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The relationship between eating patterns and physical activity with obesity among elementary school children: A case-control study

Ashma Lathifah [a], Hariza Adnani [a*], Wor Mi Thi [b]

[a] Public Health Study Program, STIKES Surya Global, Yogyakarta, Indonesia
[b] Faculty of Public Health, Khon Kaen University, Khon Khaen, Thailand
* Corresponding author: harizaadnani541@gmail.com

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ABSTRACT

In broad terms, eating patterns encompass three primary components: the type of food consumed, the frequency of eating occasions, and the portion sizes consumed. Schools are recognized as pivotal settings for initiatives aimed at preventing obesity, particularly given the potential for multifaceted interventions when addressing obesity and its associated health issues in childhood. These interventions may involve diverse strategies targeting dietary habits, physical activity levels, and broader environmental factors within the school setting. In local data between 2017 and 2020, the Province of Yogyakarta reported a 6.01% increase in the prevalence of obesity, with Yogyakarta City having the highest rate at 14.73%. This study aimed to investigate the connection between obesity in elementary school students and their eating habits and physical activity levels. This study uses a case-control methodology and is an analytical observational investigation. Purposive sampling was used in the sampling process, with 20 kids serving as the case group and 40 as the control group. Data was obtained using the formulas for physical activity, meal frequency, and 24-hour recall. The Chi-square test was used to examine the results. The results show the relationship between physical activity and eating patterns. Also, children with low physical activity have a 1.14 times greater risk of developing obesity than children who have moderate physical activity. The findings of this study show a clear correlation between obesity and food choices and physical activity levels. Thus, it can be concluded that eating behavior and physical activity levels contribute significantly to the development and management of obesity. Further research needs to be carried out into other factors that can cause obesity and effective management of children's weight requires family involvement in managing eating habits and encouraging physical exercise.

1. Introduction

Obesity experienced by children and adolescents is a global health problem with increasing prevalence in low and middle-income countries and high prevalence in many high-income countries. In 2019, the World Obesity Federation estimated that there would be 206 million children and adolescents aged 5–19 years living with obesity in 2025 and 254 million in 2030. Each of the 42 countries is estimated to have more than 1 million children with obesity. In 2030, the top ranking

will be China, followed by India, the United States, Indonesia, and Brazil, with only seven of the top 42 countries being high-income countries [1,2].

The prevalence of severe obesity in pediatric populations has increased in many high-income countries, although overall obesity prevalence is stable [3,4]. The World Health Organization states that 41 million children under the age of 5 are overweight or obese. This increase occurred equally between boys and girls. In 2016, 18% of girls were overweight, and 19% of boys were overweight. Data shows that more than 124 million children and adolescents (6% of girls and 8% of boys) in the world were obese in 2016 [5]. RISKESDAS data in 2018, nationally, the nutritional status of overweight and obesity shows an increase to 20.0%, with the percentage of nutritional status overweight at 10.8% and obesity at 9.2%. The lowest prevalence of obesity was in East Nusa Tenggara (2.4%) and the highest in Papua (15.3%), while the DI Yogyakarta Province showed a figure of 10.2%. The prevalence of obesity in DI Yogyakarta has increased from 2017 to 2020 by 6.01%, with the highest area in Yogyakarta City at 14.73% [6]. The highest obesity data in Yogyakarta is in the Gondomanan Community Health Center working area, with 17.91% or 163 cases out of 910 students in children's health screening activities at schools [7].

Childhood obesity is likely to persist into adulthood and is associated with cardiometabolic and psychosocial comorbidities and premature mortality [8]. Cardio metabolism is a group of metabolic disorders characterized by five criteria: abdominal obesity, increased triglyceride levels, decreased HDL-cholesterol, increased fasting blood glucose levels, and increased blood pressure [9]. Physical activity in childhood and adolescence can play an important role in preventing overweight and obesity, as well as reducing the health risks of these conditions [14]. In general, eating patterns have three components, namely: type, frequency and amount of food. Schools are viewed as critical locations for obesity prevention, including multifactorial interventions when obesity and related health conditions develop during childhood.

Based on nutritional status screening data carried out by the Gondomanan Yogyakarta Community Health Center in 2020, there were 69 cases of obesity at Muhammadiyah Kauman Elementary School Yogyakarta, 56 cases at Marsudini II Elementary School Yogyakarta, 54 cases at Marsudini I Yogyakarta Elementary School, 43 cases at Ngupasan Elementary School Yogyakarta, and SD Pangudi Luhur I Yogyakarta had 39 cases of obesity. Based on a preliminary study conducted on students at SD Pangudi Luhur I Yogyakarta, 3 out of 5 students interviewed by the author stated that students had eating habits with excessive calorie intake and low intensity of physical activity. Based on the background of the problem above, researchers are interested in conducting research regarding the relationship between eating patterns and physical activity and obesity in school children at Pangudi Luhur I Elementary School, Yogyakarta City. This study aims to determine the relationship between eating patterns and physical activity and obesity in children at Pangudi Luhur I Elementary School, Yogyakarta City.

2. Method

This research is an analytical observational research. The research design is case-control. The independent variables in this study are diet and physical activity, while the dependent variable is obesity. The population size was obtained through screening by measuring body weight and height to determine obese and normal (not obese) students. The sample size was determined with a ratio of 1:2. Namely, the obese student group was 20 people, and the normal student group was 40. The research sample was taken using non-probability sampling with a purposive sampling technique for determining samples with certain considerations [11]. Inclusion criteria: students aged 6-12 years, obese nutritional status category, and willing to be respondents. The exclusion criteria are students who take medication, are not present or unwilling to be respondents. This research was carried out

in June - July 2022. The instruments used in this research were a 24-hour food recall form and a physical activity form [12], step scales and TB measuring equipment. The data analysis technique used is univariate and bivariate analysis. To find the relationship between the independent variables (diet and physical activity) and the dependent variable (obesity), the chi-square test is used. This research has received ethical information from the Health Research Ethics Committee of STIKES Surya Global Yogyakarta number 1.26/KEPK/SSG/IX/2020.

3. Results and Discussion

3.1. Results

Table 1 show that student characteristics and a table of relationships between variables, namely the relationship between diet and physical activity and obesity in school children:

Table 1. Frequency Distribution of School Children's Characteristics

Characteristics		F	%
Gender	Man	32	53.3
	Woman	28	46.7
Age (Years)	7-9	34	56.7
	10-12	26	43.3
Dietary habit	Frequency of Food Consumption		
	< 3 times a day	0	0
	= 3 times a day	60	100
	> 3 times a day	0	0
	Frequency of Snack Consumption		
	> 2 times a day	7	11.6
	= 2 times a day	53	88.3
	< 2 times a day	0	0
	Calorie consumption rate		
	More		
	7-9 (Male and Female)	15	25
	10-12 (Male)	1	1.6
	10-12 (Female)	2	3.2
	Good		
	7-9 (Male and Female)	0	0
	10-12 (Male)	0	0
	10-12 (Female)	0	0
	Not Enough		
	7-9 (Male and Female)	19	31.6
	10-12 (Male)	18	30
	10-12 (Female)	5	8.3
Physical Activity	Low (< 600 METS minutes/week)	24	40
	Currently (= 600 METS minutes/week)	36	60
	Heavy (> 600 METS minutes/week)	0	0
Nutritional status	Obesity (Z-skor ≥ + 2)	20	33.3
	Normal (Z-skor < + 2)	40	66.7

Table 1 showed that in general, the students are 32 male students (53.3%), based on the age category, generally 6-9 years old, 34 children (56.7%), based on their diet, they generally had a food consumption frequency of 3 times a day (100 %). The frequency of snack consumption among school children is generally = two times a day (88.3 %). The level of calorie consumption in school children in the 7-9 years age group is generally not enough (31,6 %). In the 10-12 years age group, males are generally not enough (30%). In the 10-12 years age group, females are generally insufficient (8.3%). Based on physical activity is generally moderate as many as 36 children (60.0%), and based on nutritional status, it is generally normal as many as 40 children (66.7%).

Table 2. The Relationship between Dietary Habit and Obesity in School Children

Dietary habit		Nutritional status				Total		λ2	p-value	OR
		Obesity		*Normal*						
		n	*%*	*n*	*%*	*n*	*%*			
Frequency of food consumption	< 3 times a day	0	0	0	0	0	0			
	= 3 times a day	20	33.3	40	66.6	60	100	17.06	0.000	0.75
	> 3 times a day	0	0	0	0	0	0			
Frequency of snack consumption	< 2 times a day	2	3.33	5	8.3	7	11.6			
	= 2 times a day	18	30	35	58.3	53	88.3	6.67	0.001	0.77
	> 2 times a day	0	0	0	0	0	0			
Calorie consumption rate	More	11	18.3	7	11.6	18	30			
	Good	0	0	0	0	0	0	8.93	0.004	5.76
	Not enough	9	15	33	55	42	70			

Table 2 showed that 20 school children who are obese generally have a food consumption frequency of 3 times a day (33.3%), and 40 school children who are not obese generally have a food consumption frequency of 3 times a day (66.6%). The results of data processing show the Pearson chi-square value (λ2) count=17.06 > chi-square (λ2) table = 3.841 and p value = 0.00 < 0.05 so Ho is rejected and Ha is accepted, which means there is a relationship between frequency of food consumption and obesity in school children at SD Pangudi Luhur I Yogyakarta. This relationship also has a value of OR =0.75, which shows that children who frequently consume more food have a 0.75 times lower risk of becoming obese compared to children who frequently consume less food. The frequency of snack consumption among obese school children is generally two times a day (30,0 %), and those who are not obese are generally two times a day (58.3 %).

The results of data processing show the Pearson chi-square value (λ2) count 6.67 > chi-square (λ2) table = 3.841 and p-value = 0.01 < 0.05, so Ho is rejected and Ha is accepted, which means there is a relationship between Frequency of snack consumption and obesity in school children at SD Pangudi Luhur I Yogyakarta. This relationship also has a value of OR =0.77, which shows that children who frequently consume more snack have a 0.77 times lower risk of becoming obese compared to children who frequently consume less snacks. The calorie consumption rate among obese school children is generally more (18.3%), while nine school children who are not obese generally eat less (15.0%). The results of data processing show the Pearson chi-square value (λ2) count=8.93 > chi-square (λ2) table = 3.841 and p-value = 0.003 < 0.05, so Ho is rejected and Ha is accepted, which means there is a relationship between diet and obesity in school children at SD Pangudi Luhur I Yogyakarta. This relationship also has a value of OR = 5.76, which shows that children who eat more have a 5.76 times greater risk of developing obesity than children who eat less.

Table 3. The Relationship between Physical Activity and Obesity in School Children

Physical Activity	Nutritional status				Total		λ2	p-value	OR
	Obesity		*Normal*						
	n	*%*	*n*	*%*	*n*	*%*			
Low	12	20.0	12	20.0	24	40			
Currently	8	13.3	28	46.7	36	60	5.000	0.025	3.50
Heavy	0	0	0	0	0	0			

Based on Table 3, it can be seen that, in general, there are 12 students (20.0%) who are obese and have low physical activity. In comparison, 28 students who are not obese generally have moderate physical activity (46.7%). The statistical test results show that the Pearson chi-square (λ2) value = 5,000 >*chi-square (*λ2) table = 3.841 and p value = 0.025 < 0.05, so Ho is rejected and Ha is accepted, which means there is a relationship between physical activity and obesity in school children at SD Pangudi Luhur I Yogyakarta. This relationship also has an OR value of 3.50, which shows that

children with low physical activity have a 1.14 times greater risk of developing obesity than children who have moderate physical activity.

3.2. Discussion

The research results show that there is a relationship between diet and obesity in school children at SD Pangudi Luhur I Yogyakarta. The results of this study are in line with the results of research which states that diet greatly influences obesity, one of which is the frequency of consuming junk food which occurs due to environmental influences, both from the school, family and surrounding environment [13]. The results of other research, among others, state that students who consumed energy-dense and less nutritious foods, tended to be overweight/obese [14]. The results of this research are also in line with the research results of Jing et.al which, among other things, stated that some eating habits influence body weight, and suggests that certain cultural and economic factors may influence a child's risk of being overweight or obese [10].

A School children have a habit of snacking on high-calorie, low-fiber foods so they are very vulnerable to becoming overweight or obese. Snacks are usually dominated by high carbohydrate content and contain little protein, vitamins or minerals. Junk food is included in snack foods in the form of light snacks which are often added with food additives with the aim of improving the aroma, texture, taste, appearance and shelf life of the food. Children who consume junk food too often can cause obesity problems as a result of high calories obtained from carbohydrates [15].

The results of this research are also in line with research conducted at SD Frater Bakti Luhur Makassar which showed significant results where children who had the habit of eating excessive amounts of calories were at risk of obesity with a ρ-value of 0.031 where the ρ-value <0.05 which means the pattern excessive eating has an influence on increasing obesity rates [16]. Dietary factors that contribute to the risk of obesity in children and adolescents include excessive consumption of energy-dense, micronutrient-poor foods; high intake of sugary drinks; and widespread marketing of fast food and convenience foods [17,18]. The results of other studies suggest that there are several other factors influencing the development of obesity that are still unclear, although they may all be important. These factors are: relative factors such as: certain eating patterns (for example frequent snacking, skipping breakfast, not eating together as a family, time span from first to last meal), portion size, speed of eating, macronutrient intake, and glycemic load

The research results show that there is a relationship between physical activity and obesity in school children at SD Pangudi Luhur I Yogyakarta. The results of this research are also in line with the results of research which states that physical activity during the pandemic showed that 53 students (55.2%) tended to do moderate physical activity, while 43 students (44.8%) tended to do light physical activity. Apart from that, some children still do physical activities such as playing ball, jogging and several other activities [19]. Children's physical activity levels decrease at age 6 years and can decrease again at age 13 years. The decline was more pronounced for girls than for boys. Overall, children who are obese tend to engage in activities with a lower level of moderate and vigorous intensity than children who are thin [20,21].

Children who are obese often have difficulty moving and exercising. Therefore, efforts are needed to adjust and adapt exercise interventions, especially for those who experience musculoskeletal pain, high levels of fatigue, urinary incontinence, skin abrasions, or have impaired motor skills. In addition, the presence of intellectual or physical disabilities must also be considered. Thus, the type of exercise intervention offered will vary according to the child's clinical picture and desired outcome (e.g., increased aerobic fitness, increased enjoyment, or reduced fat mass) [22]. In most countries, the reasons why children and young people are not active enough are the loss of public recreational spaces, the increase in motorized transport and the decline in active transport

(e.g., cycling, walking, public transport), the perception of a lack of safety in the local environment leading to less active behavior, as well as increased passive entertainment [17].

The results of other studies suggest that the most effective exercise intervention consists of sessions lasting 60 minutes or more, at least 3 days per week, for a minimum of 12 weeks [23]. Training programs should be tailored to the child's physical abilities and fitness level evaluated at baseline using standardized and age-appropriate outcome measures. The intervention carried out should be enjoyable, taking advantage of the child's preferences while still following the principles of frequency, intensity, duration, type, volume and development [24].

4. Conclusion

The choice of excessive food consumption and physical activity is associated with a higher rate of childhood obesity at SDN Pangudi Luhur I in Yogyakarta City. This study ignored additional factors that may contribute to obesity, such as hereditary and non-genetic factors, as well as the psychological and psychosocial aspects of childhood development that may potentially play a role in obesity. Therefore, in order to prevent childhood obesity, researchers advise that future studies look into broader causes and mandate family involvement in helping children make healthy food choices and encouraging physical activity.

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Conflict of Interest

The author declares that this article has no conflict of interest.

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