

## **The Relationship between Nutritional Intake and Obesity in Children during the Covid-19 Pandemic**

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### **Abstract**

The Covid-19 pandemic has affected school children who are not homeschooled. Moreover, the pandemic has negatively impacted their food intake, sleeping behavior, and physical activities; these impacts lead to obesity. This study aims to (1) describe the children's intake of energy and nutrients (KH, protein, and fat) that cause obesity during the 2021 Covid-19 pandemic, (2) describe the incidence of obesity in children during the 2021 Covid-19 pandemic, and (3) analyze the relationship between food intake and the incidence of obesity in children during the 2021 Covid-19 pandemic. This study employed a quantitative design with a cross-sectional approach. The researchers investigated the relationship between energy, carbohydrate, fat, and protein intake and obesity in children. This research was conducted at Raudhatul Mubarakah Islamic Boarding School from 31 August to 6 September 2021. This study has discovered that most of the respondents (78%) have insufficient energy intake, 23 samples (46%) have insufficient carbohydrate intake, 39 samples (78%) have insufficient fat intake, and 20 samples (40%) have sufficient protein intake. Moreover, this study has found that 22 samples (44%) are obese while 28 samples (56%) are not obese. Finally, this study has proven a relationship between protein intake and the incidence of obesity ( $p < 0.05$ ). Meanwhile, energy, carbohydrate, and fat intakes do not show significant relationships with the incidence of obesity ( $p > 0.05$ ).

**Keywords:** children, Covid-19, food intake, obesity, pandemic

### **Introduction**

Obesity is a metabolic disease characterized by excessive fat accumulation in the body. The state of obesity can be measured using the percentage of body fat as a proportion of a person's body fat mass (Effendy et al., 2018; Sriwahyuni, 2021). Obesity is defined as a state of excessive fat levels that accumulate in a person's body tissues, resulting in chronic disease accumulation in obese children (Triana et al., 2020; Sriwahyuni, 2021).

Sargowo and Andarini (2011) have discovered that being overweight and obesity is the main problems for the body because their effects delay the body's movement. Moreover, lack of movement will disable a body to process fat into carbohydrates. As a result, fat that can affect physical health continuously accumulates. An example of this condition is having many folds in the stomach, waist, and arms. Such a condition also results in psychological consequences, such as shame and a lack of confidence (Triana et al., 2020; Sriwahyuni, 2021).

Obesity is one of the first signals of the emergence of non-communicable diseases; such a condition is recently occurring in developed and developing countries. This phenomenon is described as the new world syndrome. The prevalence of obesity is increasing in both developed and developing countries (Pramono et al, 2014). According to WHO, obesity and overweight are risk factors for non-communicable diseases, such as hypertension, diabetes, and coronary heart disease. It is estimated that in 2010, 43 million children in the world were obese and overweight, and 35 million of them live in developing countries. WHO reports that in 2014, 39.0% of children aged 5-19 years were obese, and more women were obese (40.0%) than men were (38.0%) (Rahmad, 2019).

Changes in lifestyle are in line with the increasing level of prosperity; such a condition influences eating habits. The human diet shifts to the consumption of foods with high fat, sugar, and salt but little fiber and vitamins (Pramono, 2014). Diet is the most important behavior that affects nutritional conditions. Good nutritional conditions can improve an individual's and community's health. Moreover, a good diet is guided by balanced nutrition.

Three main risks that correlate between the Covid-19 pandemic and obesity in adults, adolescents, and children are chronic subclinical inflammation, impaired immune response, and cardiorespiratory disease. The Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) has that threatened public health and attracted worldwide attention. On 30 January 2020, the World Health Organization (WHO) declared the Covid-19 pandemic as a health emergency. As a result, Covid-19 has triggered international concern (Yanti et al., 2020). Indonesia also declared a national emergency due to Covid-19 (Khasanah et al., 2020). Unpredictable circumstances in the form of the Covid-19 disease outbreak have brought urgent changes to various sectors. The virus rapidly develops throughout the world. Global data report that the scope and impacts of Covid-19 continuously increase.

Unfortunately, the Covid-19 pandemic has affected school children, especially those who are not homeschooled, because they more intensely gadget screens, show a negative impact on eating and sleeping behavior, and perform insufficient physical activities; such a condition may lead to obesity (Adityawarman, 2007).

Indonesia has a high prevalence of obesity and overweight. The 2007-2013 data of the Basic Health Research denote that based on the body mass index (BMI), the prevalence of obesity in the population aged 18 years and above increased by 15.4%; 19.7% of the cases were found in men, and 32.9% of the cases were found in women. Meanwhile, the prevalence of overweight in children aged 6-14 years is 8.8% in boys and 6.4% in girls. The national figure presents that in 2013, Aceh Province was included as the province with the prevalence of overweight in the population aged >18 years is 16.3%, and that in children aged 6-14 years is 5.9%; the proportion of men (6.7% ) is greater than that of women (5.2%) (Rahmad, 2019).

## **Methods**

This study employed a quantitative design using a cross-sectional approach. The researchers investigated the relationship between substance intake and the incidence of obesity in children. This study was conducted to determine the relationship between the dependent variables (energy, carbohydrate, fat, and protein intake) and the independent variable (obesity). Furthermore, the collected data were analyzed to test the hypothesis. This study was conducted at Raudhatul Mubarakah Islamic Boarding School in Darul Imarah District. The population of this

study was all students of Raudhatul Mubarakah Islamic Boarding School. Meanwhile, the sample of this study was 50 students of the Raudhatul Mubarakah Islamic Boarding School.

## Results

### *Characteristics of the Sample*

Respondents of this study were 50 students of the Raudhatul Mubarak Islamic Boarding School. The variable characteristics of the respondents were gender, age, class, and anthropometric measurement.

The sample's characteristics are grouped based on gender and age, as follows.

Table 1. Characteristics of the sample based on gender and age

Characteristics		Frequency	Percentage (%)
Gender	Man	25	50.0
	Woman	25	50.0
Age	9 years old	15	30.0
	10 years old	17	34.0
	11 years old	18	36.0
Total		50	100.0

Table 1 presents that the gender distribution of the respondents at Raudhatul Mubarakah Islamic Boarding School is 25 males (50%) and 25 females (50%). Meanwhile, the age distribution of the respondents shows that 15 respondents are nine years old (30%), 17 respondents are ten years old (34%), and 18 respondents are 11 years old (36%).

### *Intake Rate Values*

The respondents' characteristics based on values of intake levels of energy, protein, fat, and carbohydrates are summarized in Table 2.

Table 2. Values of Intake Levels

Types of Intake	Min	Max	Mean	Standard Deviation
Energy intake	536.8	2174.4	1286.246	357.8005
Protein intake	17.7	71.2	44.466	11.7168
Fat intake	8.6	117.2	36.136	16.3566
Carbohydrate intake	92.9	385.7	214.848	58.2893

Table 2 shows the minimum values of intake levels: energy intake of 536.8, protein intake of 17.7, fat intake of 8.6, and carbohydrate intake of 92.9. Moreover, the table shows the maximum value of intake levels: energy intake of 2174.4, protein intake of 71.2, fat intake of 117.2, and carbohydrate intake of 385.7. The average value of energy intake is 1286.242, that of protein intake is 44.466, that of fat intake is 36.136, and that of carbohydrate intake is 214,848.

### *Occurrence of Obesity*

The respondents' characteristics based on the incidence of obesity are categorized into two: obesity and non-obesity. These categories are seen in Table 3.

Table 3. Frequency distribution of respondents based on the incidence of obesity

<b>Incidence of obesity</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Obese</b>	22	44.0
<b>Not obese</b>	28	56.0
<b>Total</b>	50	100.0

Table 3 shows that 22 respondents (44%) are obese while only 28 respondents (56%) are not obese.

#### *Intake Energy*

The respondents' characteristics based on energy intake are categorized into three: low, adequate, and excessive intakes. These categories are presented in Table 4.

Table 4. Frequency distribution of respondents based on energy intake

<b>Energy intake</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Sufficient intake</b>	11	22.0
<b>Insufficient intake</b>	39	78.0
<b>Total</b>	50	100.0

Table 4 shows that most of the respondents or 39 respondents (78%) have insufficient energy intake while 11 respondents (22%) have sufficient energy intake.

#### *Carbohydrate Intake*

The respondents' characteristics based on carbohydrate intake are categorized into three: low, adequate, and excessive intakes. These categories are presented in Table 5.

Table 5. Frequency distribution of respondents based on carbohydrate intake

<b>Carbohydrate intake</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Excessive intake</b>	7	14.0
<b>Sufficient intake</b>	20	40.0
<b>Insufficient intake</b>	23	46.0
<b>Total</b>	50	100.0

Table 5 presents that most of the respondents or 23 respondents (46%) have insufficient carbohydrate intake. Meanwhile, 20 respondents (40%) have sufficient carbohydrate intake, and 7 respondents (14%) have excessive carbohydrate intake.

#### *Fat Intake*

The respondents' characteristics based on fat intake are categorized into three: low, adequate, and excessive intakes. These categories are summarized in the following table.

Table 6. Frequency distribution of respondents based on fat intake

<b>Fat intake</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Excessive intake</b>	7	14.0
<b>Sufficient intake</b>	4	8.0
<b>Insufficient intake</b>	39	78.0
<b>Total</b>	50	100

Table 6 deploys that the majority of the respondents or 39 respondents (78%) have insufficient dietary fat intake, 7 respondents (14%) have excessive dietary fat intake, and 4 respondents (8%) have sufficient intake.

*Protein Intake*

The respondents' characteristics based on protein intake are categorized into three: low, sufficient, and excessive intakes. These categories are presented in Table 7.

Table 7. Frequency distribution of respondents based on protein intake

<b>Protein intake</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Excessive intake</b>	14	28.0
<b>Sufficient intake</b>	20	40.0
<b>Insufficient intake</b>	16	32.0
<b>Total</b>	50	100.0

Table 7 shows that the majority of respondents or 20 respondents (40%) have sufficient protein intake, 16 respondents (32%) have insufficient protein intake, and 14 respondents (28%) have excessive.

*Relationship of Energy Intake with Obesity Incident*

The Chi-Square test to see the relationship between energy intake and the incidence of obesity during the COVID-19 pandemic at Raudhatul Mubarakah Islamic Boarding School can be seen in the table below.

Table 8. The relationship between energy intake and the incidence of obesity

<b>Energy intake</b>	<b>Incidence of obesity</b>		<b>Total</b>	<b>(%)</b>	<b>P-Value</b>
	<b>Obesity</b>	<b>Fat</b>			
<b>Sufficient intake</b>	1	10	11	9,0	0,014
<b>Less intake</b>	21	18	39	53,0	
<b>Total</b>	22	28	50		

The chi-square test has revealed that the p-value of the relationship between energy intake and the incidence of obesity during the Covid-19 pandemic is 0.014. This result indicates

no relationship between energy intake and the incidence of obesity during the COVID-19 pandemic at Raudhatul Mubarakah Islamic Boarding School ( $p > 0.05$ ).

*Relationship between Carbohydrate Intake and Obesity Incident*

The chi-square test examines the relationship between carbohydrate intake and the incidence of obesity during the COVID-19 pandemic at Raudhatul Mubarakah Islamic Boarding School. The test results are summarized in the following table.

Table 9. The relationship between carbohydrate intake and the incidence of obesity

Carbohydrate intake	Incidence of obesity		Total	(%)	P-value
	Obesity	Fat			
<b>Excessive intake</b>	6	1	7	85.7	0.036
<b>Sufficient intake</b>	9	11	20	45.0	
<b>Insufficient intake</b>	7	16	23	30.0	
<b>Total</b>	22	28	50		

The chi-square test has discovered that the p-value of the relationship between carbohydrate intake and the incidence of obesity during the Covid-19 pandemic is 0.036. This score indicates no relationship between carbohydrate intake and the incidence of obesity during the Covid-19 pandemic at Raudhatul Mubarakah Islamic Boarding School ( $p > 0.05$ ).

*Relationship between Fat Intake and Obesity*

The Chi-Square test examines the relationship between fat intake and the incidence of obesity during the Covid-19 pandemic at Raudhatul Mubarakah Islamic Boarding School. The test results are summarized in the following table.

Table 10. Analysis of the relationship between fat intake and obesity

Fat intake	Incidence of obesity		Total	(%)	P-values
	Obesity	Fat			
<b>Excessive intake</b>	6	1	7	85.7	0.049
<b>Sufficient intake</b>	2	2	4	50.0	
<b>Insufficient intake</b>	14	25	25	56.0	
<b>Total</b>	22	28	50		

The Chi-Square test has revealed that the p-value of the relationship between fat intake and the incidence of obesity during the Covid-19 pandemic is 0.049. This result indicates no relationship between fat intake and the incidence of obesity during the Covid-19 pandemic at Raudhatul Mubarakah Islamic Boarding School ( $p > 0.05$ ).

*Relationship between Protein Intake and Obesity*

The chi-square test examines the relationship between protein intake and the incidence of obesity during the Covid-19 pandemic at Raudhatul Mubarakah Islamic Boarding School. The test results are summarized in the following table.

Table 11. Analysis of the relationship between protein intake and obesity

Protein intake	Incidence of obesity		Total	(%)	P-Value
	Obesity	Fat			
<b>Excessive intake</b>	2	12	14	14.2	0.003
<b>Sufficient intake</b>	8	12	20	40.0	
<b>Insufficient intake</b>	12	4	16	75.0	
<b>Total</b>	22	28	50		

The Chi-Square test has discovered that the p-value of the relationship between protein intake and the incidence of obesity during the Covid-19 pandemic is 0.003. This result indicates a relationship between protein intake and the incidence of obesity during the Covid-19 pandemic at Raudhatul Mubarakah Islamic Boarding School ( $p > 0.05$ ).

## Discussion

### *The Relationship between Energy Intake and Obesity Incidence*

The Chi-Square test has discovered that the p-value of the relationship between energy intake and the incidence of obesity is 0.014. This value denotes no relationship between energy intake and the incidence of obesity during the Covid-19 pandemic at Raudhatul Mubarakah Islamic Boarding School ( $p > 0.05$ ). This finding disagrees with Ramadhaniah et al. (2014) who have discovered a significant relationship between energy intake and the incidence of obesity in health workers in Pidie Jaya District, Aceh Province.

The relationship between energy intake and the weakness of the 2 x 24-hour food recall method cannot describe daily food intake. In addition, the accuracy is highly dependent on the respondents' memory. The results of the food recall demonstrate that in general, respondents consume the main food three times a day without being interspersed with other additional food. In addition, they consumed less food, less menu, and less diverse food menu (Kurniawati et al., 2016).

Another study by Dewi (2017) postulates that excessive energy intake is the main cause of obesity problems. Energy is obtained from the metabolism of nutrients in the body. Types of nutrients obtained by the body include protein, carbohydrates, and fats. Each nutrient requires different processes and produces a different amount of energy. Energy-dense food accompanied by a lack of physical activities will result in weight gain. Moreover, most of the excessive energy will be stored as fat, and this fat accumulation will cause obesity.

Energy is produced from four classes of nutrients: fats, carbohydrates, proteins, and alcohol. The digestive process converts the four nutrients into monomers through the hydrolysis process. These monomers can be taken from circulating the tissues and oxidized elements to produce ATP (the basic energy-producing molecule). Greater energy intake than the amount of energy used will make the body store excessive energy. This excessive energy will usually be stored in the form of triglycerides in adipose tissue (Emirza, 2012).

### *The Relationship between Carbohydrate Intake and Obesity Incidence*

The chi-square test has discovered that the p-value of the relationship between carbohydrate intake and the incidence of obesity is 0.036. This result indicates no relationship

between carbohydrate intake and the incidence of obesity during the COVID-19 pandemic at Raudhatul Mubarakah Islamic Boarding School ( $p > 0.05$ ). This result is supported by Sasmito (2015) who has discovered the correlation between the carbohydrate intake and the incidence of obesity with a  $p$ -value = 0.021 ( $p > 0.05$ ). This score denotes no significant relationship between carbohydrate intake and the incidence of obesity in adolescents aged 13-15 years.

The coefficient values are in the same direction. Higher carbohydrate intake will result in a higher nutritional status. In contrast, lower carbohydrate intake will result in a lower nutritional status. A study investigated adolescents in New York and has found that adolescents with low carbohydrate intake for 12 weeks experience a weight loss of 9.9 + 9.3 kg. If carbohydrate intake is carried out for a longer time, the desired normal nutritional status will be obtained (Sasmito, 2015).

Carbohydrates are the main macronutrients for humans because carbohydrates act as the main energy source. All types of carbohydrates, such as monosaccharides, disaccharides, and polysaccharides, consumed by humans will be converted into glucose in the liver. Carbohydrates contribute energy for + 4 kcal per 1 gram (Emirza, 2012).

#### *The Relationship between Fat Intake and Obesity*

The chi-square test has discovered that the  $p$ -value of the relationship between fat intake and the incidence of obesity is 0.049. This value indicates no relationship between fat intake and the incidence of obesity during the Covid-19 pandemic at Raudhatul Mubarakah Islamic Boarding School ( $p > 0.05$ ). This result agrees with Sasmito (2015) who has discovered the correlation between fat intake and the incidence of obesity with a  $p$ -value = 0.606 ( $p > 0.05$ ). Therefore, there is no significant relationship between fat intake and the incidence of obesity in adolescents aged 13-15 years.

The result of this study is in accordance with the theory postulating that excessive fat intake over a long period can trigger obesity. High-fat food has a delicious taste and low satiety ability. Consequently, people tend to consume High-fat food in excess. The storage capacity of micronutrients also determines energy balance. In fact, fat has an unlimited storage capacity (Dewi, 2015).

Obese adolescents consume more total energy, fat, and more saturated fatty acids than non-obese adolescents with nutritional status do. This excess intake will determine the percentage of body fat that controls physical activities. However, this statement disagrees with Gilis et al. (2004) who conducted a partial regression statistical test for bivariate analysis. He only measures the intake of adolescents with obese nutritional status, and the adolescents with more nutritional status are categorized as non-obese adolescents. Other factors that affect a person's nutritional status, such as hormones and abnormal hormone production, can increase the risk of obesity (Sasmito, 2015).

Continuously consuming excessive fat can result in overnutrition. Fat is a macronutrient that contributes to the highest energy per gram among other macronutrients. Every 1 gram of fat can produce +9 kcal of energy. The fat consumed will be converted into fatty acids after going through the digestive process. Most of the produced fatty acids will be absorbed by muscle cells, fat cells, and other cells. Muscle cells normally use fatty acids to produce energy. Meanwhile, fat cells will store fatty acids as triglycerides. Excess fat intake will continuously accumulate fat tissue and can be stored in unlimited amounts (Emirza, 2012).



*The Relationship between Protein Intake and the Incidence of Obesity*

The chi-square test has discovered that the p-value of the relationship between protein intake and the incidence of obesity is 0.003. This result is supported by Maria et al. (in Rahmawati, 2018) who have proven a relationship between protein intake and obesity in elementary school children in Italy ( $p = 0.01$ ). Maria et al. (in Rahmawati, 2018) have discovered that obese children aged 9-13 years have a higher percentage of protein adequacies and protein intake than normal children do. Moreover, elementary school children's appetite tends to increase because their body needs preparation for the growth and development phases. Unfortunately, children prefer replacing vegetables with side dishes from animal and vegetable protein sources at mealtime. As a result, they have less fiber intake but high protein intake.

Furthermore, protein as one of the macronutrients produces energy. Every 1 gram of protein can contribute + 4 kcal of energy. Excessive protein intake can lead to weight gain because protein can be converted into energy. When the protein intake is more than required by the body, the excessive amino acids will be converted into fat (lipogenesis). Glucogenic and ketogenic amino acids will undergo deamination, a process of releasing the amino group ( $\text{NH}_2$ ) from amino acids into energy and acetyl-CoA. Afterward, the acetyl-CoA molecule will be assembled into fat and stored in fat tissues (Emirza, 2012).

Adolescents' protein intake comes from vegetable protein sources, such as nuts, soy products (tofu, tempeh), vegetables, and fruit. Meanwhile, 20 grams of beans, 110 grams of rahu, and 50 grams of tempeh contain 5 grams of protein, for each. Vegetables and fruit also contain protein but in a small amount. Vegetable B (spinach, broccoli, and kale) contains 1 gram of protein while vegetable C (cassava leaves and young jackfruit) contains 3 grams of protein. The most consumed vegetable protein intake by adolescents is fruit, but fruit contains a small quantity of protein. A vegetable that contributes the largest protein content is soybean products. The intake of soybean products is 65 grams/day. This amount is still less than the recommended intake of vegetable protein, namely 2-3 units of exchange in one day (Suryandari et al., 2015).

## **Conclusion**

During the Covid-19 pandemic, children have insufficient energy, carbohydrates, and fat intake, but have sufficient protein intake. The incidence of obesity in children during the pandemic is 44%. This study has proven energy, carbohydrate, and fat intakes do not relate to the incidence of obesity in children during the pandemic. However, there is a significant relationship between protein intake and the incidence of obesity in children during the pandemic.

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