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Original Research

The Relationship Between Nutritional Knowledge and Macronutrient Intake and Underweight Status Among Adolescents at SMPN 13 Depok

Hubungan antara Pengetahuan Gizi dan Asupan Makronutrien dengan Status Gizi Kurus pada Remaja di SMPN 13 Depok

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Abstract: *Nutritional problems in adolescents remain a significant public health challenge because this period is a period of rapid growth that determines the quality of health in adulthood. This study aims to examine the factors associated with undernutrition among adolescents aged 13–15 years at State Junior High School 13 Depok. The research employed an analytical approach with a cross-sectional design, utilizing secondary data derived from previous studies. The variables analyzed included the level of nutritional knowledge and the intake of protein, fat, and carbohydrates. Data were analyzed to determine the relationship between these factors and the incidence of undernutrition among adolescents. The findings revealed no significant association between nutritional knowledge and nutritional status, nor between the intake of protein, fat, and carbohydrates and the occurrence of undernutrition among the students (p-value > 0.05). The results suggest that improving adolescents' nutritional status requires consideration of additional determinants beyond nutritional knowledge and dietary intake, such as eating behaviors, environmental factors, and social influences within the school and community setting.*

Keyword: Adolescents; Intake; Underweight; Nutritional Status

1. INTRODUCTION

Adolescents are estimated to constitute approximately 16% of the global population, with numbers ranging from 1 to 3 billion individuals worldwide. The definition of adolescence varies across institutions: the United Nations defines adolescence as individuals aged 10–19 years, the World Health Organization extends this range up to 24 years, while the Indonesian Ministry of Health classifies adolescents as those aged 10–15 years who are unmarried. Adolescence represents a transitional phase from childhood to adulthood, beginning with the onset of puberty and concluding when full independence in adulthood is achieved. This developmental stage is considered a critical period in the life course, characterized by substantial biological, psychological, emotional, and social changes. Moreover, adolescence is marked by rapid physical and cognitive growth, second only to infancy, resulting in significantly increased nutritional requirements. When adjusted for body weight and energy needs, adolescents require higher nutrient intake compared to adults (7).

Nutritional status refers to a condition resulting from the balance between dietary nutrient intake and the body's nutritional requirements and is strongly influenced by food consumption patterns (8). According to the 2023 Indonesian Health Survey

(Survei Kesehatan Indonesia/SKI), the prevalence of thinness and severe thinness among adolescents aged 13–15 years in Indonesia was 5.7% and 1.9%, respectively. In West Java Province, 6.1% of adolescents were classified as thin, while 2.3% were categorized as severely thin (16). Assessment of nutritional status among students at SMPIT Generasi Rabbani revealed that 15% of students were identified as thin or severely thin (5). In contrast, a study conducted by Pangow in 2020 reported that 57% of adolescents experienced undernutrition (10). Collectively, these findings indicate that undernutrition among adolescents remains a significant public health concern. Underweight is a multidimensional nutritional problem influenced by various factors, one of which is dietary intake, subsequently affecting overall nutrient consumption. Being underweight can have adverse effects on growth and intellectual development and may increase morbidity and mortality rates among children and adolescents (15). Several determinants contribute to adolescent nutritional problems, including the level of nutritional knowledge and dietary intake.

Nutritional knowledge refers to an individual's intellectual understanding of nutrition-related concepts, including knowledge of nutrients and their interactions with nutritional status (9). The level of nutritional knowledge influences an individual's ability to make appropriate food choices (17). Differences in nutritional knowledge arise due to variations in individual perceptions of nutritional information. The negative effects of inappropriate food choices are not immediately apparent after consumption but tend to manifest over the long term (4). Dietary intake, on the other hand, encompasses all foods and beverages consumed by an individual over a specific period and includes all nutrients absorbed by the body from these sources. Adequate and balanced intake is essential for maintaining health and well-being, including sufficient energy, carbohydrates, proteins, fats, vitamins, and minerals (14). Carbohydrates, proteins, and fats are essential macronutrients required by the body. Carbohydrates serve as the primary source of energy and consist of carbon, hydrogen, and oxygen, with the general chemical formula $Cn(H_2O)n$. In addition to energy production, carbohydrates contribute to food palatability, protein sparing, regulation of fat metabolism, and facilitation of waste excretion. Carbohydrate metabolism begins in the oral cavity through the action of amylase and is absorbed as glucose in the small intestine. Proteins are essential biomolecules that function as enzymes, transporters, antibodies, hormones, and structural components of cell membranes. Fats, meanwhile, represent the most energy-dense macronutrient (9 kcal/gram) and play crucial roles in cell membrane formation, hormone synthesis, and the absorption of fat-soluble vitamins. Excess fat is stored in subcutaneous tissue, and body fat percentage can be assessed using bioelectrical impedance analysis (BIA) to evaluate conditions such as obesity, which can be differentiated into subcutaneous and visceral fat (2). The present study was conducted at SMPN 13 Depok City. This school was selected due to its proximity to vendors selling foods high in sugar, salt, and fat, which facilitates easy access for students to purchase such foods around the school environment. Preliminary findings indicated that during the 2024/2025 academic year, SMPN 13 Depok City had a total of 98 students. Based on secondary data obtained from the preliminary study, information was collected on the number of students, height, weight, Z-scores, nutritional knowledge, and daily dietary intake. Based on these data, this study aims to examine factors associated with nutritional status (BMI-for-age) among adolescents aged 13–15 years at SMPN 13 Depok City in 2025.

2. METHODS

This study uses an analytical study design with a (cross-sectional) approach aimed at examining the relationships between variables and utilized a cross-sectional approach to identify factors associated with nutritional status, particularly underweight, among adolescents. Within this framework, secondary data derived from lecturers' previous research activities were initially reviewed to support the analytical process. The study population comprised students enrolled at SMPN 13 Depok City in 2025. A random sampling technique was applied to ensure that each individual in the population had an equal opportunity to be selected. The study sample consisted of adolescents aged 13–15 years attending SMPN 13 Depok City. Furthermore,. Inclusion Criteria, participants who met the inclusion criteria for this study were adolescents between the ages of 13 and 15. Furthermore, subjects had to voluntarily agree to participate in the study, as evidenced by signing the provided questionnaire. Exclusion Criteria, meanwhile, exclusion criteria that prevented subjects from participating included being absent during data collection or having other commitments, such as attending a competition or exam. Furthermore, this study involved individuals on special diets and subjects with incomplete data that could not be further explained. Primary data were collected using anthropometric questionnaires and a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) to assess the intake of carbohydrates, proteins, and fats. This data was then analyzed to communicate the nutritional status of underweight by looking at the BMI-for-age among the study participants.

3. RESULTS

Table 1. Univariate Analysis Results of Study Participants

Variables	Frequency (n)	Percentage (%)
Sex		
Male	50	55,6
Female	40	44,4
Usia		
13 years old	56	62,2
14 years old	17	18,9
15 years old	17	18,9
Nutritional Status		
Underweight	7	7,8
Normal	83	92,2
Nutritional Knowledge		
Poor	71	78,9
Adequate	19	21,1
Protein Intake		
Inadequate	82	91,1
Adequate	8	8,9
Fat Intake		
Inadequate	75	83,3
Adequate	15	16,7
Carbohydrate Intake		
Inadequate	88	97,8
Adequate	2	2,2

Based on Table 1, most respondents were male (55.6%), with the majority aged 13 years (62.2%). This cross-sectional study included 90 respondents, of whom 7 individuals (7.8%) were classified as underweight. Underweight refers to a condition in which body

weight is below the expected range for age and may indicate undernutrition in the absence of wasting data. Factors associated with underweight include nutritional knowledge and macronutrient intake, namely protein, fat, and carbohydrates.

The findings showed that most respondents had poor nutritional knowledge (84.4%), which may be related to limited access to nutrition-related information through formal education or educational media (11). In addition, the majority of respondents exhibited inadequate dietary intake, with insufficient protein intake observed in 91.1% of respondents, fat intake in 83.3%, and carbohydrate intake in 97.8%.

Despite the high prevalence of inadequate intake, most respondents had normal nutritional status. Analysis of 24-hour food recall data indicated that inadequate energy intake does not necessarily correspond to underweight status, suggesting that individuals with normal nutritional status may still fail to meet their daily energy requirements (13).

4. DISCUSSION

Table 2. Association between Nutritional Knowledge and Underweight

Nutritional Knowledge	Nutritional Status				Total		*p-value*
	Underweight		Normal				
	n	%	n	%	n	%	
Poor	7	9,86	64	90,14	71	100	
Adequate	0	0	19	100	19	100	0,154
Total	7	7,78	83	92,22	90	100	

Based on Table 2, the analysis of the association between nutritional knowledge and underweight showed that respondents with poor nutritional knowledge were more frequently classified as having normal nutritional status than underweight status (90.14%). Statistical analysis yielded a p-value of 0.154, indicating that there was no significant association between nutritional knowledge and underweight among adolescents.

Age is known to influence an individual's level of knowledge; as age increases, cognitive ability, maturity in thinking, and the capacity to receive and process information generally improve compared to younger or less mature individuals. Adequate nutritional knowledge is considered to contribute to positive attitudes toward nutritional fulfillment, which, when perceived as appropriate, may lead to positive nutritional behaviors (18). However, knowledge, attitude, and behavior do not always demonstrate a linear relationship. A gap may exist between knowledge and behavior, as good behavior requires not only adequate knowledge but also a supportive attitude.

This study did not examine attitudinal factors. Attitude refers to an individual's readiness or willingness to act and consists of three components: beliefs, emotional aspects, and behavioral tendencies, which together form a comprehensive attitude. In addition, knowledge, thoughts, beliefs, and emotions play essential roles in shaping attitudes. Nevertheless, attitudes do not necessarily translate into action, as their implementation often depends on other supporting factors, such as the availability of facilities and infrastructure (3).

Table 3. Association between Macro(Protein, Fat, and Carbohydrate) Intake and Underweight

Protein Intake	Nutritional Status	Total	*p-value*

	Underweight		**Normal**				
	n	**%**	**n**	**%**	**n**	**%**	
Inadequate	6	7,32	76	92,68	82	100	
Adequate	1	12,5	7	87,5	8	100	0,601
Total	7	7,78	83	92,22	90	100	
Fat Intake	**Nutritional Status**				**Total**		***p-value***
	Underweight		**Normal**				
	n	**%**	**n**	**%**	**n**	**%**	
Inadequate	6	8	69	92	75	100	
Adequate	1	6,67	14	93,33	15	100	0,860
Total	7	7,78	83	92,22	90	100	
Carbohydrate Intake	**Nutritional Status**				**Total**		***p-value***
	Underweight		**Normal**				
	n	**%**	**n**	**%**	**n**	**%**	
Inadequate	7	7,95	81	92,05	88	100	
Adequate	0	0	2	100	2	100	0,678
Total	7	7,78	83	92,22	90	100	

Based on Table 3, the analysis of the association between protein intake and underweight showed that respondents with inadequate protein intake were more frequently classified as having normal nutritional status than underweight status (92.68%). Statistical analysis produced a p-value of 0.601, indicating that there was no significant association between protein intake and underweight among adolescents.

Protein is an essential macronutrient that plays a crucial role in maintaining, repairing, and replacing damaged tissues, as well as serving as an alternative energy source when fat and carbohydrate intake is insufficient. Excess protein that is not utilized by the body may be converted into fat and stored as energy reserves. Beyond its role as an energy source, protein is a fundamental structural component of body cells and functions as a key building block for body tissues. During early adolescence, protein requirements among female adolescents are higher than those of males due to earlier onset of growth and development. However, with increasing age, female adolescents tend to gain body weight primarily through fat accumulation, whereas male adolescents experience weight gain mainly through increases in muscle mass and skeletal development. Consequently, protein requirements in later adolescence are generally higher in males than in females. Inadequate protein intake during adolescence may impair optimal growth and development. Overall protein requirements increase substantially during adolescence due to increases in muscle mass, erythrocyte and myoglobin synthesis, and hormonal changes (12).
Nevertheless, nutritional status is not determined solely by protein and iron intake. Other factors, including physical activity, carbohydrate and fat intake, as well as the intake of vitamins and minerals, also play important roles in shaping nutritional status. In addition, both dietary intake and the body's ability to utilize consumed nutrients contribute to overall nutritional status (12).

Based on Table 3, the analysis of the association between fat intake and underweight showed that respondents with inadequate fat intake were more frequently classified as having normal nutritional status than underweight status (92.0%). Statistical analysis yielded a p-value of 0.860, indicating that there was no significant association between fat intake and underweight among adolescents.

Fat is an energy-dense nutrient and serves as a major source of energy, playing an essential role in metabolic processes. Based on its function in the body, fat can be classified into storage fat and structural fat. Storage fat primarily consists of triglycerides stored in plant and animal tissues and represents the main form of energy reserve in the body. Structural fat, on the other hand, is a critical component of body tissues and contributes to optimal physiological function (19). In addition, fat plays an important role in the transport and absorption of fat-soluble vitamins (A, D, E, and K), acts as a protein-sparing nutrient, helps maintain body temperature, protects vital organs, and supplies essential fatty acids that are necessary to support normal growth and maintain physical fitness during adolescence (6).

Based on Table 3, the analysis of the association between carbohydrate intake and underweight showed that respondents with inadequate carbohydrate intake were more frequently classified as having normal nutritional status than underweight status (92.05%). Statistical analysis produced a p-value of 0.601, indicating that there was no significant association between carbohydrate intake and underweight among adolescents.

Carbohydrate intake represents energy consumption derived from food that is required to support daily activities. Carbohydrates serve as the primary source of energy and are utilized by the body during metabolic processes. Insufficient carbohydrate intake may lead to reduced energy availability, and when this condition persists over time, it can result in weight loss and subsequently affect the nutritional status of adolescents (1).

5. CONCLUSION

The majority of adolescents at SMPN 13 Depok City were classified as having normal nutritional status, and no significant association was found between nutritional knowledge or macronutrient intake and the occurrence of underweight. This finding may be attributed to other unexamined factors, such as eating habits, physical activity, and environmental influences. Adolescents are therefore encouraged to improve both their nutritional knowledge and the implementation of balanced dietary practices to support optimal growth and development. Future studies are recommended to explore additional factors, including physical activity patterns, psychological conditions, and social environments, which may influence adolescent nutritional status.

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