

# The Relationship Between Energy Intake, Macro Nutrition, and Other Factors with the Incidence of Obesity in Students of Senior High School 11 South Tangerang

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**Keywords:** Adolescents, Nutrient Intake, Obesity.

**Abstract:** The prevalence of obesity in South Tangerang is quite high at 15.9%. Factors causing obesity in adolescents are excessive macronutrient intake, increased consumption of junk food, decreased physical activity, and lack of nutrition knowledge. This study aims to analyze the relationship between energy intake, macronutrients and other factors with the incidence of obesity in students of SMAN 11 South Tangerang. This study used Cross Sectional design with a Random Sampling Technique and obtained 66 samples of X and XI grade students of SMAN 11 South Tangerang. Data were collected by 24-hour recall interview, distribution of nutritional knowledge questionnaire, FFQ (Food Frequency Questionnaire), and IPAQ (International Physical Activity Questionnaire), and measurement of height and weight. Bivariate data analysis using Chi-Square test. Students of SMAN 11 South Tangerang were obese as much as 24.2%. The results of the relationship test with obesity obtained energy intake ( $p=0.563$ ), protein intake ( $p=0.462$ ), fat intake ( $p=0.202$ ), carbohydrate intake ( $p=0.143$ ), junk food consumption ( $p=0.572$ ), nutritional knowledge ( $p=0.712$ ), and physical activity ( $p=0.002$ ). The conclusion is that there is no relationship between energy intake, macronutrient intake, junk food consumption, and nutritional knowledge with the incidence of obesity in students of SMAN 11 South Tangerang with a  $P>0.05$ . There is a relationship between physical activity and the incidence of obesity in students of SMAN 11 South Tangerang with a  $p$ -value of ( $>0.05$ ).

## 1 INTRODUCTION

Nutritional status is a condition caused by a balance between intake of nutrients from food and the body's need for nutrients. Obesity is an indicator of nutritional status where the intake of nutrients from food consumed exceeds the nutrients needed by the body. Obesity occurs due to excessive accumulation of fat due to an imbalance between energy intake and energy used for a long time. The problem of obesity has become a big problem in Indonesia. Obesity in adolescents can continue into adulthood because it is a serious problem (Telisa, Hartati, & Haripamilu, 2020). Based on data from the 2018 Riskesdas, there is a prevalence of obesity or overweight in adolescents aged 13-15 years, namely 16.0% and in adolescents aged 16-18 years, namely 13.5%. Banten Province is one of the provinces with a prevalence rate of obesity in adolescents above the Indonesian national average, which is 22.1%. South Tangerang is one of the cities in Banten Province which has a high prevalence of obesity, which is 15.9%.

Lifestyle changes are currently occurring in society, especially among adolescents in the form of decreased physical activity and changes in eating patterns that can cause nutritional status instability, namely increased body weight. Other factors that can cause obesity in adolescents include excessive intake of macronutrients, increased consumption of junk food, age and gender (Telisa et al., 2020). In addition, the level of knowledge of adolescents is also one of the factors that cause obesity (A. Dewi et al., 2023). Factors such as decreased physical activity, excessive intake of macronutrients, increased consumption of junk food, and this level of nutritional knowledge, if carried out in a sustainable manner, can lead to the risk of obesity. Adolescents who are obese and who are not treated until adulthood can increase the risk of metabolic diseases and non-communicable diseases (NCDs) such as coronary heart disease, hypertension, stroke, cholesterol, and diabetes mellitus (Suha & Rosyada, 2022).

According to research conducted by Sembiring (2022), there is a relationship between physical activity and obesity in adolescents at Cerdas Bangsa

Private High School, Deli Tua District, Deli Serdang Regency, Medan with a p-value of 0.021(Sembaring, Rosdewi, & Yuningrum, 2022). Research conducted by Telisa (2020), shows that factors that are significantly related and become risk factors for obesity in adolescents are energy, protein, fat, and carbohydrate intake, fast food consumption, and physical activity(Telisa et al., 2020).

According to research conducted by Dewi, et al (2023), there is a relationship between diet, level of knowledge, and consumption of fast food with the incidence of obesity with the results of 67.1% of students experiencing obesity, 71.1% of students experiencing poor diet, 67.1% of students experiencing a low level of knowledge, and 57.8% of students choosing fast food consumption(A. Dewi et al., 2023).

The researcher chose the research location at SMAN 11 South Tangerang because it is located in an urban area, there has never been any previous research, and the survey results can describe many students who have obesity nutritional status. Based on previous studies which stated that there are many factors that cause obesity in adolescents and see the prevalence rate of obesity in South Tangerang is quite high. This study aims to determine the relationship between energy intake, intake of macronutrients (protein, fat, and carbohydrates), consumption of junk food, physical activity, and knowledge of nutrition with the incidence of obesity.

## 2 METHODS

This research is a type of observational research with a cross-sectional research design. The population in this study were all students of class X and XI at SMAN 11 South Tangerang with a total of 783 students who met the inclusion and exclusion criteria. Samples were taken using the Simple Random Sampling technique with a hypothesis testing formula with a population proportion approach of 2 (Lemeshow, 1997) and a total sample of 66 was obtained. This research has obtained ethical eligibility and has been approved by the KEPK FKK-UMJ.

The instrument testing in this study, namely:

- a. Body weight was obtained by measuring using standard The scales with an accuracy of 0.1. The scales were placed on a flat floor, and the respondents who were weighed did not use footwear. Body height was obtained by measuring using a microtoise that was attached to the wall with a height of 2 meters from the floor (accuracy 0.1).The respondents were

measured in an upright standing position with their shoulders and heels against the wall and did not use footwear. Then the data obtained is calculated using the BMI formula to determine a person's nutritional status.

- b. In terms of energy intake and intake of macronutrients, researchers and enumerators with a background in nutrition education conducted 2x24 hour recall interviews with respondents by asking what food and drink they had consumed the previous day. This 1x24 hour recall is carried out 2 times on different days.
- c. For the consumption of junk food, researchers used a modified FFQ (Food Frequency Questionnaire) questionnaire(Irawan, 2022) and(Arifin, 2019).
- d. In measuring physical activity, researchers used a questionnaire regarding physical activity or what activities were carried out during the last 7 days using a questionnaire(IPAQ., 2004)short form version.
- e. In terms of nutritional knowledge, researchers used a questionnaire regarding knowledge of balanced nutrition that had been tested for validity and reliability tests.

Data analysis was performed using the SPSS application to obtain univariate and bivariate analysis test results. Bivariate analysis in this study was the relationship between energy intake, protein intake, fat intake, carbohydrate intake, consumption of junk food, physical activity, and knowledge of nutrition with the incidence of obesity using the Chi-Square Test.

## 3 RESULTS

### 3.1 Overview of Respondent Characteristics

Table 1: Characteristics of Respondents.

Characteristics	Amount	
	n	%
<b>Age</b>		
15 years	4	6,1
16 years	27	40,9
17 years	30	45,5
18 years	4	6,1
19 years old	1	1,5
<b>Gender</b>		
Man	17	25,8
Woman	49	74,2
<b>Total</b>	<b>66</b>	<b>100.0%</b>

This research was conducted on 66 students of SMAN 11 South Tangerang, which consisted of students in class X and class XI. Based on Table 1, most of the age of the respondents in this study were 16 and 17 years old. The gender characteristics of the respondents were mostly female (74.2%), while 25.8% were male.

### 3.2 Univariate Analysis Results

Obesity is one of the health problems of adolescent nutritional status. To find out, it can be calculated using a z-score by looking at the age, gender, weight and height of the student. To find out the distribution data of the variable description, it can be seen in the table below.

Table 2: Distribution of Respondents Based on Research Variables.

Variable	Category	Amount	
		n	%
Nutritional status	Obesity (BMI/U > +2SD)	16	24,2
	Not Obese (BMI/U ≤ +2SD)	50	75,8
<b>Total</b>		<b>66</b>	<b>100,0</b>
Energy Intake	More (>110% AKG)	1	1,5
	Enough (80-110% RDA)	8	12,1
	Less (<80% DDA)	57	86,4
<b>Total</b>		<b>66</b>	<b>100,0</b>
Protein Intake	More (>110% AKG)	6	9,1
	Enough (80-110% RDA)	11	16,7
	Less (<80% DDA)	49	74,2
<b>Total</b>		<b>66</b>	<b>100,0</b>
Fat Intake	More (>30% AKE)	6	9,1
	Enough (20-30% AKE)	20	30,3
	Less (<20% AKE)	40	60,6
<b>Total</b>		<b>66</b>	<b>100,0</b>
Carbohydrate Intake	Enough (80-110% RDA)	3	4,5
	Less (<80% DDA)	63	95,5
<b>Total</b>		<b>66</b>	<b>100,0</b>
Consumption of Junk Food	Often (≥26.34)	34	51,5
	Rarely (<26.34)	32	48,5
<b>Total</b>		<b>66</b>	<b>100,0</b>
Physical Activity	Low (<600 METs)	13	19,7
	Moderate (≥600 METs)	45	68,2
	High (≥3000 METs)	8	12,1
<b>Total</b>		<b>66</b>	<b>100,0</b>
Nutrition Knowledge	Less (<60%)	12	18,2
	Enough (60-75%)	26	39,4
	Good (>75%)	28	42,4
<b>Total</b>		<b>66</b>	<b>100,0</b>

Based on the research results obtained in Table 2, there were 24.2% of respondents in the obese nutritional status category. This figure far exceeds the prevalence of obesity in South Tangerang, which is 15.9%.(Ministry of Health RI Banten, 2013).

According to WHO (2018) the prevalence of obesity in adolescents has increased to 18%.

Respondents' intake of energy and macronutrients was calculated based on the results of a 24-hour food recall interview and compared with the AKG (Nutrition Adequacy Rate)(Kemenkes, 2019). Based on the results obtained in Table 2, it can be seen that most of the respondents received energy, protein, fat and carbohydrate intake which were categorized as lacking (respectively: 86.4%; 74.2%; 60.6%; 95.5%).

The habit of consuming junk food is categorized into rarely and often by using the cut off point in the form of the mean from the distribution of the respondent's data as was done by(Arifin, 2019).From the results of the data in Table 2, it can be seen that the consumption of junk food in the frequent category is 51.5%.

Respondents' physical activity was obtained using MET calculations and divided into three categories, namely low/inactive (<600 MET minutes/week), moderate/minimum active (≥600 MET minutes/week), and high/active HEPA (≥3000 MET minutes /Sunday). Data on the distribution of physical activity can be seen in Table 2. It was found that some respondents had moderate physical activity (68.2%). There are respondents with low activity as much as 19.7% and high activity as much as 12.1%.

Respondents' nutritional knowledge was obtained by filling out a nutritional knowledge questionnaire. Based on Table 2, it can be seen that most of the respondents have good nutrition knowledge (42.4%). However, there are still respondents who have less nutritional knowledge, namely as much as 18.2%.

### 3.3 Results of Bivariate Analysis

In this study, bivariate analysis was used to see if there was a significant relationship between the dependent variable (obesity) and the independent variables (energy intake, intake of macronutrients, physical activity, consumption of junk food, and knowledge of nutrition). In this bivariate analysis, the data were processed using the chi-square test with a significance limit of  $\alpha = 0.05$ . If the p-value <0.05 it can be concluded that there is a relationship between the two variables.

Table 3: The results of the relationship test between the independent variables and obesity.

Variable	Nutritional Status				Total		P-value
	Obesity		Not Obese		n	%	
	n	%	n	%			
<b>Energy Intake</b>							
More (>110% AKG)	0	0.0	1	100	1	100	0.563
Enough (80-110% RDA)	3	37.5	5	62.5	8	100	
Less (<80% DDA)	13	22.8	44	77.2	57	100	
Total	16	24.2	50	75.8	66	100	
<b>Protein Intake</b>							
More (>110% AKG)	2	33.3	4	66.7	6	100	0.462
Enough (80-110% RDA)	4	36.4	7	63.6	11	100	
Less (<80% DDA)	10	20.4	39	79.6	49	100	
Total	16	24.2	50	75.8	66	100	
<b>Fat intake</b>							
More (>30%)	2	33.3	4	66.7	6	100	0.202
Enough (20-30%)	2	10.0	18	90.0	20	100	
Less (<20%)	12	30.0	28	70.0	40	100	
Total	16	24.2	50	75.8	66	100	
<b>Carbohydrate intake</b>							
Enough (80-110% RDA)	2	66.7	1	33.3	3	100	0.143
Less (<80% DDA)	14	22.2	49	77.8	63	100	
Total	16	24.2	50	75.8	66	100	
<b>Junk food Consumption</b>							
Often (≥26.34)	9	26.5	25	73.5	34	100	0.442
Rarely (<26.34)	7	21.9	25	78.1	32	100	
Total	16	24.2	50	75.8	66	100	
<b>Physical Activity</b>							
Low (<600 METs)	8	61.5	5	38.5	13	100	0.002*
Moderate (≥600 METs)	7	15.6	38	84.4	45	100	

High (≥3000 METs)	1	12.5	7	87.5	8	100	
Total	16	24.2	50	75.8	66	100	
<b>Nutrition Knowledge</b>							
Not enough	4	33.3	8	66.7	12	100	0.712
Enough	6	23.1	20	76.9	26	100	
Good	6	21.4	22	78.6	28	100	
Total	16	24.2	50	75.8	66	100	

\*Significant at  $\alpha < 0.05$

### 3.3.1 Relationship of Energy Intake with Obesity

Based on the results of the bivariate test in Table 3, it shows that there is no significant relationship between energy intake and the incidence of obesity with a p-value >0.05. All respondents with more, sufficient, or less energy intake categories have the same proportion of obese and not obese.

### 3.3.2 Relationship of Macronutrient Intake with Obesity

Based on Table 3, the results of statistical tests show that there is no significant relationship between the variables of protein, fat and carbohydrate intake and the incidence of obesity in adolescents with a p-value >0.05. The distribution of the data shows that all respondents in the category of more, sufficient, or less protein and fat intake have the same proportion of obese and non-obese.

In contrast to protein and fat intake, the distribution of data on carbohydrate intake shows that respondents with sufficient intake have a higher tendency to be obese compared to respondents who have less carbohydrate intake. However, the results of the chi-square test showed that the p-value was 0.143 (P>0.05), which means that there was no significant relationship between carbohydrate intake and the incidence of obesity in adolescents.

### 3.3.3 Relationship Between Junk Food Consumption and Obesity

Based on the results of the bivariate test in Table 3, it shows that there is no significant relationship between the variable consumption of junk food and the incidence of obesity with a P>0.05. All respondents in the category of frequent or infrequent consumption of junk food had the same proportion of obesity and non-obesity.

### 3.3.4 Relationship of Physical Activity with Obesity

The statistical test results obtained a p-value of 0.002 ( $P < 0.05$ ), so there is a significant relationship between physical activity and obesity. Based on the data distribution in Table 3, it can be seen that most of the respondents with low physical activity category were obese (61.5%), while most of the respondents with moderate and severe physical activity had nutritional status not obese (respectively: 84.4 %; 87.5%).

### 3.3.5 Relationship of Nutrition Knowledge with Obesity

Based on Table 3, the results of the statistical test obtained a p-value of 0.712 ( $P > 0.05$ ), which means that there is no significant relationship between nutritional knowledge and obesity in adolescents. The distribution of the data shows that respondents with poor, sufficient, and good nutrition knowledge categories have the same proportion of obesity and non-obesity.

## 4 DISCUSSIONS

### 4.1 Relationship of Energy and Macronutrient Intake with Obesity

Energy intake is not related to obesity, these results are in line with Fridawanti's research (2016) which states that there is no relationship between energy intake and obesity. Based on the results of 2x24 hour food recall interviews with respondents, it shows that respondents consumed food in small quantities and types and had irregular eating patterns (eating 1 to 2 times a day), eating small portions, and the food consumed was not varied. thus affecting the amount of energy consumed. This is in accordance with the respondents in Fridawanti's study (2016) which showed that the food consumed by respondents in their daily lives was lacking and not in accordance with the RDA (Nutritional Adequacy Rate) (Fridawanti, 2016).

Protein intake is not related to obesity, the results of data on the distribution of protein intake are in line with research conducted by Rahmani and Dewi (2018) which shows that there is no significant relationship between protein intake and obesity. This is evidenced by the p-value obtained, namely 0.120 ( $> 0.05$ ). It is also similar to Pramono's research

(2015) which states that there is no relationship between protein intake and the incidence of obesity with a p value = 0.32 ( $> 0.05$ ). If energy intake is lacking for various reasons, protein intake will be used to meet energy needs, so that there is not enough protein available for the formation of new tissue or for repairing damaged tissue. Aside from being a source of energy, protein also has a function that cannot be replaced by other nutrients. which builds and maintains the cells of the body's tissues. Protein also functions to regulate fluid balance, maintain body neutrality, form antibodies and also transport nutrients (Pramono Dwi Sasmito, 2015).

Fat intake is not related to obesity, the results of data on the distribution of fat intake are in line with Praditasari's research (2018) which states that there is no relationship between fat intake and obesity with a p value = 0.240 ( $> 0.05$ ). Fat intake is not associated with obesity status in adolescents, but the contribution of fat to the RDA which is higher allows obesity to occur. Food intake is one of the factors that causes obesity, but besides fat intake, there are intakes of carbohydrates, protein, water consumption, and other micronutrients that can also cause obesity. In addition to fatty acid composition, overweight and obesity can be affected by the energy balance in the body. In addition, food intake and energy expenditure can be influenced by diet, hereditary history (Praditasari & Sumarmik, 2018).

This research is not in line with Ainun (2022) which states that there is a significant relationship between fat intake and obesity, this is evidenced by the p value  $< 0.05$ , namely  $p = 0.0001$ . Excessive fat intake over a long period of time can lead to obesity. Accumulation of fat in the body will be stored in adipose tissue which can cause obesity if it occurs continuously (Ainun, 2022).

Carbohydrate intake is not related to obesity, the results of the distribution of carbohydrate intake data are in line with research conducted by Ainun (2022), namely there is no relationship between carbohydrate intake and obesity in adolescents with a p-value of 0.06 ( $> 0.05$ ). Excess carbohydrate intake will be stored in muscle or fat. Excessive carbohydrate intake in adolescents can increase insulin secretion, increase fat storage, and increase serum triglyceride levels. This will cause obesity if allowed to accumulate for a long time (Ainun, 2022). It is also similar to the research conducted by Pramono (2015) which states that there is no relationship between carbohydrate intake and the incidence of obesity. Adequate intake is important to maintain the glycogen reserves required for long-term physical activity. An increase in muscle glycogen with the accumulation of

carbohydrates will increase stamina for 30-60 minutes longer (Pramono Dwi Sasmito, 2015).

#### 4.2 Relationship Between Junk Food Consumption and Obesity

Consumption of junk food is not related to obesity, the results of this analysis test are in line with research conducted by Indriawati and Soraya (2009) which states that there is no significant relationship between the frequency of consumption of junk food and obesity with  $P > 0.05$  (Indriawati & Soraya, 2009). This research is not in line with research conducted by Nugroho and Hikmah (2020) which states that there is a significant relationship between the frequency of consumption of junk food and the incidence of obesity in adolescents with a p-value of 0.001 ( $< 0.05$ ) (Nugroho & Hikmah, 2020).

This happens because with the advancement of technology, teenagers can find various kinds of information, one of which is from social media. The effects of using social media are various, one of which is that many teenagers follow the trend that is circulating. Junk food is one of the trends that is usually followed by teenagers, because the marketing of junk food on social media is quite extensive. The rise of junk food marketing makes teenagers have a high sense of curiosity to try these junk food products, so that every time there is a new type of junk food, teenagers have the desire to try it without thinking about the impact or effects of frequent consumption of junk food. Frequent consumption of junk food can increase fat in the body which is not balanced, thus increasing degenerative diseases (Tanjung et al., 2022).

#### 4.3 Relationship of Physical Activity with Obesity

Physical activity is associated with the incidence of obesity, this is in line with research conducted by Ayu, Paramita, and Indonesiani et al. (2023) that there is a significant relationship between physical activity and the incidence of obesity in adolescents at SMAN 4 Denpasar with a p-value ( $< 0.05$ ) (Ayu, Paramita, Indonesiani, & Gede, 2023). Similar to the research conducted by Prima et al. (2018) which shows that there is a relationship between physical activity and the incidence of obesity in adolescents. This happens because most adolescents who are obese do less physical activity or do more light physical activity at higher risk of developing obesity due to lack of energy expenditure. Sedentary behavior in adolescents is a strong risk factor for obese

adolescents (Mahasiswa, Biomedis, Prima, Andayani, & Abdullah, 2018).

#### 4.4 Relationship of Nutritional Knowledge with Obesity

Nutritional knowledge is not related to obesity, this result is in line with research conducted by Dewi and Kartini (2017) which states that there is no relationship between nutritional knowledge and the incidence of obesity with a p-value of 0.076 ( $> 0.05$ ). Nutritional knowledge is an indirect factor that can affect a person's nutritional status, so if there is no relationship between nutritional knowledge and the incidence of obesity, then this can be influenced by the direct factor, namely food consumption (P. L. P. Dewi & Kartini, 2017).

This research is not in line with the research conducted by Sineke et al. (2019) to students of SMK Negeri 1 Biaro which stated that there was a very strong relationship between the level of nutritional knowledge and the incidence of obesity in students with a p value = 0.042 ( $P < 0.05$ ) (Sineke, Kawuluan, Purba, & Dolang, 2019).

## 5 CONCLUSIONS

Students of SMAN 11 South Tangerang have a nutritional status of obesity as much as 24.2%. Intake of energy and macronutrients (protein, fat, and carbohydrates) of SMAN 11 South Tangerang students are mostly in the less category, namely 86.4%, 74.2%, 60.6%, and 95.5%, respectively. Some students of SMAN 11 South Tangerang have a habit of consuming junk food frequently, namely 51.5%. As many as 68.2% of students at SMAN 11 South Tangerang have moderate physical activity. There are 18.2% of students at SMAN 11 South Tangerang who have poor nutritional knowledge. There is no significant relationship between energy intake, intake of macronutrients, consumption of junk food, and knowledge of nutrition with the incidence of obesity in students of SMAN 11 South Tangerang with a p-value ( $> 0.05$ ).

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