, research conducted by (Marlina et al., 2016) in Pekanbaru showed different results. They did not find a significant association between

physical activity and systolic blood pressure (p=0.829) or diastolic blood pressure (p=0.643) in high school students who were the subjects of their study. Nonetheless, it is important to note that physical activity is still necessary to keep blood pressure mechanisms running optimally. This is because a lack of physical activity can cause blood vessels to begin to narrow, which can eventually increase blood pressure. Through physical activity, peripheral resistance can be reduced, so that blood pressure can be maintained at a healthy level.

Based on the results of the study and the supporting theory, the researcher argues that there is a relationship between physical activity and blood pressure. Moderate physical activity can help strengthen the heart, allowing it to pump blood more efficiently without requiring great energy or ability. With lighter heart work, there is an increase in the elasticity of blood vessels which results in vasodilation, which is the dilation of blood vessels. This causes the heart muscle to relax, which ultimately results in a decrease in blood pressure. In contrast, in less physically active individuals, heart rate tends to increase, resulting in the heart having to work harder. This can lead to an increase in blood volume and an increase in cardiac output, which in turn can lead to an increase in blood pressure. Thus, doing physical activity for at least 15-30 minutes per day can reduce the impact of increased blood pressure in the body

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of research conducted to find out how the relationship between nutritional status and physical activity with blood pressure at the age of 16-18 years at SMA Negeri 7 Samarinda, the following results were obtained:

1. Of the 56 respondents who participated in this study, there were 19 people (33.9%) who were male and 37 people (66.1%) who were female. The majority of respondents came from class 10, with a total of 21 people (37%), followed by class 12 with 18 people (32.1%), while class 11 had the lowest number of respondents, namely 17 people (30.4%). A total of 31 people (55.4%) of the respondents were 16 years old, 18 people (32.1%) were 17 years old, and 7 people (12.5%) were 18 years old.
2. Of the 56 respondents, 5 people (8.9%) were undernourished, 32 people (57.1%) were well nourished, 9 people (16.1%) were overnourished, and 10 people were obese (17.9%).
3. Of the 56 respondents, 3 people (5.4%) had very low physical activity, 16 people (28.6%) had low physical activity, 18 people (32.1%) had moderate physical activity, and 19 people (33.9%) had high physical activity.
4. Of the 56 respondents, 22 people (39.3%) had normal blood pressure, 24 people (42.9%) had pre-hypertensive blood pressure, and 10 people (17.9%) had grade 1 hypertensive blood pressure.
5. From the results of the analysis, there was a relationship between nutritional status and blood pressure in children aged 16-18 years, with a significance value of p-value of 0.032. This shows that there is a significant correlation between the two variables. Similarly, from the relationship between physical

activity and blood pressure at the age of 16-18 years, a significance value of p-value of 0.011 was obtained, which also indicates a significant correlation between the two variables. Therefore, it can be concluded that the relationship between nutritional status and blood pressure and between physical activity and blood pressure is unidirectional.

FURTHER STUDY

Every research is subject to limitations; thus, you can explain them here and briefly provide suggestions to further investigations. Based on the researcher's experience in this research process, there are several limitations that need to be considered by future researchers to improve the perfection of their research. This research has several shortcomings that must be continuously improved for future studies. Some of the limitations faced in this study are: Number of The respondents were limited to only 56 people, which is certainly not enough to reflect the actual situation thoroughly, and in the process of collecting data, sometimes the information provided by the respondents through questionnaires does not fully reflect their true opinions. This is due to differences in thinking, assumptions, and understandings between respondents, as well as other factors such as the level of honesty in filling out the questionnaire.

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