

Dietary Intake and Physical Activity in Relation to Obesity in 6-12 Years Old Children at SDN Banyu Urip III/364 Surabaya

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ABSTRACT

Introduction: Obesity is a multifactorial disorder characterized by excessive accumulation of fat in the body. Obesity can increase the risk of various diseases in adulthood. The aim of this study is to find the relationship between carbohydrates, protein, fat, fiber intake and physical activity to obesity rate in school-age children. **Methods:** This was an analytic observational study and a cross-sectional design. This study was held at State Elementary School (SDN) Banyu Urip III/364 Surabaya from February to October 2022. The sample of this study was chosen by random sampling of all students at SDN Banyu Urip III/364 Surabaya. The data collected were nutritional status with anthropometric measurements, food intake with the 24-hour Dietary Recall (24HR), and physical activity with the Physical Activity Questionnaire for Older Children (PAQ-C). The data were analyzed by Chi-Square test and logistic regression analysis. **Results:** The prevalence of obesity in this school is 19.57%. The obese students have a high carbohydrate intake (100%), high protein intake (83,33%), high fat intake (94,44%), and half of them have a high fiber intake (50%). Majority of obese students do low-intensity physical activity. From the analysis, there is a relationship between carbohydrate intake ($p=0.045$), fat intake ($p=0.013$), fiber intake ($p=0.010$), and physical activity ($p=0.000$) with obesity. However, there is no relationship between protein intake ($p=0.264$) and obesity. **Conclusion:** Intake of carbohydrates, fats, fiber, and physical activity have a role in the incidence of obesity in school-age children.

Keywords: school-age children; macronutrient; dietary fiber; physical activity; obesity

INTRODUCTION

Nutritional status shows the growth and development of children. Factors that affect children's growth are genetics, gender, age, hormones, and nutrition [1]. The body consumes several types of nutrients, there are carbohydrates, proteins, fats, vitamins, minerals, and fiber (BPOM 2013). School-age children (6-12 years old) have a characteristic of faster growth and intellectual-skill development [2]. Based on Permenkes 2/2020, the nutritional status of 5-18 years old children can be classified by the body mass index for age indicators and a child is categorized as obesity if their z-score more than +2 SD [3].

Obesity is one of the global epidemic problems. WHO states that obesity is the fifth most common risk factor for death in the world [4]. The National Child Measurement Program shows that 19.8% of 10-11 years old children are obese (Jannah 2018). Riskesdas Indonesia 2010 states that the prevalence of obesity in 6-12 years old children is 9.2% [1].

3 years later, from the 2013 Riskesdas data, the prevalence of obesity increased to 18.8% [5]. In Surabaya, out of 46.48% residents whose BMI was measured, 15.51% were obese. Data from the Public Health Center (Puskmas) shows that the Banyu Urip Health Center in Sawahan District has the third largest prevalence of obesity with a total 47.89% obese patients [6].

Obesity is a multifactorial disorder characterized by excessive accumulation of fat in the body [7]. The cause of obesity is an imbalance of incoming energy and expended energy. The high energy intake can be caused by the excessive consumption of high-energy food sources. Less energy expended can be caused by a sedentary lifestyle [8]. Obesity can increase the risk of various diseases in adulthood. 80% obese adolescents will become obese adults as well [9]. Obesity will increase 44% risk of diabetes, 23% risk of ischemic heart disease, and 7-41% risk of cancer [10].

Another risk factor that can occur in obesity is metabolic syndrome. 45.8% obese adolescents have metabolic syndrome [11]. With all this risk, it is important for early detection of obesity in children.

This study aims to determine the relationship between intake of carbohydrates, protein, fat, fiber and physical activity with the incidence of obesity at SDN Banyu Urip III/364 Surabaya, and to determine which factors have a more dominant effect on obesity. Through this research, it is expected that there is a relationship between intake of carbohydrates, protein, fat, fiber and physical activity on obesity in school-age children

METHODS

This study was an analytic observational study and a cross-sectional design. This study was held at State Elementary School (SDN) Banyu Urip III/364 Surabaya from February to October 2022. The total population of this study was 1166 students at SDN Banyu Urip III/364 Surabaya. The sample in this study were 6-12 years old students in the population selected by simple random sampling technique, with the Slovin formula a total of 92 respondents were obtained (e = 10%).

There are 3 variables in this study: nutritional status, nutrient intake, and physical activity. Nutritional status is determined using the BMI for age classification from Permenkes 2/2020. Nutritional status was obtained from measurements of height and weight in the school medical room and the body mass index categorized based on the age of the students. It was divided into 2 categories in this study, obesity (z-score > +2 SD) and non-obesity (z-score severe thinness < -3 SD, thinness -3 SD until < -2 SD, normal -2 SD until +1 SD, and overweight +1 SD to +2 SD). Nutrient intake was obtained from a 24-hour food recall questionnaire which was filled out by students accompanied by their parents to find out the type of nutrition and the amount consumed in a day using Nutrisurvey. It was divided into 2 categories on each type of nutrition, high intake (more than the Recommended Dietary Allowances (RDA) recommendations) and low intake (less than the RDA recommendations). Physical activity was measured using the Physical Activity Questionnaire for Older Children (PAQ-C) which was filled out by students accompanied by their parents. It was divided into 2 categories, high intensity (individual scores above the median score of all samples) and low intensity (individual scores below the median score of all samples). The data were processed using Microsoft Excel and analyzed by Chi-Square test and logistic regression analysis using IBM SPSS Statistic 23. This study has received ethical approval from KEPK FKUA with number 28/EC/KEPK/FKUA/2022 and research permit approval from Dinas Pendidikan with number 070/463/S/RPM/436.7.15/2022.

RESULTS

The sample in this study is 92 students with the following characteristics:

TABLE 1: Distribution of subjects' characteristics.

Characteristics	n	%
Age		
6 years old	1	1.08
7 years old	22	23.91
8 years old	22	23.91
9 years old	7	7.60
10 years old	10	10.87
11 years old	12	13.04
12 years old	18	19.57

Characteristics	n	%
Sex		
Male	41	44.57
Female	51	55.43
Nutritional Status		
Severe Thinness	4	4.34
Thinness	12	13.04
Normal	40	43.48
Overweight	18	19.57
Obese	18	19.57

Table 1 shows that the majority of respondents are 7 and 8 years old children and are female. From the table above, the nutritional status of obesity in students had a prevalence of 19.57% and 80.43% for non-obese students.

TABLE 2: Distribution of nutrient intake.

Characteristics	n	%
Carbohydrate		
High intake	78	84.78
Low intake	14	15.21
Protein		
High intake	67	72.82
Low intake	25	27.17
Fat		
High intake	65	70.65
Low intake	27	29.34
Fiber		
High intake	24	26.08
Low intake	68	73.91

Nutrient intake in Table 2 shows students' food intake in a day using a 24-hour food recall questionnaire and adjusted for RDA according to children's age and sex. From the table it was found that the majority of students had high intake of carbohydrates (84.78%). The majority of students also had high protein intake (78.82%) and high fat intake (70.65%). Students at these schools also had low fiber intake (73.91%).

TABLE 3: Distribution of physical activity.

Physical Activity	n	%
High intensity	46	50.0
Low intensity	46	50.0

Table 3 shows the intensity of physical activity done by students. From the table it was found that 50% of students did high-intensity physical activities or above the median score of all respondents, while the other half did them with low intensity.

TABLE 4: Result of Chi-Square Test and Cross Tabulation in Obese and Non-Obese Student.

	Obese	Non-Obese	p (sig)
	n	n	
Carbohydrate			
High intake	18	60	0.045
Low intake	0	14	
Protein			
High intake	15	52	0.264
Low intake	3	22	
Fat			
High intake	17	48	0.013
Low intake	1	26	
Fiber			
High intake	9	15	0.010
Low intake	9	59	

	Obese	Non-Obese	p (sig)
	n	n	
Physical Activity			
High intensity	2	44	0.000
Low intensity	16	30	

The Chi-Square test aims to determine the relationship between carbohydrate intake, protein intake, fat intake, fiber intake, and physical activity on obesity in this study. The p value <0.05 means that there is a relationship with obesity. And also, table 4 shows the cross tabulation of nutrient intake and physical activity in obese and non-obese students. Table 4 shows some of the characteristics of obese students in this study. All obese students have high carbohydrate intake and from the Chi-Square test, a p value of 0.045 < 0.05 means that carbohydrate intake has a relationship with obesity. The majority of obese students have high protein intake with a total of 15 out of 18 students and obtained a p value of 0.264 > 0.05, meaning that protein intake has no relationship with obesity. The majority of obese students have high fat intake with a total of 17 out of 18 students and obtained a p value of 0.013 < 0.05, meaning that fat intake has a relationship with obesity. Half of the obese students had low fiber intake and obtained a p value of 0.010 < 0.05, meaning that fiber intake has a relationship with obesity. The majority of obese students did low intensity physical activity with a total of 16 out of 18 students and obtained a p value of 0.000 < 0.05, meaning that physical activity has a relationship with obesity. From all the Chi-Square tests, it was found that carbohydrate intake, fat intake, fiber intake, and physical activity had a relationship with obesity.

TABLE 5: Result of Logistic Regression Test.

	B	S.E	Wald	df	Sig	Exp
Carbs	19.9	921	0.00	1	0.99	454
Fat	1.67	1.11	2.26	1	0.13	5.35
Fiber	1.29	0.65	3.90	1	0.04	3.64
Physical	-2.22	0.82	7.26	1	0.00	0.10
Constant	-22.2	921	0.00	1	0.99	0.00

The logistic regression test aims to determine whether the factors in this study can have a relationship with obesity simultaneously and partially, and to determine how much impact it has on obesity. From the test, p value 0.000 was obtained on the Omnibus Test and a Nagelkerke R score 0.424 was obtained. This means that carbohydrate intake, fat intake, fiber intake, and physical activity simultaneously influence obesity and give an effect of 42.4%. The partial influence of these factors is shown in the table above. Table 5 shows that fiber intake has a p value of 0.04 < 0.05 which means that fiber intake has a partial effect on obesity. Physical activity also has a p value of 0.00 < 0.05 and it is significant that physical activity has a partial effect on obesity.

DISCUSSION

Nutritional problems that can occur in school-age children are anemia, stunting, wasting, and obesity [12]. Obesity is associated with an increase in body weight due to an increase in excess fat. Obesity can occur if energy intake is higher than energy output. Someone is said to be obese if their z-score is > +2 SD [3]. The characteristics of students in this study showed that the prevalence of non-obese students was 80.43%. This is in line with Putri's research [13] that most children experience good nutrition. The prevalence for obese students in this study is 19.57%, and this number is close to the obesity prevalence rate in Septiani's study [5]. for students at SDN 01 Tonjong of 16.7%.

The high prevalence of obesity in school-age children is also influenced by their social environment, where there is an assumption in society that obese children are healthy, adorable, and a symbol of parents' financial success [14].

Macronutrients are needed by the body in large amounts compared to micronutrients for child growth. The types of macronutrients are carbohydrates, proteins, and fats. Fiber is one of the food ingredients related to body weight control. The majority of students in this study had a high carbohydrate intake (84.78%). This data is different from the research by Maesarah [15] and Astuti [16] where the majority of carbohydrate intake is low or below the RDA. All obese students consume carbohydrates more than the RDA recommendation in a day. This is in line with research by Bibiloni [17] that the carbohydrate intake of obese children is higher than normal nutritional children. The results of the study analysis show that there is a relationship between carbohydrate intake and obesity. The results of this study are in line with the research by Widyantari [18] and Primashanti [19]. Carbohydrates are the main source of energy for the body. Foods that contain carbohydrates will be processed by the body through the process of glycolysis and produce energy for the body's metabolic processes. If energy needs are met, glucose will be stored in the form of glycogen in the liver, muscle tissue, and fat tissue [19].

The majority of protein intake in the study was high (72.82%). Research in Vietnam also shows that children get a lot of energy from high protein intake, especially animal protein [20]. 15 of the 18 obese students in the study had a high protein intake. This data is in line with Rachmawati's research [21] that 71.4% of obese respondents had excess protein intake and were 4.81 times at risk of developing obesity. However, in the analysis results, it was found that there was no relationship between protein intake and obesity. These results are in line with research by Ariani [22] and Ermona [23] that there is no effect of protein intake on obesity. Protein gives the impression of increasing body weight because there is an increase in body muscle mass. This increase is related to the fat free mass index (FFMI) and the anabolic effects of insulin before puberty. Insulin resistance begins to rise at puberty and several years before puberty, so this increase in insulin resistance causes changes in growth hormone (GH), insulin like growth factor-1 (IGF-1), and steroid hormones which all contribute to an increase in fat-free mass. /FFMI. High protein intake will induce insulin resistance through insulinogenic amino acids [24].

The majority of fat intake in the study was high (70.65%). This data is in line with several studies in Asia, there is research by Wan Dali [25] in Malaysia, Huynh [20] in Vietnam, Gharib [26] in Bahrain, and Zhao [27] in China which shows that children's daily energy intake is mostly obtained from fat. . 17 out of 18 obese students have high fat intake. This data is in line with Widyantari's research [18]. where obese children more often consume high-fat foods. Children who have excessive fat intake will cause hypertrophy and hyperplasia of adipocyte tissue. Excessive fat consumption without being followed by an increase in fat oxidation will cause 96% of fat to be stored in the body and cause nutritional problems [23].

The majority of fiber intake in the study was low (73.91%). This data is in line with research by Armin [28] and Nabilah [29] where most children consumes less fiber. A person's low fiber intake is influenced by the level of knowledge related to fiber and the role of parents in their child's intake [28]. In the study, it was found that there was a relationship between fiber intake and obesity.

These results are in line with the research by Maharani [30] and Rizqiya [31] that there is a significant relationship between fiber intake and obesity. High fiber intake is associated with high HDL-C levels and low blood triglyceride levels, both of which are closely related to the body's cardiometabolic health. The mechanism by which fiber relates to blood lipid levels can be explained by two mechanisms. First, fiber decreases gastric emptying and reduces the acute postprandial response that can control postprandial fluctuations in glucose and lipid levels. Low fluctuations in the long term can reduce the risk of cardiometabolic disturbances. Second, there is lipid absorption which is affected by fiber intake which leads to a decrease in liver cholesterol [32]. Fiber can also control body weight through intrinsic, hormonal and colonic pathways. These three pathways can provide satiety effects, reduce hunger, and increase fat oxidation in the body [33]. Soluble fiber slows down the absorption of glucose, cholesterol and bile salts so it can control blood sugar and cholesterol levels. Water-insoluble fiber also helps facilitate the process of defecation [34].

Physical activity is the activity of moving the body to release energy. This activity is important to improve physical fitness [35]. The benefits of exercise include reducing fat mass and increasing muscle strength so that it can prevent excess fat accumulation in the body [23]. There were 50% of the 92 students doing high intensity physical activity and the remaining 50% doing less intensity physical activity. 16 out of 18 obese students (88.89%) did low intensity physical activity. This is in line with research in China [27] that sedentary behavior is mostly carried out by children. Lack of physical activity will cause fewer calories to be burned so that there is the potential for excess fat accumulation in the body. From the results of the analysis, a relationship was found between physical activity and obesity. These results are in line with research by Wahyuni [36] and Rahma [37] that there is a relationship between physical activity and obesity.

From the results of multivariate analysis, it was found that intake of carbohydrates, fats, fiber and physical activity worked simultaneously to affect obesity. Factors of carbohydrate intake, fat intake, fiber intake, and physical activity have an effect of 42.4% on the incidence of obesity. This is in line with research conducted by Aprilia [38] where children who do not exercise regularly tend to have a higher energy intake, so that these two factors affect nutritional status. The more dominant factor from the results of this study was physical activity which had the greatest significance (Sig. 0.000) with the incidence of obesity, then there were factors of fiber intake, fat intake, and carbohydrate intake. These results are in line with Lubis' research [9] that physical activity is the dominant factor in obesity. Research by Brown [39] also states that nutrient intake interventions do not reduce body mass index (BMI), but physical activity interventions have an effect on reducing BMI numbers and reducing the risk of obesity in 6-12-year-old children.

CONCLUSIONS

Intake of carbohydrates, fats, fiber, and physical activity have a role in the incidence of obesity in school-age children. In contrast, protein intake has no effect on the incidence of obesity at that age.

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