



## Body Mass Index and Macronutrient Requirements of Students Aged 13-14 Years

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### ABSTRACT

This study aims to analyze the nutritional status on Body Mass Index and macronutrient requirements of students aged 13-14 years at SMP Negeri 4 Bangli. This research is a quantitative descriptive research with a survey method. The population consisted of 110 eighth-grade students, with 54 students selected through stratified cluster random sampling. Anthropometric measurements were conducted to determine BMI, while daily energy requirements were calculated based on Basal Metabolic Rate (BMR), Specific Dynamic Action (SDA), physical activity level, and growth factors. The results showed that of the 54 students of SMP Negeri 4 Bangli who were studied, there were 12 students (22%) who were mildly thin, there were 7 students (13%) who were severely thin, 26 students (48%) had ideal/normal nutritional status, 3 students (6%) were mildly obese, and 6 students (11%) were severely obese. The average daily energy requirement is 1538.14 kcal, consisting of a carbohydrate requirement of 1758.74 kcal or 439.68 grams per day. The average fat requirement is 732.81 kcal or 81.42 grams per day. The average protein requirement is 439.68 kcal or 109.92 grams per day. Regular monitoring of nutritional status and nutrition education in the school environment are important to support optimal growth and prevent nutritional problems among adolescents.

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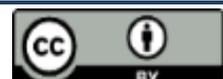
### AUTHORS' CONTRIBUTION

A. Conception and design of the study;  
B. Acquisition of data;  
C. Analysis and interpretation of data;  
D. Manuscript preparation;  
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## INTRODUCTION

Rapidly increasing population growth is one of the global challenges faced by various countries, including Indonesia (Liska et al., 2024) Based on data (Badan Pusat Statistik, 2024) the number of Indonesia's population in mid-2024 will reach 281.6 million people. This condition has a direct impact on the increasing number of adolescents in Indonesia, according to the World Health Organization (WHO) adolescents are in the age range of 10-19 years (Putri & Utama, 2024) Adolescents aged 13-16 years who are generally at the Junior High School (SMP) level are included in the adolescent phase mediate, which is a period marked by rapid growth and development both physically, psychologically, and intellectually (Azmi et al., 2023).



In the middle adolescence phase, the risk of nutritional problems is quite high. Common nutritional problems in adolescents include underweight, overweight, and obesity (Rachmawati & Kartika, 2024) Rikesdas data in 2018 shows the prevalence of middle adolescents with undernourished status as much as 8.1%, more than 13.5% with nutritional status, thin and very thin conditions 8.1%, and 52.6% with stunting, overweight or obese 12%, obesity 4.9% (Ministry of Health of the Republic of Indonesia, 2019). This malnutrition condition has significant long-term impacts, such as growth stunts, increased risk of infectious diseases, and impaired cognitive development that can affect learning achievement (Zemene et al., 2023)

Body mass index (BMI) is an important indicator in determining body composition, including the categories of malnutrition, normal, and obesity (Zulfadilah et al., 2025) Imbalances in nutritional status can negatively impact students' concentration, stamina, and academic achievement (Ditya Yankusuma & Ratna, 2023) Therefore, BMI measurement and macronutrient needs are very important to be carried out in schools to detect nutritional problems as early as possible.

The results of initial observations at SMP Negeri 4 Bangli show that students still have low knowledge related to balanced nutrition. It can be seen that many students eat unhealthy foods during break hours, such as ready-to-eat foods, fried foods, and foods with artificial colors. In addition, most students have not been able to adjust physical activity to their Body Mass Index (BMI) condition. Physical Education, Sports, and Health (PESH) teachers have also never measured BMI or macronutrient needs, so the supervision of student growth and development has not been optimal. Considering that PESH aims to improve physical fitness, movement skills, thinking skills, socializing, reasoning, emotional stability and being able to implement a healthy lifestyle (Sryanawati et al., 2021). The purpose of PESH itself is to make changes in individuals, including physical, mental, and emotional aspect (Yoda et al., 2022).

Looking at these various problems, this study was conducted to determine the macronutrient needs and body mass index of students at SMP Negeri 4 Bangli. The results of the research are expected to be a reference for PESH teachers, schools, and parents in making recommendations related to nutritional fulfillment, physical activity programs, and extracurricular activities that are in accordance with the student's condition. This effort is expected to be able to support the formation of a healthy lifestyle, prevent nutritional problems, and support the development and learning achievement of students optimally.

## **METHODS**

This research is a quantitative descriptive research with a survey method. Quantitative descriptive research shows data in the form of numbers which are further described clearly related to certain symptoms, phenomena or events, namely about body mass index and macronutrient needs of SMP Negeri 4 Bangli students for the 2025/2026 school year using the survey method. Quantitative research is a research approach that utilizes data in the form of numbers to answer research problems or questions (Waruwu et al., 2025)

The population in this study is 110 students in grade VIII of SMP Negeri 4 Bangli. The sample technique used was stratified cluster random sampling, so that the subjects in this study were 54 students in grades VIII A and VIII C at SMP Negeri 4 Bangli, consisting of 27 female students and 27 male students. Data collection techniques for the body mass index include anthropometric tools, including spring scales with the serenity-ZT model (which has been tested by the Tera at the Bangli Departemen Perindustrian dan Perdagangan on August 28, 2025) for weight and height measurement. The characteristics of grade VIII students at SMP Negeri 4 Bangli are as follows.

**Table 1.**  
 Characteristics of Grade VIII Students

Gender	Quantity	Average Age	Average Height	Average Weight	Percentage
Male	27	13,48	155,67	49,80	50%
Women	27	13,48	155,67	49,80	50%
<b>Total</b>	<b>54</b>				<b>100%</b>

This research began with initial observations at SMP Negeri 4 Bangli. Then, height and weight measurements were carried out and questionnaires containing physical sports activities and non-sports physical activities of grade VIII students at SMP Negeri 4 Bangli. The calculation was carried out using the formula BMR, Specific Dynamic Action (SDA), energy from sports activities, energy from non-sports physical activity, and calculation of macronutrient needs.

## RESULTS AND DISCUSSION

### Result

The research began with the measurement of students' weight and height, which aimed to find the nutritional status of students through anthropometric calculation of Body Mass index (BMI). So that the following results were obtained, of the 54 students of SMP Negeri 4 Bangli who were studied, there were 12 students (22%) who were classified as mildly thin, there were 7 students (13%) who were classified as severely thin, 26 students (48%) had ideal/normal nutritional status, 3 students (6%) were mildly obese, and 6 students (11%) were included in the category of severe obesity. So that overall, the nutritional status of students of SMP Negeri 4 Bangli can be said to be ideal/normal, where there are 26 students or 48% have ideal nutritional status, which can be seen in the following table:

**Table 2.**  
 Body Mass Index

Klasifikasi	BMI	Frequency	Percentage
Light skinny	<17,0	12	22%
Skinny Weight	17,0-18,4	7	13%
Ideal/Normal	18,5-25,0	26	48%
Mild Obesity	25,1-27,0	3	6%
Severe Obesity	>27,0	6	11%
<b>Total</b>		<b>54</b>	<b>100%</b>

After calculating BMI, the next step is to calculate your daily energy needs. The calculation of daily energy needs is carried out to determine the total daily energy needs

of students, both sports physical activity energy and non-sports physical activity. The calculation is through basic energy needs or Basal Metabolism Rate (BMR) and Specific Dynamic Action (SDA). From the calculation results, it is known that the average BMR is 1398.31kcal while the average natural resource is 139.83kcal. Therefore, the average energy needs of BMR and SDA are 1538.14 kcal per day, which can be seen in the following table:

**Table 3.**  
 Calculation of BMR and SDA Energy Density

	<b>BMR</b>	<b>SDA</b>	<b>BMR+SDA</b>
Average	1398,31	139,83	1538,14
SD	160,39	16,04	176,43
Minimum	1141,5	114,15	1255,65
Maximum	1942,1	194,21	2136,31

Next is to calculate the energy needs of non-sports activities, namely the energy needs needed by the body in carrying out daily activities outside of sports activities such as walking up stairs, sweeping, and others. This non-sports activity is divided into three categories, namely light, medium, and heavy where between men and women have differences in the value of factors or points because of the energy needs between men and different weights, which can be seen in the following table:

**Table 4.**  
 Calculation of Non-Sporting Energy Density

<b>Gender</b>	<b>Categories</b>	<b>Value</b>	<b>Quantity</b>
Male	Lightweight	1,56	5
	Medium	1,76	19
	Weight	2,1	3
Women	Lightweight	1,55	3
	Medium	1,7	19
	Weight	2	5

Based on the calculation of non-sports activities and sports activities of students, the researcher obtained results that most students of SMP Negeri 4 Bangli have a level of non-sports physical activity in the MEDIUM category. The average daily energy needs from non-sports activities of these students reached 2,688.25 kcal. After that, the energy needs of sports activities are also calculated by consider the type of exercise performed, the duration of exercise per day, and the frequency of exercise in a week. The type of exercise affects the activity factor that is adjusted to the student's weight. In addition, it is necessary to record how many minutes of exercise is done each day and how many times in a week. The calculation of sports energy is carried out by multiplying the factor of sports activity by the duration of daily exercise, then multiplying it by the frequency of weekly exercise. So that the average daily energy needs from students' sports activities reached 163.12 kcal, the average total energy requirement was 2851.37 kcal.

**Table 5.**  
 Calculation of Non-Sporting Energy Density

	<b>Non-Sports</b>	<b>Sports</b>	<b>Total Energy</b>
Average	1398,31	163,12	2851,37
SD	160,39	115,47	407,20

Next is the calculation of energy needs based on the age of growth, because in the junior high school phase students are in a period of rapid growth so that they need additional energy that is adjusted to their age, which is under 19 years old. It was obtained that most of the students of SMP Negeri 4 Bangli aged 10-14 were 54 people.

**Table 6.**  
Age of Growth

Age	Value	Quantity
10-14 years	2 kkl/kg	54
15 years	1 kkl/kg	0
16-18 years old	0,5 kkl/kg	0
>19 years old	0 kkl/kg	0
<b>Total</b>		<b>54</b>

So that the average additional energy needs of the growth age of SMP Negeri 4 Bangli students are 99.59 kkl, and the daily energy needs are 2950.96 kkl per day.

**Table 7.**  
Energy Requirements Based on Growth Age

	Age	Total Energy	Additional Energy	Total Daily Energy
Average	13,48	2851,37	99,59	2950,96
SD	0,50	407,20	21,88	422,82

Then the next is to calculate the macro nutritional needs of students, namely carbohydrates, fats, and proteins. Where the proportion of macronutrients is 60% carbohydrates, 25% fat, and 15% protein.

**Table 8.**  
Macro Nutritional Needs

	Macro Nutritional Needs					
	Carbohydrates		Fat		Protein	
	Calories	Gram	Calories	Gram	Calories	Gram
Average	1770,58	442,64	737,74	81,97	442,64	110,66
SD	253,69	63,42	105,70	11,74	63,42	16,86

## Discussion

Nutritional status is one of the important indicators in determining an individual's health condition and quality of life, especially in adolescence (N. R. Aulia, 2021). Adolescence is characterized by rapid physical growth as well as significant biological and psychological changes, resulting in increased nutritional needs (Mikraj et al., 2025). An imbalance between nutritional intake and the body's needs can cause nutritional problems, both in the form of undernutrition and overnutrition (Ruspita et al., 2024).

Malnutrition occurs due to insufficient energy intake and nutrition for the body's needs in a certain period of time. This condition can be caused by irregular diets, consumption of foods with low nutritional value, and a lack of knowledge about balanced nutrition (Hamdiana et al., 2025). Adolescents with poor nutritional status generally have a *low body mass index* and appear thinner than their peers. The impact of malnutrition is not only limited to physical conditions, but also affects the immune system thereby increasing susceptibility to infectious diseases (Puspitasari et al., 2024).

On the other hand, overnutrition is a condition when energy intake exceeds the body's needs. Overnutrition in adolescents is often caused by the habit of consuming foods high in fat, sugar, and calories, as well as low physical activity (Rahayu et al., 2024). In addition, physical activity still needs to be done so that the body remains healthy and fit, to overcome intake with unbalanced calorie expenditure (Wijaya et al., 2022). A lifestyle that lacks physical activity and increases the consumption of fast food also plays a role in increasing weight and *body mass index*. The impact of overnutrition is not only seen on changes in body shape, but also has the potential to increase the risk of health problems such as obesity, metabolic disorders, as well as being overweight and obesity in adolescents can increase the risk of chronic diseases such as cardiovascular disease and cancer later in life (Nisa et al., 2020).

Both undernutrition and overnutrition have an impact on daily activities and the learning process. Adolescents with poor nutrition are less likely to experience decreased concentration, fatigue easily, and lack enthusiasm in participating in learning activities (Ngurah Mahendra, 2025). Meanwhile, adolescents with excess nutrition often experience limitations in physical activity, feel tired quickly, and decrease in physical fitness, which can affect participation in learning activities, especially in subjects that require physical activity.

Thus, a balance of nutritional intake is needed to support the optimal growth and development of adolescents. Efforts to increase nutritional knowledge, implement a balanced diet, and increase physical activity regularly are important steps in preventing malnutrition and overnutrition and their impacts.

This study aims to provide an overview of the macro nutritional needs and *body mass index* of SMP Negeri 4 Bangli students with a focus on quantitative data covering macronutrient needs, namely carbohydrates, fats and proteins, and *body mass index* (BMI). Based on the average findings, the basic energy needs (BMR+SDA) of students are 1538.14, the highest energy needs are 2136.31 kcal and the lowest value is 1255.65 kcal.

Based on the average energy needs of non-sports physical activity students of SMP Negeri 4 Bangli, it was recorded at 2670.28 kcal with the highest energy of 3759.91 kcal and the lowest energy of 1997.60 kcal. With the majority of students in the medium category 43 (80%), the light category 6 (11%), and the heavy category 5 (9%). Non-sports physical activity is energy expenditure for daily physical activity with low, medium and high intensity (Mahendrayani & Laksana, 2023). Then based on the average energy needs of physical sports activities of students of 2833.40 kcal, the highest energy is 4077.05 kcal and the lowest value is 2077.60 kcal. Calculating students' sports energy by multiplying the value of sports activity factors adjusted to body weight (Mashuri, 2022).

Students of SMP Negeri 4 Bangli are in the age range of 13-15 years so they need this additional energy. The average additional energy is 97.83 kcal. So the average total energy requirement per day is 2931.23 kcal with the largest energy of 4245.05 kcal while the smallest energy is 1282.56 kcal. Based on macronutrient needs, the average carbohydrate requirement is 1758.74 kcal or 439.68 grams per day. Meanwhile, the average fat requirement is 732.81 kcal or 81.42 grams per day. The average protein

requirement is 439.68 kcal or 109.92 grams per day. These three things are able to provide energy for the body so that it can carry out its activities and functions (Gunarto & Mashuri, 2023). The results of these findings are in line with a study (Khairunnisa et al., 2024) conducted at SMK R.A Kartini Bandung, showing that the average carbohydrate intake of respondents was  $240.6 \pm 116.8$  grams/day, for the average protein intake of  $52.6 \pm 24.9$  grams/day, and for the average fat intake of  $67.3 \pm 31.7$  grams/day, then for the daily energy needs of SMK R.A Kartini Bandung students, the average energy intake was  $1793 \pm 821$  kcal/day.

## CONCLUSION

Based on the results of the study, it is known that of the 54 students of SMP Negeri 4 Bangli who were studied, there were 12 students (22%) who were classified as mildly thin, there were 7 students (13%) who were classified as severely thin, 26 students (48%) had ideal/normal nutritional status, 3 students (6%) were mildly obese, and 6 students (11%) were classified as severely obese. In general, the nutritional status of grade VIII students of SMP Negeri 4 Bangli is in the normal/ideal category, although there are still students with undernutrition and overnutrition status. In terms of energy needs, the average carbohydrate requirement is 1758.74 kcal or 439.68 grams per day. The average fat requirement is 732.81 kcal or 81.42 grams per day. The average protein requirement is 439.68 kcal or 109.92 grams per day. Therefore, this condition needs to be a concern, both for students personally, PJOK teachers, and parents, so that students can get balanced nutrition so that the ideal category can be achieved. The importance of regular monitoring of nutritional status, increasing nutrition education in the school environment supports the growth and development of students to prevent nutritional problems in adolescents. So that this research can be a reference for recommendations for schools, sports teachers in monitoring the nutritional status of students to overcome nutritional problems.

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