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The relationship between physical activity and diet on BMI of elementary school students

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ABSTRAK

Physical activity and diet are factors that affect nutritional status, excessive energy intake and not being balanced by physical activity will certainly increase the risk of having underweight, which is not ideal. This study aimed to determine the relationship between physical activity and diet on the BMI of SDN 2 Polobogo students. The method in this study was observational analytic with a cross-sectional design. The research population is students of SDN Polobogo 2 Class IV-VI. The sample in this study was students who met the standard criteria, amounting to 40 students. The instrument in this study used the SQ-FFQ questionnaire, the PAQ-C questionnaire, and the measuring instrument for height and weight. The data analysis technique used was the Pearson correlation test, which continued with multiple linear regression. This study's results indicate a significant effect between physical activity and diet on the BMI of grade 4-6 students at SDN Polobogo 2, Semarang Regency. It can be seen that physical activity and diet together have a positive effect on students' BMI. It can be concluded that physical activity and diet are significantly related to the BMI of students in grades 4-6 SDN Polobogo 2 Semarang Regency.
***Keywords**: Physical activity, Diet, Body mass index.*

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INTRODUCTION

The development of quality human resources (HR) can be successful if the ideal growth and development are started early. One of the human resources goals is children because children are the hope of the nation's future. This is understandable and quite reasonable, considering the formation of humans in the future is the formation of children today. Nutrition is an essential factor in the growth and development of a child growth itself is a process of increasing the number of cells in the body and accompanied by an increase in body sizes physically and structurally, both locally and overall. His nutritional status influences the optimum growth and development of a child. Nutritional status is one of the benchmarks for assessing the adequacy of daily nutritional needs and the body's use of these nutrients. If

children's nutritional intake is always fulfilled and used optimally, their growth and development will be optimal (Sholikah et al., 2017). The high level of nutritional problems in school children is currently quite worrying. The data obtained by Riskesdes in 2018 shows that the nutritional status of children aged 5-12 years in Indonesia, namely the prevalence of being very thin, is 2.4%, while the problem of adiposity in children is still severe, consisting of 10.8 fat. % and obesity at 9.2%, where the prevalence of short is 16.9% (Badan Penelitian dan Pengembangan Kesehatan, 2018).

Body mass index or BMI is an indicator set by WHO as an analogy of weight with the square of height. BMI can be determined by measuring weight and height separately, then the weight and height values are divided to get the BMI value in units lightweight kg/m. BMI values are given based on five criteria, namely: underweight <17kg/m, lightweight 17.0-18.4 kg/m, normal 18.5-25 kg/m and overweight >277 kg/m (Situmorang, 2015). Physical activity is one factor that affects nutritional status, such as excessive energy intake but not balanced with balanced energy expenditure, which will lead to obesity or weight gain. In the modern era such as today, physical activity is becoming increasingly minimal so that life is more relaxed because it is made easier by technological advances (Westerterp-Plantenga, 2020). The results cause lifestyle changes and lead to changes in people's eating patterns, which refer to high-calorie eating patterns that are not balanced by physical activity activities, and can cause more nutritional problems. More nutrition is caused by an imbalance of energy expenditure with energy obtained (Romieu et al., 2017a).

Physical activity is essential for the health of children and adolescents to carry out daily activities. Physical activity is divided into three levels: light, moderate and heavy. Regular physical activity has significant protection against the possibility of contracting several diseases (Kumar et al., 2015). On the other hand, a sedentary lifestyle is known to be at risk of causing various diseases (Park et al., 2020). Obesity occurs when there is an imbalance between energy intake and energy output over a long period, so it will be stored as excessive fat (Hill et al., 2012). Excess food consumption causes high energy intake as a result of low physical activity (Ermona & Wirjatmadi, 2018).

Good nutritional status is undoubtedly influenced by a good diet, such as managing time, the type of food consumed, and the amount of good food consumed by children. An imbalance in consumption patterns results in a lack or excess of nutrients that enter the body. This is coupled with the habit of children who prefer snacks and can choose the snacks they like (Sogari et al., 2018). Types of snacks that children primarily consume are types of snacks that contain lots of fat and energy. High enough energy intake from food intake will be stored as

fat by the body. This high intake of energy and fat will cause weight gain in children. Several studies suggest a relationship between diet and the incidence of obesity (Romieu et al., 2017b). Adequacy of animal intake is 25-40% of protein needs, while Adequacy of vegetable protein intake is 65-80% of protein needs. The human body cannot accommodate excess protein, so it will be stored in the form of triglycerides by the body, which increases fat tissue and fat Make children obese (Maliszewska et al., 2022). Carbohydrates are essential in maintaining healthy intestinal function and as a source of energy. Carbohydrate consumption should be given at specific intervals. This is so that the body can obtain glucose for energy needs because glycogen supplies last only a few hours (Jentjens & Jeukendrup, 2003). However, excessive carbohydrate consumption will undoubtedly impact health, such as increased cholesterol levels and difficulty losing weight.

SDN Polobogo 2 is one of the schools in the Getasan sub-district, Semarang district. Based on the initial study, the researchers saw that there were still many students at SDN Polobogo 2 who did not care about their physical health, the number of snacks that were not healthy and did not meet nutritional standards became their favorite snacks every day, plus their lack of awareness about physical activity made children Many children at SDN Polobogo 2 are obese, students play more in the classroom than outside the classroom, such as playing smartphones, drawing and playing musical instruments. Therefore, the researcher wanted to know the relationship between physical activity and diet with the BMI of SDN Polobogo 2 students.

METHODS

This research is an analytic observational study with a cross-sectional study design. The population in this study were all students of SDN Polobogo 2 class 4-6 Semarang Regency. Sampling in this study was done by purposive sampling. The criteria for determining the sample include inclusion criteria, namely (1) active students at SDN Polobogo 2, Semarang Regency, (2) students in grades 4-6, and exclusion criteria, namely there are data on physical activity, diet, and BMI. Based on the criteria that meet the number of 40 students.

This study uses a physical activity research instrument using a PAQ-C questionnaire, with the validity of the PAQ-C instrument being between 0.577-0.780. Reliability in the PAQ-C instrument proved to be reliable with a Cronbach alpha score of 0.682 and a diet instrument using the SQ-FFQ questionnaire and processed with Nutrisurvey software to obtain the adequacy value of macronutrients, namely carbohydrates, proteins, and fats and then compared with the nutritional adequacy rate, while the body mass index (BMI) using anthropometric

measurements with measurements of weight and height, then calculated using the formula for body mass index (BMI). The analysis technique in this study used the pearson correlation test and continued with multiple linear regression.. The analysis was used to determine how big the relationship between the independent variables, namely: physical activity (X1) and diet (X2) to the dependent variable, namely BMI (Y). The multiple linear regression equation is as follows Y= + b1x1+b2x2 . The classical assumption test is a statistical requirement that must be met in multiple regression analysis based on ordinary least squares. In this case, normality, multicollinearity, and heteroscedasticity assumptions will be tested.

The coefficient of determination test is used to see the feasibility of the research conducted by looking at the effect of the independent variable on the dependent variable. The coefficient of determination R2 is used to determine how many percent of the variation in the dependent variable can be explained by the variation of the independent variable. This R^2 value lies between 0 and 1. If the R^2 value is close to 0, it means minimal variation in the dependent variable explained by the independent variable. If it turns out that in the calculation, the value of R^2 is equal to 0, then this shows that the independent variable cannot explain the dependent variable. This test was conducted to determine whether, simultaneously or jointly, the independent variables had a significant effect or not on the dependent variable. A significance level (α) used is a 5% F distribution with degrees of freedom.

RESULTS AND DISCUSSION

This study was intended to determine the relationship between physical activity and diet on the BMI of students in grades 4-6 SDN Polobogo 2 Semarang Regency

Results

Before conducting data analysis techniques , the characteristics of respondents and the results of data processing for each variable will be presented as follows:

Table 1. Distribution of Respondents by Gender

characteristics	Obesity		Normal	
	f	**%**	**f**	**%**
4th grade				
Male	5	41,7	7	58,3
Female	5	41,7	7	58,3
5th grade				
Male	8	57,1	6	42,9
Female	8	47,1	9	52,9
6th grade				
Male	10	53,0	9	37,5
Female	4	41,7	7	58,3

Table 1 shows that of the 40 respondents, judging by gender, five males for grade 4 (41.7%) and 5 females (41.7). For grade 5, males are 8 (57.1%), females are 8 (47.1%), and for grade 6 are ten males (53.0%) and females as many as 4 (41.7%).

Table 2. Frequency Distribution Based on Physical Activity

Physical Activity	**f**	**%**	**f**	**%**
Good	8	27,6	10	72,4
Less	15	69,7	7	30,3

Table 2 shows that from 40 respondents, those with promising activity in the case group were eight people (25.8%), compared to 10 in the control group (67.7%). In contrast, those with less activity in the case group were mainly greater than the control group, namely seven people (32.3%).

Diet	**BMI**					
	control		**case**		**Total**	
	F	%	F	%	F	%
Male						
Energy (kkal)						
Over	6	9,7	6	9,7	12	19,4
Less	10	16,1	9	14,5	19	30,6
Carbohydrate(kg)						
Over	9	14,5	9	14,5	18	19,6
Less	6	9,7	7	11,3	13	21,0
Fat (kg)						
Over	5	8,1	8	13,0	13	21,0
Less	10	16,1	8	13,0	18	19,6
Protein						
Over	7	11,3	0	0	7	11,3
Less	8	13,0	16	25,8	24	39,0
Female						
Energy (kkal)						
Over	2	3,2	0	0	2	3,2
Less	5	8,1	5	8,1	10	16,1
Carbohydrate(kg)						
Over	3	4,8	1	1,6	4	6,5
Less	4	6,5	4	6,5	8	13,0
Fat (kg)						
Over	7	11,3	0	0	7	11,3
Less	0	0	5	8,`	5	8,1
Protein (kg)						
Over	1	1,6	0	0	7	11,3
Less	6	9,7	5	8,1	11	17,8

Table 3 shows that among 40 respondents, there was a lack of energy eating patterns in the case group, as many as ten people (52.6%). There was a balanced value for the carbohydrate diet between the case group and the control group, with as many as nine people (50, 0%). The protein diet was lacking in the case group of as many as 16 people (66.7%), and the fat diet was lacking in the control group of as many as ten people (55.6%). While the female

gender, the energy diet was less balanced between the case and control groups. As many as five people (50.0%), the carbohydrate diet lacked a proportional value between the case and control groups. As many as four people (50.0%), there were fewer protein eating patterns in the control group and as many as six people (54.4%) for the design.

Table 5. Pearson Correlation Test for Physical Activity

Correlations

		Physical Activity	BMI
Physical Activity	Pearson Correlation	1	.662**
	Sig. (2-tailed)		.000
	N	40	40
BMI	Pearson Correlation	.662**	1
	Sig. (2-tailed)	.000	
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

There is a significant positive relationship between Physical Activity and BMI because the calculated r-value is 0.662 or more significant than r table = 0.312. Also, the significance value is 0.000 or less than 0.05. The Pearson correlation coefficient value is 0.662, so it is included in the category of a solid relationship.

Table 6. Pearson's Dietary Correlation Test

Correlations

		Diet	BMI
Diet	Pearson Correlation	1	.698**
	Sig. (2-tailed)		.000
	N	40	40
BMI	Pearson Correlation	.698**	1
	Sig. (2-tailed)	.000	
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

There is a significant positive relationship between Diet and BMI because the calculated r-value is 0.698 or more significant than r table = 0.312. Also, the significance value is 0.000 or less than 0.05. The Pearson correlation coefficient value is 0.698, so it is included in the category of a solid relationship.

Tabel 7. Linearity Test

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
BMI * Physical Activity	Between Groups	(Combined)	170.941	33	5.180	2.267	.154
		Linearity	82.139	1	82.139	35.947	.001
		Deviation from Linearity	88.802	32	2.775	1.214	.440
	Within Groups		13.710	6	2.285		
	Total		184.651	39			

Based on table 7, it can be concluded that there is a linear relationship between physical activity and BMI because the linearity significance value is 0.001 or less than 0.05, and the deviation from the linearity value is 0.440 or greater than 0.05.

Tabel 8. Normality Test

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		40
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	1.37245844
Most Extreme Differences	Absolute	.094
	Positive	.094
	Negative	-.072
Test Statistic		.094
Asymp. Sig. (2-tailed)		.200[c,d]

Based on the test results in table 8, the one-sample Kolmogorov-Smirnov test resulted in the residual value being generally distributed because the significance value of the Kolmogorov-Smirnov test was 0.200 or greater than 0.05.

Table 9. Multicollinearity test results

Coefficients[a]								
		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	9.270	1.472		6.297	.000		
	Phyisical Activity	1.472	.504	.376	2.919	.006	.649	1.540
	Diet	.111	.029	.492	3.825	.000	.649	1.540

Table 9 it can be concluded that there is no multicollinearity problem because the VIF value is less than ten, and the Tolerance value is more significant than 0.10.

Table 10. Heteroscedasticity test results

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	-1.034	.763		-1.356	.183
	Physical Activity	.494	.261	.340	1.888	.067
	Diet	.015	.015	.181	1.003	.322

Based on the results of the Glejser test above, the significance value of all independent variables is more significant than 0.05. Based on this explanation, it can be concluded that the regression model does not contain heteroscedasticity, meaning that the data does not have

variance inequality from error for all observations of each independent variable in the regression model.

Table 11. Determination test results

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.776[a]	.602	.581	1.40906

Based on **Table 11**, the R Square value is 0.602, which means that a BMI of 60.2% influences the ability of the variables of Physical Activity and Diet. In comparison, the remaining 39.8% is explained by other variables, not in this study.

The F test was conducted to see whether there was an effect of independent variables (physical activity, diet) on the dependent variable (BMI) together. The table below is the result of the F test.

Table 12. F test results

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	111.189	2	55.594	28.001	.000[b]
	Residual	73.462	37	1.985		
	Total	184.651	39			

Based on table 12, we obtained an F value of 28.001, where this value is more significant than the F table = 3.252. Also, with a significance value of 0.000, which is much smaller than 0.05, it can be said that the variables of Physical Activity and Eating Patterns together or simultaneously significantly related to the BMI variable.

Discussion

The variables of physical activity (PA) and eating patterns are significantly related to students' BMI, as evidenced by F<0.05. This proves that physical activity and eating patterns are associated with the BMI of students in grades 4-6 SDN Polobogo 2 Semarang Regency. The results showed that physical activity was significantly related to BMI students in grades 4-6 at SDN Polobogo 2, Semarang Regency. The results are similar to the results of a previous study by (Gunter et al., 2015), which showed that there was a correlation between physical activity expressed in moderate-heavy physical activity (MVPA) and lower BMI in elementary school children grades 1-6.

The reference to physical activity identified in this study is divided into three periods: physical activity on ordinary school days without sports lessons, physical activity on ordinary

school days with sports lessons, and physical activity on holidays (Primacakti et al., 2014) The purpose of using these three times is to influence the overall picture of students' physical activity. In this study, it is known that most students have attended an entire day school, so the proportion of active time in school is longer. In addition, the type of activity carried out also tends to be light physical rather than moderate or heavy physical activity. Another study by (Yu et al., 2002) showed that children with obesity tend to be less active than children with normal BMI. This also occurs in obese adults due to changes in skeletal metabolism, although in obese children, there is still no similar explanation (McManus & Mellecker, 2012). (Christoph et al., 2017) reported different results, which showed that children with a higher BMI were found in rural settings and with higher PA.

The research results on the relationship of Physical activity to various BMI still cannot deny the general understanding of the physiological benefits of physical activity. Physical activity provides benefits for body health. Physical activity, significantly sports, can increase myocardial efficiency by increasing blood flow and oxygen to meet local metabolism (Ani et al., 2014). Physical activity also reduces the risk of insulin resistance, blood pressure, glucose, postprandial hyperglycemia, and hepatic gluconeogenesis (Raju, 2017; Vogel et al., 2009; Wibowo et al., 2020). Physical activity is known to play a role in the distribution of body fat through the use of fat from the abdominal area due to the redistribution of adipose tissue (Zhao & Zhang, 2015). (Thompson et al., 2012) Also explained is that physical activity that is not carried out regularly causes the body fat to accumulate in the tissues.

Some limitations may need to be considered in interpreting the results of this study. Physical activity is measured through the self-reporting method, thus allowing for bias. In addition, BMI, the most accessible measuring tool to determine nutritional status, has not been able to represent the overall changes in body fat composition. Not only physical activity but students' eating patterns can also affect students' BMI (Atella & Kopinska, 2014).

The results showed that eating patterns were significantly related to BMI students. The findings reveal that diet has a significant relationship with BMI in students because it obtained r = 0.602. This is inseparable from the factors that cause changes in students' eating patterns. In addition, environmental conditions, peer influence, and lifestyle are supported by environmental modernization. This is inseparable from the factors that cause changes in students' eating patterns. In addition, environmental conditions, peer influence, and lifestyle are supported by environmental modernization. An increasingly modern lifestyle makes everything practical. One of the modern lifestyles is fast and junk food consumption. Both types of food contain high fat, so if consumed in excess and not followed by sufficient physical

activity, it will cause an increase in BMI value (Bhaskar, 2012). This statement is supported by research results (Saba Tariq et al., 2020) which state that there is a significant relationship between fast food consumption habits, body mass index, and adolescent health. Students often consume junk food because it is practical and tastes good. The junk food that students often consume is potato chips, crackers, and other snacks. In essence, the student's diet affects the student's body mass index (BMI).

CONCLUSION

Based on the research results described, it can be concluded that physical activity and eating patterns are significantly related to the BMI of students in grades 4-6 SDN Polobogo 2 Semarang Regency. It is expected that students can maintain a diet so that obesity does not occur and BMI remains stable. Physical activity alone is balanced with adequate rest.

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