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The Relationship between Nutritional Adequacy Level and Nutritional Status among School-going Adolescents in West Aceh

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Abstract

The triple burden of malnutrition is the primary nutritional problem experienced by many adolescents. This condition is triggered by unhealthy consumption patterns, a sedentary lifestyle, low economic status, and poor nutritional knowledge. **Methods.** This study employed a cross-sectional approach with a sample of 312 school-going adolescents in West Aceh. It aimed to examine the differences in the level of nutritional adequacy and its relationship with the nutritional status of adolescents in urban and rural areas. The instruments used were a 2x24-hour food recall questionnaire and anthropometric measurements using BIA scales and a microtomies. Statistical analysis used Spearman's rank correlation and the Mann-Whitney test. **Results.** The results showed the level of energy and carbohydrate adequacy was different significantly between adolescents in rural and urban areas ($p>0.05$). There was a significant positive relationship between the level of carbohydrate adequacy and BAZ among adolescents in both rural and urban areas ($p<0.05$). **Conclusion.** The level of energy adequacy is not related to BAZ, but the level of carbohydrate adequacy is significantly related to BAZ between adolescents in rural and urban areas. Nutrition interventions should focus on balanced carbohydrate consumption rather than simply increasing food quantity.

Keywords: Adolescents; BAZ; Nutritional adequacy; Nutritional Status; Rural- Urban

Introduction

Adolescents hold a strategic position as the nation's fundamental asset. Adolescence is a critical period that requires adequate nutrient intake so that the growth and development process can proceed optimally. The biggest nutritional challenge facing adolescents today is the phenomenon of the *triple burden of malnutrition*, a situation in which undernutrition, overnutrition, and micronutrient imbalances occur simultaneously (UNICEF 2021).

Referring to the results of the 2013 Basic Health Research (Riskesdas) conducted the Ministry of Health, the prevalence of undernutrition among adolescents aged 13-15 years was recorded at 11.1%. This figure then decreased to 8.7% in 2018. Conversely, the prevalence of overnutrition in the same age range increased from 10.8% in 2013 to 16% in 2018. Meanwhile, the prevalence of stunting decreased from 35.2% to 25.7% during the same period (Ministry of Health, 2018) For adolescents aged 16-18 years, the prevalence of overnutrition was recorded at 13.5% (an increase from 7.3% in 2013), undernutrition at 8.1% (a slight decrease of 0.5% from 2013), and stunting at 26.9% (a decrease from 31.4% in 2013). The incidence of anemia among adolescents also increased significantly from 18.4% in 2013 to 32% in 2018 (Ministry of Health, 2013; Ministry of Health, 2018).

Aceh Province ranks fifth in Indonesia in terms of the highest prevalence of stunting among adolescents. Riskesdas Aceh data from 2018 show that among adolescents aged 13-15 years, the prevalence of undernutrition reached 8.3% (a decrease from 12.9% in 2013), stunting was 36.9% (a decrease from 40.4%), while overnutrition jumped sharply from 9.8% (2013) to 18.5% (2018). Among adolescents aged 16-18 years, undernutrition was recorded at 6.0% (a decrease from 8.5%), stunting at 36.4% (a slight increase from 35.7%), and overnutrition increased drastically from 6.9% in 2013 to 14.9% in 2018. The prevalence of anemia in Aceh also showed a significant increase from 22.7% (2013) to 36.9% (2018) (Ministry of Health, 2013; Ministry of Health, 2018). Upon closer examination, adolescents with short stature aged 13-18 years are more commonly found in rural areas than in urban areas, while adolescents with overnutrition tend to be more dominant in urban areas. At the district level, West Aceh recorded a prevalence of undernutrition among adolescents aged 13-15 years of 4.7%, stunting reached 52.1%, and overnutrition was 16.4%. Meanwhile, for adolescents aged 16-18 years in the same district, the figures were 7.3% for undernutrition, 30.8% for stunting, and 18.0% for overnutrition (Ministry of Health, 2013). Thus, West Aceh Regency is the district with the highest prevalence of stunting among adolescents aged 13-15 years in all of Aceh Province.

Nutritional problems in adolescents are triggered by various factors. These include unhealthy eating habits, incorrect understanding of nutrition, an excessive preference for certain foods, and being easily influenced by various media broadcasts (Intantiyana, 2018). The school environment not only functions as a place to gain knowledge but also as an effective means for students to shape and improve their behaviour in a more positive direction. There is a close relationship between a person's level of knowledge and behaviour (Haryana *et al.* 2017; Lathifa dan Mahmudiono 2020).

The geographical location of residence, whether urban or rural areas, helps shape people's way of life, including aspects such as knowledge, access to food, local policies, and daily consumption patterns. Efforts to prevent the emergence of nutritional problems require a series of educational activities focused on implementing balanced nutrition principles according to established guidelines. The process of behavioural change in the community is largely determined by how the socialization and training on balanced nutrition practices are carried out. The success of all these efforts depends heavily on the active role of the government, both at the central and regional levels, as well as the direct involvement and genuine participation of the community itself.

West Aceh Regency is one of the areas in Aceh Province that records the highest prevalences of adolescents with stunting in all of Aceh. Although various interventions and treatment programs have been implemented to address nutritional problems, the reality is that the triple burden of malnutrition remains relatively high in this area. Adolescent groups are among those most susceptible to nutritional problems due to many factors, such as a lack of nutritional knowledge and poor food consumption patterns, both at school and at home. Based on these problems, this study will analyze the Relationship between Nutritional Adequacy Level and nutritional status of school-going adolescents in West Aceh.

Methods

This study used a cross-sectional design and was conducted in West Aceh Regency, rural and urban. The minimum sample size was calculated using the Lameshow formula (Lemeshow *et al.* 1997). The duration was from August until

October 2023. The total number of respondents was 312. The types of data collected included family and respondent characteristics, food intake, and BAZ (BMI-for-Age Z-score). Food intake was collected using the 2x24-hour recall method (weekend and weekday). Height was measured using a microtomies, and body weight was measured using an Omron BIA Bio Impedance Analysis. Data on subject characteristics were collected through a questionnaire. The relationships between variables were analyzed using Spearman's rank correlation test, while differences between groups were tested using the Mann-Whitney U test and Chi-squared test ($p < 0.05$). This study has obtained ethical approval from the Ethics Commission of Muhammadiyah University of Semarang with number: No.221/KE/09/2023.

Subject Characteristics

Subject characteristics consisted of age and sex. Table 1 shows the differences in subject characteristics between rural and urban areas.

Table 1 Subject characteristics by age and sex

Variable	Rural		Urban		*p-value**
	N	%	n	%	
Age (years)					
12-15	82	53	78	50	
16-18	74	47	78	50	
Median (Min-Max)	13 (12-18)		13(12-18)		0.569[1]
Mean±SD	15.7 ±0.7		15.8±0.7		
Sex					
Male	56	36	63	40	
Female	100	64	93	60	0.415[2]

Note: [1)] *Mann-Whitney test*, [2)] *Chi-squared test* (χ), [*]significant if p<0,05

One-fifth of the subjects were aged 13-15 years and one-fifth were aged 16-18 years in urban areas, while more than one-fifth of subjects in rural areas were aged 13-15 years. Based on Table 1, it is known that there was no significant difference in age characteristics between school-going adolescent in rural and urban areas (p>0.05). More than half of school-going adolescent in both rural and urban areas were female.

Nutritional Adequacy Level of Subjects

The average food consumption was obtained from the 2x24-hour recall results. The distribution of the subjects' based on energy and carbohydrate adequacy levels and area is presented in Table 2.

Tabel 2 Distribution of nutrient adequacy levels by area

Variable	Rural		Urban		*p-value**
	n	%	n	%	
Energy					
Deficient (<80%)	21	27	5	6	
Adequate (80%-110%)	29	37	20	26	
Excess (>110%)	28	36	53	68	0.028*
Mean±SD	115.2±40.3		125.5±45.8		
Median (Min-Max)	110.0 (38.0-251.0)		121.0 (35.0-281.0)		
Carbohydrate					
Deficient (<80%)	24	31	9	12	
Adequate (80%-110%)	37	47	31	40	
Excess (>110%)	17	22	78	49	0.008*
Rerata±SD	183.1±21.0		188.5±20.5		
Median (Min-Max)	179.8(52.7-252.8)		184.9(58.8-281.6)		

Note: [1)] *Mann-Whitney test*, [2)] *Chi-squared test* (χ), [*]significant if p<0,05

More than one-third of school-going adolescent in rural areas and more than one-quarter of school-going adolescent in urban areas had an adequate level of energy. More than one-third of school-going adolescents in rural areas and more than two-thirds of school-going adolescents in urban areas had an excess level of energy adequacy. The average level of energy adequacy in urban areas was significantly higher than in rural areas ($p<0.05$).

Nearly one-fifth of school-going adolescents in both rural and urban areas had an adequate level of carbohydrate adequacy. Nearly one-quarter of school-going adolescents in rural areas and nearly one-fifth of school-going adolescents in urban areas had an excess level of carbohydrate adequacy. The average level of carbohydrate adequacy of school-going adolescents in urban areas was significantly higher than in rural areas ($p<0.05$).

Nutritional Status (BMI-for-Age Z-score)

The distribution of subjects based on BMI-for-Age Z-score (BAZ) and area is presented in Table 3. The average BAZ of school-going adolescents in rural areas was higher than in urban areas, but there was no significant difference ($p>0.05$). More than three-quarters of school-going adolescents in rural areas and nearly three-quarters of school-going adolescents in urban areas had normal nutritional status based on BAZ. There was no difference in BAZ between school-going adolescents in rural and urban areas ($p>0.05$).

Tabel 3 Distribution of nutritional status (BAZ) by area

Variable (BAZ)	Rural		Urban	
	n	%	n	%
Underweightn (<−3 s/d <−2 SD)	6	4	10	6
Normal (≥−2 s/d ≤1 SD)	121	78	113	72
Overweight (>1 s/d >2 SD)	29	19	33	21

Note: [1)] *Mann-Whitney test*, [2)] *Chi-squared test* (χ), [*]significant if $p<0,05$

Relationship between Nutritional Adequacy Level and Nutritional Status (BMI-for-Age Z-score)

The variables analyzed for their relationship with BMI-for-Age Z-score were the level of energy adequacy and the level of carbohydrate adequacy. The relationship between the research variables and BAZ by area is presented in Table 4.

Tabel 4 Relationship between nutritional adequacy level and nutritional status (BAZ) by area

Variable	Rural		Urban	
	r	*p-value*[1]	r	*p-value*[1]
Energy adequacy level	-0.097	0.229	-0.195	0.055
Carbohydrate adequacy level	0.755	0.001*	0.575	0.001*

Note: *p-value based on Spearman's test*, ^*^significant if $p<0.05$

Based on Table 4, the level of energy adequacy was not related to BAZ, while the level of carbohydrate adequacy had a significant positive relationship with BAZ in both rural and urban areas. The level of carbohydrate adequacy was significantly positively related to of school-going adolescent in both rural and urban areas ($p<0.05$).

Discussion

Subjects Characteristics

The subjects in this study came from junior and senior high school populations. The average age of the subjects was 12-18 years. Adolescence is a period of nutritional vulnerability because it requires higher nutrient intake due to increased physical growth and development, changes in lifestyle and eating habits that affect both intake and nutritional needs, and high levels of activity (Hanani *et al.* 2021).

Nutritional Adequacy Level

Humans need energy to sustain life, support growth processes, and perform daily activities. Energy is produced from the metabolism of carbohydrates, proteins, and fats in the body (Utami *et al.* 2020). According to the Recommended Dietary Allowance (RDA), adolescent females aged 13-15 years need 2125 kcal of energy, 69 g of protein, 71 g of fat, and 292 g of carbohydrates. Meanwhile, adolescent females aged 16-18 years need 2125 kcal of energy, 59 g of protein, 71 g of fat, and 292 g of carbohydrates. The body requires an adequate supply of all nutrients to grow properly (Rokhmah *et al.* 2016).

The average carbohydrate consumption of school-going adolescents in urban areas was higher than that of school-going adolescents in rural areas, so when related to the level of carbohydrate adequacy, this aligns with the results in Table 2, which show that the level of carbohydrate adequacy of school-going adolescents in urban areas was significantly higher than that of school-going adolescents in rural areas. Carbohydrates have several functions, including as an energy source, providing a sweet taste to food, and aiding bowel movements. Consuming excessive carbohydrates can result in nutritional problems, including overweight and obesity. Carbohydrate intake stimulates insulin secretion, which increases fat storage and strongly inhibits adipose tissue lipolysis and fatty acid oxidation (Hyde *et al.* 2019). Carbohydrate-containing foods have significant regulatory control over intravascular lipid metabolism (Hyde *et al.* 2019).

Nutritional Status (BMI-for-Age Z-score)

Measuring and calculating nutritional status using body mass index provides a useful indicator for population-level assessment but is not very good at determining the health status of an individual. Good nutritional status also indicates that an individual's daily nutritional needs have been met, or in other words, their nutrient intake is appropriate for their body's needs. Undernutrition is usually caused by a recent illness, food deprivation causing significant weight loss in a short period, or chronic undernutrition. Excessive eating patterns can also cause weight gain, which will lead to obesity (Cohen *et al.* 2015). Changes in nutritional status are also caused by poor quantity and quality of nutritional intake consumed (Andrea & Health, 2022). If health and body function are below normal, this can lead to various infectious disease (Ahmed *et al*, 2022). Infectious diseases and inadequate intake will have a direct impact on nutritional status.

Relationship between Nutritional Adequacy Level and Nutritional Status (BMI-for-Age Z-score**)**

The level of carbohydrate adequacy was significantly positively related to BAZ in both rural and urban areas ($p<0.05$). The higher the level of carbohydrate adequacy, the higher the BAZ. This study aligns with research by Telisa *et al.* (2020), which found that carbohydrate intake is positively related to the incidence of obesity; adolescents with excess intake are 2.004 times more at risk of obesity (OR: 2.004; 95% CI 0.919 - 4.367). Carbohydrates are a macronutrient that serves as the body's main energy source. If carbohydrate intake exceeds needs, cells can convert carbohydrates into fat. This conversion process occurs in the liver. Dietary regulation based on knowledge of eating patterns can predict overweight and obesity in adults (Balani *et al.* 2019). This is also consistent with research by Permatasari *et al.* (2022), which stated that protein intake and nutritional status have a significant positive relationship ($p<0.001$, $r=0.32$). This study is not in line with research by Putri *et al.* (2022), which stated that protein intake is not related to nutritional status ($p=0.848$ and $r=0.021$). Carbohydrate intake is directly related to the incidence of overnutrition.

Conclusion

Nearly two-thirds of the school-going adolescents were female. The average scores for the level of energy adequacy and level of carbohydrate adequacy in urban areas were significantly higher than in rural areas. The level of energy adequacy was not related to BAZ in either rural or urban areas, while the level of carbohydrate adequacy had a significant positive relationship with BMI/Age Z-score in rural and urban areas. Nutrition interventions for school-going adolescents should focus on promoting balanced carbohydrate consumption according to balanced nutrition guidelines, rather than simply increasing overall food quantity.

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Author Contribution and Competing Interest

Each author made substantial contributions to this research. RSD designed the study, collected the data, analyzed the data, interpreted the results, and wrote the initial draft. CMD and AK supervised the research process and revised the manuscript. There is no conflict of interest that could have influenced the results or interpretation of the research.

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