



# Correlation of Energy, Protein, Carbohydrate, and Physical Activity Intake with Nutritional Status of Adolescents

Firdausi Ramadhani<sup>1\*</sup>, Herman Hatta<sup>1</sup>, Nuryani Nuryani<sup>1</sup>, Maesarah Maesarah<sup>1</sup>, Deysi Adam<sup>1</sup>, Sahrir Sillehu<sup>2</sup>, Heru Santoso Wahito Nugroho<sup>3</sup>

<sup>1</sup>Department of Nutrition Science, Faculty of Public Health, Universitas Gorontalo, Gorontalo, Indonesia; <sup>2</sup>Department of Public Health, Sekolah Tinggi Ilmu Kesehatan Maluku Husada, Nusaniwe, Indonesia; <sup>3</sup>Department of Health, Poltekkes Kemenkes Surabaya, Surabaya, Indonesia

## Abstract

**Edited by:** Sasho Stoleski  
**Citation:** Ramadhani F, Hatta H, Nuryani N, Maesarah M, Adam D, Sillehu S, Nugroho HRW. Correlation of Energy, Protein, Carbohydrate, and Physical Activity Intake with Nutritional Status of Adolescents. Open Access Maced J Med Sci. 2022 Jun 16; 10(E):1440-1445. https://doi.org/10.3889/oamjms.2022.8110  
**Keywords:** Nutritional status; Nutritional intake; Physical activity  
**\*Correspondence:** Firdausi Ramadhani, Department of Nutrition Science, Faculty of Public Health, Universitas Gorontalo, Gorontalo, Indonesia. E-mail: firdausiramadhani410@gmail.com  
**Received:** 28-Nov-2021  
**Revised:** 02-Jun-2022  
**Accepted:** 06-Jun-2022  
**Copyright:** © 2022 Firdausi Ramadhani, Herman Hatta, Nuryani Nuryani, Maesarah Maesarah, Deysi Adam, Sahrir Sillehu, Heru Santoso Wahito Nugroho  
**Funding:** This research did not receive any financial support  
**Competing Interests:** The authors have declared that no competing interests exist  
**Open Access:** This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)

**BACKGROUND:** Adolescence is a period of growth and development. So that adolescents must get a balanced intake of nutrients and in accordance with the needs to achieve optimal growth and development. Balance of intake with development can cause nutritional problems.

**AIM:** The purpose of this study was to determine the relationship between energy intake, protein, carbohydrates, and physical activity with the nutritional status of adolescents.

**METHODS:** This study used an analytical survey method with a cross-sectional approach. The sample is 115 respondents. The sampling technique is using simple random sampling. Research variables include energy intake, protein, carbohydrates, physical activity, and nutritional status. Data were collected using a questionnaire, form recall, PAL, and nutritional status using anthropometric measurements.

**RESULTS:** The results of the study using the Chi-square test showed that the intake of energy ( $p = 0.179$  protein ( $p = 0.529$ ), carbohydrates ( $p = 0.081$ ), and physical activity ( $0.065$ ). This shows that there is no significant relationship between energy intake, protein, carbohydrates, and physical activity with the nutritional status of adolescents at SMPN Bulango Selatan and SMPN Tapa in Bone Bolango Regency.

**CONCLUSION:** Teenagers are expected to get used to consumption patterns according to the balanced nutrition guidelines. In addition, the role of parents is also needed to pay attention to the food consumed by members' food intake family at home, especially teenagers, so that optimal nutritional status is achieved.

## Introduction

Indonesia is currently experiencing double Barden. On one side of the problem of malnutrition which has not been resolved, on the other hand, there is an overnutrition problem. The WHO states that obesity is a global epidemic and is a health problem that must be addressed immediately addressed. Globally, the prevalence of overnutrition in adults has an increase of 27.5% between 1980 and 2013, whereas in children, the increase was much greater at 47.1% [1]. Riskesdas 2018 data showed that 25.7% of adolescents aged 13–15 years and 26.9% aged 16–18 years with short and very short nutritional status. In addition, there are 8.7% of adolescents aged 13–15 years and 8.1% of adolescents aged 16–18 years with very thin conditions. While nutritional status based on BMI/U, the prevalence of underweight is 135% and the prevalence of obesity is 20.7% [2].

Adolescents are one of the groups that are vulnerable to nutrition. They have a lot activities but

the consumption of food is not controlled. Imbalance between foods consumed with the needs of adolescents will cause problems under nutrition or over nutrition problems [3]. Teenagers need food adequate not only in terms of quantity but also in terms of quality [4]. Nutritional status is needed for adolescents to support their growth and development. Optimal nutritional status will create healthy and productive adolescents. Nutritional status is a state of health of a person's body caused by consumption, absorption, and use of food nutrients. According to the Almatsier nutritional status, a person's nutritional status can be measured and assessed to determine whether his nutritional status is classified as normal or abnormal [5].

A good diet if it meets a balanced nutritional pattern, that is, if the nutrients are adequate in accordance with the needs of the body obtained through daily food, namely, a balanced source of nutrition grouped in energy sources, sources of building blocks, and sources of regulatory substances [6]. Teenagers are experiencing physical growth quickly, so that sufficient energy intake is needed [7]. Adolescents

who experience weight loss due to lack of energy intake in the long-term, on the contrary, excess energy intake will result in obesity [8]. In addition to energy intake, protein is also necessary for youth. Protein is a macro mineral that is needed for humans which serves as a source of energy, body building substances, and regulatory substances in the body [8]. Health problems and underconsumption eating will cause disturbances in metabolic processes that will cause an infectious disease, depression, anemia, and easily tired so that cause unproductive. However, if you eat too much, and not balanced with physical activity, obesity will occur.

In Indonesia and especially in Gorontalo Province, the nutritional status of adolescents is still a major concern problem. Based on the results of the previous studies, it is known that there are 7.0% of adolescents with underweight nutritional status and 24.0% adolescents with obese status [9]. Results Riskesdas 2018 in Gorontalo Province showed that there were 13.5% of the very short group and 27.7% of the short group. The nutritional status based on the index body mass according to age showed a thin prevalence of 2.1% [10]. Based on data from the city health office, which was carried out in all districts/cities Gorontalo Province in 2018, shows the prevalence of obesity in the population adults (15 years and over), namely, Gorontalo Regency 30.9%, Gorontalo City 36.7%, Bone Bolango Regency 21.6%, Boalemo Regency 18.6%, Pohuwato Regency 14.7% [9]. Analysis of factors related to nutritional status in children, adolescents are very important to do because nutritional status is a very important thing and must be known by each individual to be able to anticipate and prevent the occurrence of undernutrition and overnutrition [3].

Many factors affect the nutritional status of adolescents, either directly or indirectly. The direct causative factors consist of food intake and infectious diseases. While the indirect causal factors consist of physical activity, individual factors (age, gender, and adolescent knowledge), family factors (parental education and income), school environment and peers, and mass media, as well as intake of nutritious food [6]. Nutritious food is if it contains sufficient food substances in quantity and quality according to the needs of the body. Food consumed every day can be divided into several groups, namely, protein, fat, carbohydrates, vitamins, minerals, water and oxygen, and fiber foods. Sources of energy in foodstuffs can be obtained from macronutrients, namely, carbohydrates, fats, and proteins [11]. The results of Riskesdas 2010 show that the average energy consumption adequacy of the population aged 13–15 years (pre-adolescent age) is 54.5%, consuming energy below the minimum requirement and those consuming protein below the minimum requirement are 38.1%. The average energy consumption adequacy of adolescents aged 16–18 years is 54.5% [12]. The results of the previous studies showed that there was a relationship between

energy and protein intake with nutritional status [6]. Likewise with the results of other studies, there is a significant relationship between energy intake and nutritional status [13]. However, this result is different from Mustika's research that there is no relationship between energy intake and nutritional status [14]. Likewise, research conducted by Nurwulan *et al.* that there is no relationship between energy, protein, and carbohydrate intake with nutritional status [15]. Another study conducted by Khairunnisah stated that there was no significant relationship between energy intake and nutritional status of adolescents at Madrasah Aliyah Annajah Petukangan, South Jakarta [16].

Another factor that affects nutritional status is physical activity. Based on Riskedas 2013, it is known that the proportion of physical activity is classified as less active in general is 26.1%. As many as, 44.2% of the people in DKI Jakarta are classified as less active [17]. Physical activity should be done regularly 3 or more times a week with moderate-to-moderate levels of exercise heavy. Physical activity should be done at least 30 min every day [18]. Based on Aini's research, it is known that there is a relationship between physical activity and physical activity the risk of the occurrence of nutritional status in adolescents [19]. Same with results, other studies have shown a relationship between physical activity and physical status nutrition, where the lower the physical activity, the greater the risk of over nutrition [20]. The results of the research by Hendra *et al.*, show that physical activity plays a role in the incidence of overweight (obesity) status [21].

This study is not in line with that of Ramadhani *et al.* that physical activity not associated with excess nutritional status [22]. The purpose of this study was to determine the relationship between energy intake, protein, carbohydrates, and physical activity with adolescent nutritional status.

This research is an independent study and there is also no potential conflict of interest in the research.

## Research Methods

### Research design

The type of research conducted is analytic observational using a “*cross-sectional study*” design, which is a research design to see the relationship between independent variables which include: Carbohydrate protein energy intake and physical activity, the dependent variable, namely, nutritional status. The research was carried out in April 2021.

### Data sources

The primary data were obtained directly from the subject. Nutritional status data were calculated by measuring weight using a digital scale and measuring height using a microtoise with an accuracy of 0.1 cm.

### Research targets

The population in this study were students at SMPN Tapa and SMPN Bulango Selatan, students of Class VII and Class VIII. The sampling technique used in this study was simple random sampling. The total population in SMPN Tapa is 426 people and SMPN Bulango Selatan is 76 people, so the total population in this study is 502 people. Determination of the sample using the sample calculation formula until the total number of research samples is 262. However, due to the COVID-19 pandemic, not all schools conduct face-to-face learning. So that the research was partly carried out by distributing questionnaires directly and partly being done online using the WhatsApp grub application and Google Form. This causes that many respondents do not answer, or answers are not perfect and do not meet the requirements. So that the answers that meet the requirements are only 115 samples. The answer that meets the requirements is if all the answers are filled in completely. Meanwhile, if the answers are not filled, all will be aborted. Sampling using simple random sampling. The type of data used is primary data obtained directly from the subject.

### Development of instruments and data collection techniques

The nutritional status of adolescents was determined using the anthropometric index of body mass index according to age (BMI/U), categorized as normal nutritional status if z-score  $-2$  SD to  $+1$  SD and abnormal nutritional status if z-score  $> +1$  SD (Ministry of Health, 2011). Data on energy, protein, and carbohydrate intake were obtained using the 24-h Form Reccal method. Data were obtained through a  $2 \times 24$  h recall questionnaire method, which is to measure individual or family food habits so that there is a picture of a person's eating patterns. It is categorized as sufficient intake if the total intake is 80–110% RDA, categorized as insufficient if the total intake is 80% RDA and categorized as more if the total intake is  $> 110\%$  RDA. Physical activity was calculated using PAL, which is the amount of energy expended (kcal) per kilogram of body weight in 24 h. Physical activity data were obtained by the researcher interviewing the respondents directly using a questionnaire that was filled out by the researcher himself. Then, to find out the objective criteria for physical activity, a score is given based on PAR (Physical Activity Ratio) then averaged

and divided by 24 h and the final value is PAL (Physical Activity Level). Categorized as very light activity if PAL value  $< 1.9$ , light activity if PAL 1.4–1.69, moderate activity if PAL 1.7–1.99, and heavy activity if PAL  $> 1.99$  (FAO, 2001). The physical activity form was given to respondents to find out the activities carried out for 24 h starting from waking up to going to bed.

### Data analysis techniques data

Analysis was univariate and bivariate. This research has received approval from the Chandra Brahmanda Lentera Research Ethics Commission with certificate No. 003/23/IV/EC/KEP/UNIK/2021.

## Research Results

### Characteristics of research subjects

The description of the characteristics of the respondents is shown in Table 1. The most of the adolescent respondents were women with 86 respondents (74.8%), the most age category was at the age of 13 years with a total of 43 respondents (37.4%), the measurement of nutritional status was based on body mass index. According to the age, there are 47 respondents with abnormal status (40.9%). This abnormal nutritional status consists of more nutritional status and less nutritional status. Adequate energy intake was 59 respondents (51.3%), more protein intake was 61 respondents (53.0%), carbohydrate intake was less by 63 respondents (54.8%), and very light physical activity was 52 respondents (45.2%).

**Table 1: Distribution of respondents**

Characteristic	n (%)
Gender	
Male	29 (25.2)
Female	86 (74.8)
Age	
12	39 (33.9)
13	43 (37.4)
14	27 (23.4)
15	6 (5.2)
School	
SMP 1 Tapa	81 (70.4)
SMP 1 Bulango	34 (29.6)
Status gizi IMT/U	
Normal	68 (59.1)
Not normal	47 (40.9)
Energy intake	
Less	50 (43.1)
Enough	59 (51.3)
More	6 (5.2)
Protein intake	
Less	8 (7.0)
Enough	46 (40.0)
More	61 (53.0)
Carbohydrate intake	
Less	63 (54.8)
Enough	39 (33.9)
More	13 (11.3)
Aktifitas fisik	
Very light	31 (27.0)
Light	52 (45.2)
Moderate	28 (24.3)
Heavy	4 (3.5)

### Relationship between diet and physical activity with nutrition status

Analysis of the relationship between energy intake, nutrients, and physical activity with nutritional status is shown in Table 2. Energy intake is 32.0% less, protein intake is less 50.0%, and carbohydrate intake less 31.7% with abnormal nutritional status while physical activity very while 8.7% and 17.14% mild abnormal nutritional status.

**Table 2: Analysis of the relationship of energy intake, nutrients, and physical activity with nutritional status in adolescents**

Variable	Normal		Not normal		Total		p value
	n	%	n	%	n	%	
Intake energy							
Less	34	68.0	16	32.0	50	100	0.179
Enough	30	50.8	29	25.2	59	100	
More	4	66.7	2	33.3	6	100	
Protein intake							
Less	4	50.0	4	50.0	8	100	0.529
Enough	30	65.2	16	34.8	46	100	
More	34	55.7	27	44.3	61	100	
Carbohydrate Intake							
Less	43	68.3	20	31.7	63	100	0.081
Enough	18	46.2	21	53.8	39	100	
More	7	53.8	6	46.2	13	100	
Physical activity							
Very Light	21	18.3	10	8.7	31	100	0.065
Light	32	27.8	20	17.4	52	100	
Currently	15	13.0	13	11.3	28	100	
Heavy	0	0	4	3.5	4	100	
Total	115						

### Energy intake and nutritional status

The results of the study – there was no relationship between energy intake and nutritional status of adolescents at SMPN Bulango Selatan and SMPN Tapa in Kabupaten Bone Bolango. Energy is one of the products of carbohydrate, protein, and fat metabolism [23]. The results of the analysis showed that there was no relationship between energy intake and nutritional status at SMPN Bone Bolango Regency. This is in line with the results of the previous studies that there is no relationship between energy intake and nutritional status [14], [16].

However, this study differs from the results of the previous studies, that there is a relationship between nutritional status and energy intake [6], [13], [24]. Food consumption in this study does not directly reflect the overall picture of the present nutritional status. Some respondents have insufficient energy intake, but normal nutritional status, on the other hand, there are also respondents whose energy intake is sufficient, but nutritional status is not normal. Respondents with normal nutritional status do not necessarily have sufficient energy intake to meet the daily needs of their bodies. Respondents who have a high energy intake will have a risk of experiencing excess nutrition, because the remaining energy that does not come out will be stored in the form of fat. Those who have good nutritional status are also at risk of experiencing a decrease in nutritional status if they do not pay attention to their food consumption. Energy intake cannot directly change a person's nutritional status, but the changes will be felt if

you do not pay attention to intake for a long time [25]. The level of energy intake is different, causing the nutritional status will also be different. However, energy intake is not the main factor affecting nutritional status. According to Peltzer and Pengpid, several factors that influence body weight in adolescents are dietary behavior, psychosocial behavior, and wrong perceptions of nutrition [26].

### Protein intake and nutritional status

The results of the study using the test Chi-square showed that there was no relationship between energy intake and the nutritional status of adolescents at SMPN Bulango Selatan and SMPN Tapa in Kabupaten Bone Bolango. Protein is closely related to life processes, so protein is a very important nutrient. Protein adequacy is influenced by body weight, age, and protein quality in every food consumed [23]. Based on the results of the study, there was no relationship between protein intake and nutritional status at SMPN Bone Bolango Regency. This is in line with the results of the previous studies which showed that there was no relationship between protein intake and adolescent nutritional status [27], [28]. Result recalls on the 1 × 24 h, many respondents consume white rice, fish, tofu, and fried foods. This causes protein intake to exceed the recommended RDA. Some respondents have also consumed adequate protein intake and have normal nutritional status. However, there are also those who have sufficient protein intake but their nutritional status is not normal. This is because protein intake is not the only one that affects nutritional status. Many factors affect nutritional status including physical conditions, infection, and stress [30]. Even though protein is fulfilled, if other nutritional intakes are not met, it will still result in abnormal nutritional status. Adolescents, who have normal nutritional status with more protein intake, do not necessarily have a good food selection pattern. Adolescents need to maintain their nutritional status to be in optimal condition. Living conditions experiencing stress will affect eating behavior which has an impact on nutritional status [31]. This is because adolescence is a transition period from children to adults. Psychologically, adolescents are prone to stress (life pressures). Stress also causes eating disorders, either decreased or increased appetite [32]. Under conditions of stress, there is an increase in intake of energy, fat, carbohydrates, and carbohydrates protein that cause changes in nutritional status [33].

### Carbohydrate intake with nutritional status

The results of further research using the test Chi-square showed that there was no relationship between carbohydrate intake and the nutritional status of adolescents at SMPN Bulango Selatan and SMPN Tapa in Kabupaten Bone Bolango. Carbohydrate adequacy was influenced by several factors, including age, weight,

and physical activity. Carbohydrates are one of the macro substances needed by the body. Carbohydrates are digested by the body to produce glucose, energy, and dietary fiber [23]. Based on the results of the analysis showed that there was no relationship between carbohydrate intake and nutritional status. This study is in line with the previous one that there is no relationship between carbohydrate intake and nutritional status [34]. This is because even though carbohydrates are met, if other nutritional intakes are not met, it will still result in abnormal nutritional status. However, this is not in line with the previous research which stated that there was a relationship between carbohydrate intake and nutritional status [13]. Result recalls on the 1 × 24 h, it was found that the respondents consumed less fruit, vegetables, tubers, and nuts, resulting in less carbohydrate intake and not in accordance with the recommended RDA. Respondents with less carbohydrate intake, but have normal nutritional status, do not necessarily have good nutritional intake. This is because the intake only contains carbohydrates but lacks vitamins and minerals, causing an imbalance between carbohydrates and the nutrients needed. Normal nutritional status is not only filled with one type of food, but there must be a variety of foods. Health problems and lack of food consumption will cause disturbances in the body's metabolic processes resulting in infectious diseases [35]. Nutritional problems in adolescents need attention because they will affect the period of growth and development that will have an impact on adults [36].

### **Physical activity with nutritional status**

The results showed that there was no relationship between physical activity and nutritional status of adolescents at South Bulango Junior High School and Tapa Junior High School in Bone Bolango Regency. One of the factors that influence the nutritional status of adolescents is physical activity. Physical activity is the movement of every limb in a person. This activity is important to maintain a healthier physical, mental, and quality of life. Lack of physical activity is a major risk factor for death [37]. A lifestyle that does not do physical activity will affect the physical condition. Increased busyness causes that individuals do not have the time to exercise, and one factor causes of overweight that is lack of physical activity [26], [38].

Physical activity in this study was carried out by measuring the classification of Physical Activity Level (PAL) based on the 2014 Food and Agriculture Organization (FAO) *standards*. PAL is the amount of energy expended (kcal) per kilogram of body weight in 24 h. The results showed that there was no relationship between physical activity and nutritional status. This is in line with the previous research that physical activity has no significant relationship with nutritional status [22], [39], [40]. However, this is different from several other studies that there is

a strong relationship between physical activity and waist circumference [41], [42]. Although the results of the study show that there is no relationship between physical activity and nutritional status, it was found that respondents do very light and light activities but have abnormal nutritional status. On the other hand, there are also respondents who do moderate activities also have abnormal nutritional status. The results of the research in the field revealed that many respondents had a PAL value of 1.40–1.69, meaning a low-intensity lifestyle and light activity. The activities that many teenagers do include watching, playing games, sleeping, eating, and bathing. Based on the results of interviews, respondents spend a lot of time with light activities, as well as in carrying out activities outside a lot of using motorized vehicles rather than walking. This sedentary lifestyle increases along with the decrease in physical activity in adolescents [43]. However, even though physical activity is sufficient, if food intake is not controlled properly, it will result in abnormal nutritional status. Nutritional status is not only influenced by physical activity, but is also influenced by several factors, such as age, occupation, smoking status, and stress levels [44]. According to Hendra, heredity also plays a role in the occurrence of nutritional status [21]. Adolescents who have more or less nutritional status tend to have parents with the same nutritional status as their children.

Weaknesses in this study – The COVID-19 pandemic has caused not all schools to conduct face-to-face learning. So that the research was partly done by distributing questionnaires directly and partly being done online using the WhatsApp group application. This makes it difficult to control respondents' answers. In addition, the number of samples was reduced from 262 to only 115 samples. Hence, this also affects the results of the study.

## **Conclusion**

Based on the results of the study, there are no relationship between energy intake, protein intake, carbohydrate intake, and physical activity with nutritional status in SMPN Bone Bolango Regency. It is recommended that people, especially parents, pay attention to their food intake so that optimal nutritional status is achieved and improve their daily diet and balanced with adequate physical activity.

## **References**

1. World Health Organization. Interim Report of the Commission on Ending Childhood Obesity. WHO Technical Report Series.

- Geneva: WHO Technical Report Series; 2013.
2. Ministry of Health Republik Indonesia. Riskesdas Results 2018. Agency for Health Research and Development. Indonesia: Ministry of Health Republik Indonesia; 2018.
  3. Postgraduate Program I. Analysis of Food Selection for Teenagers in Padang City, West Sumatra Food Preference Analysis on Teenagers in Padang, West Sumatra. 2008. p. 17-22.
  4. Gramedia Pustaka Utama. Basic Principles of Nutrition Science. Jakarta: Gramedia Pustaka Utama; 2013.
  5. Evans EW, Jacques PF, Dallal GE, Sachek J, Must A. The role of eating frequency on total energy intake and diet quality in a low income, racially diverse sample of schoolchildren. *Public Health Nutr.* 2015;18(3):474-81. <https://doi.org/10.1017/S1368980014000470>  
PMid:24780506
  6. Utami HD, Kamsiah K, Siregar A. Relationship between diet, energy adequacy levels, and protein with nutritional status in adolescents. *J Health.* 2020;11(2):279.
  7. Dhillon J, Craig BA, Leidy HJ, Amankwaah AF, Osei-Boadi Anguah K, Jacobs A, et al. The effects of increased protein intake on fullness: A meta-analysis and its limitations. *J Acad Nutr Diet.* 2016;116(6):968-83. <http://doi.org/10.1016/j.jand.2016.01.003>  
PMid:26947338
  8. Nuryani, Paramata Y. Peer education intervention increases knowledge of balanced nutrition attitudes and behaviors in adolescents at MTsN limboto model. *J Hum Nutr Indonesia.* 2015;2015:74-84.
  9. Gorontalo DK. Health Profile of Gorontalo Province. Gorontalo: Gorontalo Provincial Health Office; 2013.
  10. Masdar H, Saputri PA, Rosdiana D, Chandra F, Darmawi D. Depression, anxiety and stress and their relationship with obesity in adolescents. *J Gizi Klin Indonesia.* 2016;12(4):138.
  11. Irianto K. Balanced Nutrition in Reproductive Health. Bandung: PT Alfabeta; 2010.
  12. Sartika RA. Risk factors for obesity in children 5-15 years in Indonesia. *So Health.* 2011;15(1):37-43.
  13. Rachmayani AS, Kuswari MM. Relationship between nutrient intake and nutritional status of young women at SMK Ciawi bogor. *Indones J Hum Nutr.* 2016;5(2):125-30.
  14. Mustika MA. Physical activity level, nutrient consumption level and student nutritional status at Al Falak Islamic boarding school, Bogor city. *Bogor Agric Univ.* 2012;9(1):50-77.
  15. Nurwulan E, Furqan M, Debby ES. Knowledge of nutrition with nutritional status of Santri at At-Thayyibah Islamic boarding school Sukabumi. *Argipa.* 2017;2(2):65-74.
  16. Khairunnisah K. Relationship of Nutrition Knowledge Level, Body Image (Perception and Satisfaction), Energy Intake, and Macro Nutrients with Nutritional Status of Adolescents at Madrasah Aliyah Annajah Petukangan, South Jakarta 2014. Indonesia: University of Muhammadiyah; 2014.
  17. Department of Health of the Republic of Indonesia. Basic Health Research. Indonesia: Department of Health of the Republic of Indonesia; 2013.
  18. Brown J. Dietary Reference Intakes (DRIs): Recommended Intakes for Individuals, Vitamins Food and Nutrition Board, Institute of Medicine, National Academies. Fluoride; 2011. p. 623.
  19. Aini S. Factors, associated analysis, the recurrence, with lung, T B. *Unnes J Public Health.* 2014;3(1):1-10.
  20. Ruslie RH, Darmadi D. Logistic regression analysis for factors affecting adolescent nutritional status. *Maj Kedokt Andalas.* 2012;36(1):62.
  21. Hendra C, Manampiring AE, Budiarmo F. Risk factors for obesity in adolescents in Bitung city. *J E Biomed.* 2016;4(1):2-6.
  22. Ramadhani F, Badu FD, Djafar L. Correlation of physical activity, family income and consumption of fruits and vegetables with the incidence of obesity in adolescents. *Kinesthetic J Sci Educ Jasm.* 2021;5(2):5.
  23. Ministry of Health of the Republic of Indonesia. Nutritional Adequacy Figures for the Community of Indonesia. In Ministerial Regulation. Vol. 8. Indonesia: Ministry of Health of the Republic of Indonesia; 2019.
  24. Dewi AM, Pradigdo SF. Relationship of energy and protein intake with nutritional status of general prisoners. *J Public Health* 2017;5:266-71.
  25. Supariasa, Bakri BF. Nutritional Status Assessment. Jakarta: EGC; 2012.
  26. Peltzer K, Pengpid S. Overweight and obesity and associated factors among school-aged adolescents in Ghana and Uganda. *Int J Environ Res Public Health.* 2011;8(10):3859-70. <https://doi.org/10.3390/ijerph8103859>  
PMid:22073017
  27. Rahmawati T. Relationship of nutritional intake with nutritional status of nutritional students semester 3 stikes PKU Muhammadiyah Surakarta. Energy intake, protein, fat, carbohydrate. *Nutr Status.* 2017;1(4):50-7.
  28. Maradesa E, Kapantow NH, Punduh MI. The relationship between energy and protein intake with the nutritional status of 1-3 year old children in the working area of the Walantakan health center, Langowan District. *KESMAS.* 2015;4(2).