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ANALISIS MULTIDIMENSIONAL STATUS GIZI, PERILAKU MAKAN, DAN ASUPAN ZAT GIZI PADA MAHASISWI DI WILAYAH HUTAN TROPIS LEMBAB

A Multidimensional Analysis of Nutritional Status, Eating Behavior, and Nutrient Intake among Female Students in the Humid Tropical Rainforest Region

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ABSTRAK

Masalah gizi pada perempuan usia 19–24 tahun di Indonesia masih tinggi, dengan prevalensi KEK 24,7%, obesitas 16,8%, dan anemia 14,6%. Di Kalimantan Timur, triple burden gizi juga terjadi meskipun potensi pangan lokal melimpah. Penelitian ini bertujuan menganalisis hubungan status gizi dengan perilaku makan dan asupan zat gizi menggunakan pendekatan multidimensional. Penelitian *cross-sectional* ini melibatkan 259 mahasiswi berusia 19–20 tahun di Universitas Muhammadiyah Kalimantan Timur. Status gizi diukur menggunakan IMT, LILA, dan WHR, perilaku makan dievaluasi melalui kuesioner gizi seimbang, dan asupan zat gizi dihitung dengan SQ-FFQ. Data dianalisis menggunakan uji korelasi pada SPSS versi 26. Hasil menunjukkan 61,8% responden berstatus gizi normal berdasarkan IMT, 94,1% normal menurut LILA, namun 44,1% memiliki distribusi lemak tidak sehat berdasarkan WHR. Rata-rata asupan energi, karbohidrat, protein, dan lemak berturut-turut 1238,3 kkal, 192,1 gram, 41,0 gram, dan 40,4 gram. Status gizi IMT berkorelasi signifikan dengan asupan energi (p=0,013), protein (p=0,009), dan lemak (p=0,042), LILA berkorelasi dengan protein (p=0,034) dan lemak (p=0,021), sedangkan WHR hanya berkorelasi dengan protein (p=0,028). Perilaku makan tidak berhubungan signifikan dengan status gizi (p>0,05). Temuan ini menegaskan pentingnya pendekatan multidimensional dalam penilaian dan intervensi gizi, dengan edukasi gizi difokuskan pada pemenuhan protein dan lemak guna mencegah masalah gizi pada mahasiswi.

Kata Kunci: status gizi, perilaku makan, asupan zat gizi, mahasiswi, hutan tropis lembab.

ABSTRACT

Nutritional problems among females aged 19–24 years in Indonesia remain high, with prevalences of undernutrition (24.7%), obesity (16.8%), and anemia (14.6%). In East Kalimantan, the triple burden of malnutrition persists despite abundant local food resources. This study aimed to analyze the relationship between multidimensional nutritional status and eating behavior as well as nutrient intake. A cross-sectional study was conducted involving 259 female university students aged 19–20 years at Muhammadiyah University of East Kalimantan. Nutritional status was assessed using BMI, MUAC, and WHR; eating behavior was evaluated through a balanced nutrition questionnaire; nutrient intake was measured using a semi-quantitative food frequency questionnaire (SQ-FFQ). Data were analyzed using correlation tests with SPSS version 26. Results showed that 61.8% of respondents had normal BMI, 94.1% had normal MUAC, yet 44.1% exhibited unhealthy fat distribution based on WHR. Mean intakes of energy, carbohydrates, protein, and fat were 1238.3 kcal, 192.1 g, 41.0 g, and 40.4 g, respectively. BMI correlated significantly with energy (p=0.013), protein (p=0.009), and fat intake (p=0.042); MUAC correlated with protein (p=0.034) and fat intake (p=0.021); WHR correlated only with protein intake (p=0.028). Eating behavior showed no significant association with nutritional status (p>0.05). These findings highlight the importance of a multidimensional approach to nutritional assessment and intervention, emphasizing education focused on adequate protein and fat intake to prevent nutritional problems among female students.

Key words: *nutritional status, eating behaviors, nutrient intake, female students, tropical rainforest*

INTRODUCTION

Nutritional problems remain a significant public health concern in Indonesia, particularly among women aged 19–24 years. According to the 2023 Indonesian Health Survey (SKI), the prevalence of chronic energy deficiency (CED), obesity, and anemia in this age group reached 24.7%, 16.8%, and 14.6%, respectively (Ministry of Health, Republic of Indonesia, 2023). These figures reflect the triple burden of malnutrition, which encompasses undernutrition, overnutrition, and micronutrient deficiencies such as iron-deficiency anemia (Ferdian et al., 2024). However, national-level data do not fully capture the specific conditions of ecologically distinct regions such as tropical rainforest areas (Albert et al., 2024).

Although East Kalimantan Province is rich in biodiversity, particularly in the availability of local food sources such as forest vegetables, wild fruits, and aquatic protein, the consumption of these local foods remains relatively low. Several preliminary studies and reports indicate that young women, especially female university students, continue to face nutritional problems in the form of both undernutrition and overnutrition. According to the 2023 Indonesian Health Survey (SKI), the prevalence of chronic energy deficiency (CED), obesity, and anemia among the 19 to 24 year age group in East Kalimantan Province was recorded at 21.7%, 28.0%, and 15.1%, respectively. These findings highlight that the triple burden of malnutrition including undernutrition, overnutrition, and micronutrient deficiencies is also present at the regional level, not only at the national scale (Ariestiningsih & Has, 2024). Factors such as low awareness of balanced nutrition, high dependence on processed and imported foods, and lifestyle changes related to the transition to independence significantly influence dietary patterns and nutritional status within this demographic group (Lonati et al., 2024).

Eating behavior is one of the key determinants of nutritional status. It includes dietary patterns, food choices, eating frequency, and the quality and quantity of nutrient intake (Ardina et al., 2024). These behaviors are shaped by a complex interplay of social, cultural, economic, and environmental factors. In tropical rainforest areas such as East Kalimantan, food consumption practices are also influenced by the availability of local foods and unique cultural traditions, which may differ significantly from urban or highland regions (Albert et al., 2024). Female students, who are undergoing physiological and psychosocial transitions, are particularly vulnerable to changes in eating behavior that may negatively affect their nutritional status, especially as they begin to live independently and make autonomous decisions about their daily food intake (Almoraie et al., 2024).

A comprehensive understanding of the relationship between eating behavior and nutritional status among female students living in tropical rainforest ecosystems is therefore essential. This study aims to analyze the relationship between eating

behavior as the independent variable and nutritional status as the dependent variable among female university students in East Kalimantan. Nutritional status is assessed using anthropometric indicators, including Body Mass Index (BMI), Mid-Upper Arm Circumference (MUAC), and Waist-to-Hip Ratio (WHR), along with biochemical measurements where applicable. Eating behavior is evaluated using a balanced nutrition behavior questionnaire, while information on eating habits and nutrient intake is collected through a Food Frequency Questionnaire (FFQ).

To obtain a comprehensive overview, this study employs a multidimensional analytical approach that integrates various types of data, including anthropometric measurements, dietary patterns, and nutrient adequacy. This approach enables a more holistic evaluation of the multiple factors that interact to influence students' nutritional status. A multidimensional analysis also provides cross-dimensional insights into the physiological, behavioral, and environmental aspects that are crucial for designing effective nutritional interventions (Musfira & Hadju, 2024).

The findings of this study are expected to provide a scientific foundation for formulating evidence-based and context-specific nutritional intervention strategies and to support the development of local nutrition policies tailored to the ecological characteristics and specific needs of communities in tropical rainforest regions such as East Kalimantan.

METODE

This observational analytic study with a cross-sectional design was conducted from June to July 2024 at Muhammadiyah University of East Kalimantan (UMKT), located in a humid tropical forest region. The study population comprised 729 female students aged 19 to 20 years who were actively enrolled in their second semester across nine faculties. Inclusion criteria were female students aged 19–20 years actively enrolled in the second semester during the study period. Exclusion criteria included students who declined to participate or had health conditions potentially affecting their participation. The sample size was calculated using Slovin's formula with a 5% margin of error, resulting in a sample of 259 participants. Purposive sampling was subsequently employed to select respondents meeting the study criteria.

Data collection involved anthropometric measurements, including Body Mass Index (BMI), Mid-Upper Arm Circumference (MUAC), and Waist-to-Hip Ratio (WHR). Dietary behavior information was obtained through a balanced nutrition behavior questionnaire, while eating habits and nutrient intake data were collected using a Food Frequency Questionnaire (FFQ) and analyzed with NutriSurvey software. Data were gathered by trained enumerators to ensure data accuracy. Data analysis was performed using IBM SPSS Statistics version 26, consisting of descriptive analysis to describe sample characteristics and bivariate and multivariate analyzes to assess relationships among the variables studied.

Research Location and Time

This study was conducted at Muhammadiyah University of East Kalimantan (UMKT), situated within a humid tropical forest region, from June to July 2024.

Type and Study Design

This analytical observational cross-sectional study examined eating behavior, dietary habits, and nutritional status, assessed using anthropometric indicators including Body Mass Index (BMI), Mid-Upper Arm Circumference (MUAC), and Waist-to-Hip Ratio (WHR). The study population comprised 729 active female students aged 19–20 years in their second semester across nine faculties at UMKT, with a purposive sample of 259 participants selected based on inclusion criteria. Data were collected through anthropometric measurements and structured interviews using a balanced nutrition behavior questionnaire and a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). The anthropometric measures served as outcome indicators reflecting the nutritional status of the participants.

Research Procedure

Nutritional Status Measurement

Nutritional status in this study was assessed through anthropometric parameters, including Body Mass Index (BMI), Mid-Upper Arm Circumference (MUAC), and Waist-to-Hip Ratio (WHR). BMI was calculated based on the ratio of weight (kg) to height (m^2) and categorized as follows: severe underweight (BMI < 17 kg/m^2), mild underweight (BMI 17–18.5 kg/m^2), normal (BMI 18.5– 25 kg/m^2), overweight (BMI 25–27 kg/m^2), and obesity (BMI > 27 kg/m^2). MUAC was measured using a tape measure on the upper arm, categorized as normal (> 23.5 cm) or abnormal (< 23.5 cm), indicating potential risk of undernutrition. WHR was calculated from the waist and hip circumference ratio, classified as safe (WHR < 0.80) or at-risk (WHR > 0.80) as an indicator of metabolic risk related to fat distribution.

Eating behavior

Eating behavior was assessed using a modified balanced nutrition behavior questionnaire, which included indicators of staple food variety, fruit and vegetable intake, protein sources, and consumption of high-fat, sugar, and salt (HFSS) foods. The questionnaire also evaluated breakfast habits, water consumption, food label reading, handwashing before meals, physical activity, and sleep duration. The modified questionnaire underwent validity and reliability testing, yielding a Cronbach's alpha of 0.82, indicating good internal consistency. Data were collected through face-to-face interviews with participants, and total scores were assigned to categorize healthy lifestyle status as follows: 0–15 (very unhealthy), 16–30 (unhealthy), 31–45 (moderately healthy), and 46–55 (healthy).

Nutrient Intake Data Collection

Nutrient intake was assessed using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), which captures the types of foods consumed, frequency of consumption, and estimated portion sizes over a specified period, typically one week.

Participants reported both the frequency and estimated portion size of each food item consumed during this period. The collected data were analyzed using NutriSurvey software to estimate daily nutrient intake. These estimates were then compared to the 2019 Indonesian Recommended Dietary Allowance (Angka Kecukupan Gizi, AKG) to evaluate nutrient adequacy. Nutrient adequacy was categorized as excess (>110% AKG), adequate (100–110% AKG), moderate (80–99% AKG), low (70–80% AKG), and deficient (<70% AKG). The SQ-FFQ instrument was adapted from validated questionnaires and tailored to the study population to ensure data accuracy and reliability.

Data Collection Implementation

Data collection was conducted by trained enumerators to ensure accuracy in anthropometric measurements, completion of the nutrition behavior questionnaire, and administration of the Food Frequency Questionnaire (FFQ).

Data Analysis

Data were analyzed using IBM SPSS Statistics version 26. Descriptive analysis was employed to describe characteristics and anthropometric measures, while bivariate analysis assessed the correlation between eating behavior and nutritional status. Multivariate analysis was conducted to evaluate the relationship between eating behavior, dietary habits, and nutritional status, as well as to identify factors influencing nutritional status.

RESULTS AND DISCUSSION

The characteristics of respondents in this study provide an overview of the demographic profile and health conditions of the female students participating as research subjects. This data collection is essential for understanding respondents' backgrounds and mapping factors that may influence nutritional status and eating behavior.

The majority of respondents were 20 years old (66.8%), most had a monthly allowance ranging from Rp 1,000,000 to Rp 2,000,000, with less than Rp 500,000 allocated for food expenses (47.9%). A total of 56.4% resided in boarding houses or dormitories, reflecting a level of independence in managing daily needs. Among the respondents, 33.6% reported a history of gastritis, while 52.1% had no reported medical history.

Economic constraints and irregular eating patterns may affect the health of students living independently. Putri (2023) noted that students are prone to gastritis due to limited access to nutritious food and inconsistent eating habits. However, Nuramalia et al. (2024) found that academic stress exerts a greater influence on digestive disorders. Therefore, the interaction between economic limitations and academic stress warrants attention in efforts to maintain student health.

A total of 59.7% of respondents had normal nutritional status based on Body Mass Index (BMI), while 27.5% were classified as underweight and 12.8% as overweight. Measurement of Mid-Upper Arm Circumference (MUAC) indicated that 88.0% of

Table 1. Respondent Characteristics

Characteristic	Total	
	(n=259)	(%)
20 years	173	66.8
Monthly Allowance		
< Rp 1,000,000	110	42.5
Rp 1,000,000 – Rp 2,000,000	124	47.9
> Rp 2,000,000	25	9.7
Food Budget Allocation		
< Rp 500,000	124	47.9
Rp 500,000 – Rp 1,000,000	111	42.9
> Rp 1,000,000	24	9.3
Medical History		
None	135	52.1
Gastritis	87	33.6
Typhoid Fever	16	6.2
Malaria	1	0.4
Anemia	3	1.2
Asthma	9	3.5
Hypercholesterolemia	1	0.4
Allergy	7	2.7
Residence Status		
Own house	58	22.4
With other family members	55	21.2
Boarding/hostel	146	56.4

respondents were in the normal category, while 12.0% were categorized as abnormal. However, 91.5% of respondents showed a risk of unhealthy central fat distribution based on Waist-to-Hip Ratio (WHR), despite their BMI being in the normal category. These findings align with literature suggesting that visceral fat is a major risk factor for cardiovascular and metabolic diseases (Nurohmi et al., 2021).

While BMI is often used as an indicator of obesity risk (Pratama & Zulfahmidah, 2021), these results highlight the need for a multidimensional approach to health risk assessment, including WHR as an indicator of body fat distribution (Abdullah, 2022). Therefore, the measurement of WHR should be considered an essential component in assessing disease risk, particularly in individuals with a normal BMI that may not be detected through BMI measurement alone.

The nutritional behavior of respondents shows that the majority exhibit poor eating practices. Among the 259 female students, 70.3% demonstrated poor nutritional behavior, and 16.6% were categorized as having very poor nutritional behavior. Meanwhile, 12.7% showed moderate behavior, and only one

Table 2. Distribution of Nutritional Status Based on BMI, MUAC, and WHR

Category	Total	
	(n=259)	(%)
BMI		
Severe underweight	34	13.2
Mild underweight	37	14.3
Normal	154	59.7
Overweight	15	5.8
Obese	18	7.0
MUAC		
Abnormal	31	12.0
Normal	228	88.0
WHR		
Safe	22	8.5
At risk	237	91.5

respondent (0.4%) exhibited good nutritional behavior. These results highlight the pressing need for improved nutrition education and behavior change interventions among university students.

This finding is consistent with the study by Multazami (2022), which identified poor dietary patterns and physical inactivity as key contributors to the rising prevalence of non-communicable diseases (NCDs). Similarly, the Indonesian Ministry of Health Research (2019) underscored the urgent need for targeted strategies to improve dietary behavior and prevent NCDs. Various factors, including academic stress, time constraints, and limited access to balanced meals, may significantly influence students' eating behavior. Therefore, a multidimensional intervention strategy that addresses nutritional knowledge, psychosocial influences, and environmental access is critical in promoting healthier eating behavior in this population.

The average energy intake of 1471.83 kcal (SD 549.06 kcal) reflects significant variability. The average intake of carbohydrates, protein, and fat were recorded at 270.13 g, 56.20 g, and 51.85 g, respectively, with adequacy levels of 65.22% for energy, 90.31% for carbohydrates, 76.96% for protein, and 71.99% for fat based on daily recommendations.

Table 3. Eating Behavior Categories of Respondents

Category	Total	
	(n=259)	(%)
Very Poor Nutrition Behavior	43	16.6
Poor Nutrition Behavior	182	70.3
Moderate Nutrition Behavior	33	12.7
Good Nutrition Behavior	1	0.4

Table 3. Eating Behavior Categories of Respondents

Category	Nutrient Intake (n=259)	Nutrient Adequacy Level (%)
Energy	1471.83 ± 549.06 (kkal)	65.22 ± 25.30 (%)
Carbohydrate	270.13 ± 112.16 (g)	90.31 ± 25.75 (%)
Protein	56.20 ± 13.77 (g)	76.96 ± 28.93 (%)
Fat	51.85 ± 17.62 (g)	71.99 ± 33.60 (%)

Although carbohydrate and fat intakes are within the recommended range, the low energy intake, below 2250 kcal, poses a risk of malnutrition and impaired body function (Ministry of Health of the Republic of Indonesia, 2021).

Research by Ananda Putri et al. (2024) indicates that low energy intake is associated with an increased risk of mental health disorders in students, while Rahma & Desy (2023) emphasize the importance of a balanced diet that includes healthy proteins and fats for long-term health. These findings align with Moughan et al. (2024), who stress the significance of adequate protein intake for optimal body function. Therefore, increasing energy and protein intake, along with education on healthy food choices, is crucial to achieve nutritional balance and prevent health issues among female students.

The present study explored the correlation between nutritional status indicators Body Mass Index (BMI), Mid-Upper Arm Circumference (MUAC), and Waist-to-Hip Ratio (WHR) with nutrient intake, nutrient adequacy, and eating behavior among respondents. The findings revealed nuanced associations between these components, underscoring the multifactorial nature of nutritional status.

Relationship Between Nutritional Status, Eating Behavior, and Nutrient Intake of Respondents

Component	Nutritional Status		
	BMI	MUAC	WHR
Nutrient Intake			
Energy (kcal)	0,663 (p=0,12)	0,722 (p=0,07)	0,324 (p=0,45)
Carbohydrate (g)	0,046* (p=0,03)	0,356 (p=0,22)	0,679 (p=0,08)
Protein (g)	0,304 (p=0,10)	0,995* (p=0,00)	0,052 (p=0,34)
Fat (g)	0,031* (p=0,04)	0,895 (p=0,09)	0,282 (p=0,12)
Nutrient Adequacy Percentage			
% Energy	0,843 (p=0,09)	0,670 (p=0,12)	0,898 (p=0,08)
% Carbohydrate	0,442 (p=0,10)	0,201 (p=0,18)	0,755 (p=0,07)
% Protein	0,765 (p=0,07)	0,990 (p=0,00)*	0,000 (p=0,02)
% Fat	0,568 (p=0,09)	0,745 (p=0,08)	0,032* (p=0,04)
Eating Behavior	0,637 (p=0,11)	0,500 (p=0,14)	0,685 (p=0,09)

(*p < 0.05)

No statistically significant correlation was found between energy intake and BMI (p = 0.12), aligning with Mendez et al. (2017), who reported that total energy intake does not consistently predict BMI among young adults due to the confounding influence of physical activity levels, metabolic variations, and dietary patterns. Conversely, Heaney et al. (2020) emphasized that excessive caloric intake over time may contribute to increased BMI, particularly when coupled with sedentary lifestyles. This highlights the need to consider not only the quantity but also the quality of energy intake and its interaction with individual behaviors.

A significant positive correlation was observed between BMI and both carbohydrate intake (p = 0.03) and fat intake (p = 0.04), suggesting that diets high in these macronutrients may contribute to increased body weight. These findings are consistent with Wan et al. (2023), who reported that excessive intake of simple carbohydrates and dietary fats—particularly when disproportionate to protein—can disrupt energy balance and promote adiposity. According to international dietary guidelines, a balanced macronutrient distribution consists of approximately 50–60% carbohydrates, 10–20% protein, and 20–30% fat. Deviation from these ranges, especially through overconsumption of energy-dense and nutrient-poor foods, may lead to weight gain, particularly in young populations who are prone to irregular eating habits.

In terms of MUAC, a highly significant correlation with protein intake (p = 0.00) was identified, indicating the critical role of protein in supporting muscle mass development and maintenance. This finding is supported by Vania et al. (2024), who emphasized the role of adequate protein consumption in muscle anabolism, particularly in growing or physically active individuals. While fat intake also showed a moderate correlation with MUAC (p = 0.09), this association was not statistically significant. Previous studies by Indi Antika Falentina et al. (2023) suggest that fat may contribute to overall soft tissue mass, though Kaparang et al. (2022) argued that fat accumulation more prominently affects central rather than peripheral body regions.

For WHR, no statistically significant associations were found with carbohydrate (p = 0.08) or fat intake (p = 0.12), although the direction of correlation was positive, suggesting a possible link to visceral fat distribution. These results are in line with Cantika et al. (2021), who proposed that high intake of refined carbohydrates and saturated fats may influence central adiposity. However, Between et al. (2021) reported that in populations consuming predominantly complex carbohydrates (e.g., high in dietary fiber), carbohydrate intake may not significantly affect WHR, emphasizing the role of carbohydrate quality in fat distribution.

Significant findings also emerged from nutrient adequacy indicators. Protein adequacy was negatively associated with WHR (p = 0.02), suggesting that

higher protein adequacy may paradoxically be linked with greater abdominal fat accumulation in this sample. This is consistent with findings by Yuriah et al. (2019), although the physiological mechanisms remain unclear and may involve differences in protein sources, metabolic adaptation, or insufficient energy balance. Additionally, fat adequacy was positively correlated with WHR ($p = 0.04$), reinforcing Sari et al. (2022)'s conclusion that dietary fat contributes to central fat deposition, particularly when consumed in excess of metabolic needs.

Eating behavior, while positively associated with all nutritional status indicators, did not show statistically significant correlations. This may be due to the multifaceted nature of eating behaviors, which include not only food choices but also frequency, timing, psychological factors, and cultural influences. As suggested in previous studies, the impact of eating behavior on nutritional status may require a longer observation period to capture meaningful changes, which may be limited in a cross-sectional design

CLOSING

This study reveals the complex relationship between nutritional status, dietary behavior, and nutrient intake among female university students. Although most participants had normal Body Mass Index (BMI) and Mid-Upper Arm Circumference (MUAC), many showed unhealthy eating habits and were at risk of central obesity based on Waist-Hip Ratio (WHR). This finding highlights that BMI alone may not fully reflect underlying health risks. Nutrient intake analysis showed that energy and protein consumption were generally below recommended levels. There were also significant associations between BMI and intake of carbohydrates and fats, as well as between MUAC and protein intake. These results suggest that a more comprehensive assessment including WHR and dietary behavior is essential for identifying nutritional risks. The high prevalence of poor eating behavior further indicates the need for focused nutrition education and behavioral strategies specifically designed for students. Efforts to encourage balanced diets, improve access to healthy food, and manage stress factors like academic pressure are critical for promoting student health and preventing future metabolic and chronic diseases.

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