Profile of macro-nutrient intake and its association with undernutrition prevalence among adolescent girls in rural areas of the Western Sumatera

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ABSTRACT

Backgrounds: Poor quality of nutrient intake may impact malnutrition, mainly for vulnerable groups of age, such as children and adolescents. Based on the SSGI year 2021-2022, there was a tendency to increase undernutrition prevalence among children. It may have negative consequences for children at the next age, especially girls.

Aims: The study aimed to analyze the association of nutrient intake with nutritional status among adolescent girls.

Methods: Totally 120 girls aged 12-15 years participated in the cross-sectional study which lived in a rural area of Indonesia. The sample of the study was examined through simple random sampling with criteria agreed to follow the study, the ability to communicate well and in good health. Data was collected using a validated questionnaire, and after that data was analyzed by the SPSS program. Chi-square test for bivariate analysis examined associations between macro nutrient intake and nutritional status. Multiple logistic regression models for multivariate analysis examined the most dominant factor for undernutrition status among adolescent girls.

Results: The study reported that almost 30% of adolescents were underweight and severely underweight status, and it was identified that 12.5% of adolescents were overweight status. The nutrient intake of girls was more than 20% in the low nutrient intake category. Furthermore, macronutrient intake significantly had an association with malnutrition status among adolescent girls in a rural area (p-value=0.05). Protein intake was a dominant factor that had an association with undernutrition prevalence among adolescent girls (p-value=0.001; OR=17.813; 95%CI=3.463-91.635).

Conclusions: The institution of health should make a creative nutrition program that cooperates with nutrition science program study such as giving nutrition education through peer involvement to decrease the prevalence of undernutrition among young girls.

KEYWORDS

Malnutrition, diet quality, growth, women's health, rural area.

INTRODUCTION

Adolescent girls represent a critical demographic for addressing undernutrition due to their unique nutritional needs during periods of rapid growth and development. According to the World Health Organization[1] data from 2021-2022, approximately 22% of adolescent girls under 18 years in low- and middle-income countries are stunted. This indicates a significant issue of chronic malnutrition, where girls' height is below the age-appropriate standard due to prolonged nutrient deficiencies. Data also showed that the prevalence of wasting among adolescent girls is around 7% globally. Wasting reflects acute malnutrition and is characterized by low weight-for-height[2]. It is often associated with severe food insecurity and recent weight loss.

Data from Indonesian Nutrition Survey or SSGI 2021-2022 reports that approximately 22% of Indonesian adolescent girls (12-18 years) are stunted. This figure reflects chronic undernutrition and poor growth outcomes[3]. Actually, this number was lower than data from the National Basic Health

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Research Survey or Riskesdas year 2018 whereas more than a fourth of the adolescent population aged 13–15 years were stunted (approximately 26%) and 9% were underweight (thin). Beside age, there is also a difference of undernutrition prevalence among adolescent based on residence (rural versus urban). The previous study showed that adolescent who lived ini rural are were more risk of underweight status (40%) than adolescent who lived in urban area (26%)[4], and also adolescent who lived in rural area were more vulnerable in dietary diversity than adolescent who lived in urban area[5].

The data from both global sources and study of Indonesia's nutritional status year 2021-2022 highlighted a significant issue of undernutrition among adolescent girls. Addressing these issues requires comprehensive strategies that include improving dietary quality, enhancing food security, and implementing targeted health interventions. Both global and national efforts are crucial in reducing the prevalence of undernutrition and ensuring better health outcomes for adolescent girls[3].

Many factors were related to undernutrition problems among adolescent girls. A study in Ethiopia found that the problem of chronic lack of energy in women of reproductive age was associated with living in rural areas, not attending formal education, not working and having poor well-being[6]. Fathers' characteristics like salary, working status and food security in the family were found to be significantly associated with thinness among young girls in Darchula District, Nepal[7]. More specific factors related with low body mass index for age were age, dietary diversity score and community-based nutrition service utilization in Ethiopia[8]. Based on a literature review, factors such as body image or negative perceptions regarding body shape will affect the nutritional status of young women[9].

Adequate macronutrient intake, encompassing carbohydrates, proteins, and fats are vital for supporting physical growth, cognitive development, and overall health. Protein and healthy fats are particularly important for brain development and concentration[10,11]. Nutrition deficiencies can impair cognitive abilities, resulting in poor academic performance and reduced school attendance. Despite the significance of these nutrients, many adolescent girls, particularly in low- and middle-income countries, experience deficiencies that contribute to widespread undernutrition. The previous study found inadequate intake of some nutrients with a high prevalence happened among young girls in Damot Gale District[12]. Understanding the relationship between macronutrient intake and undernutrition prevalence among adolescent girls is essential for developing targeted nutritional interventions. Insufficient macronutrient intake can lead to various health issues, including stunted growth, delayed puberty, and increased susceptibility to infections[13].

Studies show that many adolescent girls have diets that are low in essential macronutrients. For instance, data from the Global Burden of Disease Study reveals that about 25% of adolescent girls in these regions have inadequate protein intake, and 20% are not meeting their daily caloric needs[14]. Moreover, meat consumption 1-2 times per week and feeding of meals less than 3 times per day were factors significantly affecting low height for age. Then, monotonies in diet were factors associated with low body mass index for age of adolescent girls in rural community of Aseko district, Arsi zone, Ethiopia[15]. Additionally, there is often an imbalance in fat intake, with excessive consumption of unhealthy fats and insufficient intake of essential fatty acids.

The present study aimed to identify the prevalence of undernutrition and the role of macro-nutrient intake with undernutrition among adolescent girls. The study focused in rural area settings and further explore macro-nutrient pattern among girls.

MATERIAL AND METHODS

Study Design and Sampling

A cross-sectional analytical study was conducted to determine the factors of chronic energy deficiency (CED) among 120 adolescent girls selected by simple random sampling in the Padang Pariaman and West Pasaman, Indonesia. Chosen two rural areas in the Western Sumatra because these areas had a higher prevalence of stunting based on SSGI year 2022. Adolescent girls from 12-15 years who were healthy and agreed to participate were include in the study. Then, adolescent girls who were sick during data collection were excluded in the study. The sample was taken by the probability simple random sampling.

Data Collection

Data was collected by enumerators with nutrition background and before collecting the data, there was a coaching for enumerators to explained the study's aim so they had the same perception about the study.

Variable dependent of the study was nutritional status of adolescent girls which was assessed through anthropometric measurements. Body weight was measured to the nearest 0.5 kg on a portable weighing scale, and height was measured to the nearest 0.1 cm using a microtoice. According to the WHO, nutritional status was divided into four categories based on Body Mass Index (BMI) Z-score, (1) Underweight (BMI Z-score < -2, (2) Normal weight (BMI Z-score $\geq$ -2 and $\leq$ 1), (3) Overweight (BMI Z-score > 1 and $\leq$ 2), (4) Obese (BMI Z-score > 2) [16].

Variable independent of the study was nutrient intake. This data was collected using the semi-quantitative food frequency questionnaires, was classified into two groups, macronutrients and micronutrients. Each group are categorized into low if respondent did not meet of the 80% rate of nutritional needs and adequate if respondent meet of the 80% rate of

nutritional needs. The nutrient composition of Indonesia reference was used as a standard for nutrient intake.

Prior to collecting the data, informed written consent was obtained from all participants after a full explanation of the topic, the study's aim, and procedures used for the study. Ethical approval was obtained from the ethics and research review committees of Public Health Faculty, Universitas Andalas.

Data Analysis

Analysis data consisted of univariate, bivariate and multivariate which was processed through computer program. Univariate analysis described frequency distribution of each variable and after that analysis was continued by bivariate analysis using chi-square test to examine the relationship between variables. The further analysis was done to determine the dominant factor of CED among adolescent girls by multiple regression logistic test. This test used enter method, all possible factors related with nutritional status were analyzed together, after that factor which had p-value higher than others had excluded from the model. However, the significance factor was assessed by p-value less than 0.05 with a 95% Confidence Interval (95% CI), and the dominant factor was determined through the highest of the Odd Ratio (OR) over than 1.

RESULTS AND DISCUSSION

The result showed about a half of adolescent girls were 14 years age. The study found 35.8% of adolescent girls were underweight and 64.2% were not underweight status. About 36.7% of adolescent girls were in chronic energy deficiency (Table 1).

Table 1. Characteristics Respondents

Variables	n	%
Age (year)		
13	39	32.5
14	61	50.8
15	20	16.7
Nutritional Status		
Underweight	43	35.8
Not Underweight	77	64.2
CED Status		
CED	44	36.7
Not CED	76	63.3

Analysis bivariate through chi-square test showed that there was a significant association between energy intake and macro nutrient intake with undernutrition status among adolescent girls in rural areas of the Western Sumatera (p-value < 0.05). From the result, we can see a low energy intake, fat intake and protein intake were higher prevalence on underweight adolescent girls (more than 60.0 %) (Table 2).

Table 2. Profile of Macro Nutrient Intake of Adolescent Girls based on Nutritional Status

Macro Nutrient Intake	Underweight	Not Underweight	P-value
	n (%)	n (%)	
Energy Intake Adequacy			
Low	28 (62.2)	17 (37.8)	0.0001
Adequate	15 (20.0)	60 (80.0)	
Carbohydrate Intake Adequacy			
Low	39 (50.0)	39 (50.0)	0.0001
Adequate	4 (9.5)	38 (90.5)	
Fat Intake Adequacy			
Low	40 (70.2)	17 (29.8)	0.0001
Adequate	3 (4.8)	60 (95.2)	
Protein Intake Adequacy			
Low	40 (74.1)	14 (25.9)	0.0001
Adequate	3 (4.5	63 (95.5)	

The present study identified that more than half adolescent girls were a higher of low energy, fat and protein intake. For carbohydrate intake, underweight and not underweight had the same percentage, it was 50.0% of adolescent girls on low carbohydrate intake. The majority of adolescent girls on adequate intake were not underweight. There was an association between macro nutrient intake with the underweight of nutritional status among adolescent girls (p-value=0.0001).

The result of multivariate analysis found that protein intake and energy intake were significantly the determinant of nutritional status of adolescent girls. Protein intake was the dominant factor that related with nutritional status of adolescent girls in the rural area of West Sumatera Province (p-value=0.001; OR=17.813; 95%CI=3.463-91.635).

The present study found that more than a third of adolescent girls in rural areas of the Western Sumatera were in underweight status. The percentage of undernutrition among

Table 3. Determinant Nutrient Intake of Nutritional Status Adolescent Girls

Variables	OR	95% CI		P-value
		Lower	Upper	
First Model				
Energy Intake Adequacy	1.178	0.317	4.373	0.807
Carbohydrate Intake Adequacy	7.256	1.680	31.341	0.008
Fat Intake Adequacy	4.751	0.936	24.109	0.060
Protein Intake Adequacy	17.376	3.362	89.807	0.001
Last Model				
Protein Intake Adequacy	17.813	3.463	91.635	0.001
Energy Intake Adequacy	7.761	1.981	30.413	0.003
Fat Intake Adequacy	4.895	0.978	24.511	0.053

adolescent girls was higher than Padmaja Ravula's finding in Telangana, India (24.4%) and Degu Demissie Gagebo's finding in Damot Sore District, Southern Ethiopia (19.5%)[17,18].

The study showed protein intake play an important role in the adolescent girls' nutritional status. Based on theory, protein is a critical macronutrient necessary for growth, development, and overall health, particularly during adolescence when the body undergoes rapid growth and development. Inadequate protein intake can lead to various forms of undernutrition, including stunting, wasting, and delayed physical and cognitive development. Protein also have contribution in maintaining a healthy immune system, which is particularly important during the period of adolescence when the body is developing rapidly[19]. Besides, nutrient intake also relates with quality of life which involves mental, physical and social well-being (social and environment)[20].

The present study was supported by Citrakesumasari, et al (2020) and Musfira, et al (2024), they found that all adolescents did not meet the adequacy of the 80% rate of nutritional needs[21,22]. Rika Rachmalina, et al (2019) also found almost half of the girls' daily food intake showed low dietary diversity and protein intake inadequacy showed significant unlikelihood of a normal nutritional status outcome[23]. The study was also consistent with Antika Prycilla Veronikas' finding in Sleman, Yogyakarta (2021) which found 82.8% adolescents were deficit protein intake and energy intake [24]. The research in rural areas of Thailand found that lower protein intake was significantly associated with higher rates of stunting. Girls with protein intake below the recommended levels had a higher prevalence of stunted growth compared to those with adequate protein intake[25] and related to wasting of ado-

lescent girls in sub-Saharan Africa[26]. Besides, girl in junior high school had catch-up height and growth than boy.

This finding could explain SSGI 2020-2021 which found about 30% of Indonesian adolescent girls have inadequate protein intake, indicating a need for better access to and consumption of high-quality protein sources mainly girls who live in the rural area. Through Tone Berg's study, it was found that girls were higher percentages of low in dietary diversity and rarely consume animal products. However, consuming a diverse diet from plant-based and animal-based sources, would increases the chance of meeting nutrient requirements[27]. Nathan Isabirye et al (2020) stated that low in dietary diversity among adolescents because of living with single parent, low socio-economic level and dependency on home foods[28].

The strengths of the study were; food data were collected through the semi-quantitative food frequency questionnaires which could described the behavior of dietary intake among adolescent girls. The limitation of food intake survey may have resulted in bias of recall errors and underreporting. To minimize the bias, food model book was used to memorize the dietary pattern of adolescent girl and used a trained data collector. However, cross sectional design study could not explain causality relationship.

Based on the study, strengthening school-based nutrition programs to include fortified foods and provide better-quality meals can help address deficiencies among girls. Several studies reported that intervention such as providing vitamin A fortified maize, iron tablets supplementation and nutrition education have impact to overcome undernutrition among school-age children and adolescents[29–31]. Nutrition program is not only for adolescent, but through enhancing parents' edu-

cation and strategy by using social media is needed to accelerate improving adolescents' knowledge and practice in consuming nutrition intake.

CONCLUSION

Inadequate protein intake among adolescent girls is a significant factor contributing to undernutrition. Addressing this challenge requires targeted interventions, including improved dietary programs, public education, and supportive policies to ensure that adolescents receive adequate protein for their growth and development. By focusing on these areas, it is possible to improve the nutritional status and overall well-being of adolescent girls specially who live in the urban area.

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