The Correlation Between Macronutrient Intake and The Incidence of Underweight in Toddlers

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ABSTRACT

Underweight is when a child's weight is below the average range for their age group. The prevalence of underweight toddlers in Indonesia in 2023 reached 12.9%. Underweight is directly caused by food intake. This study aims to determine the relationship between macronutrient intake and the incidence of underweight in toddlers at Posyandu Bangun Sari Indah 6. This research method uses a cross-sectional research design. The population in this study consisted of toddlers aged> 6-59 months, with a total of 135 toddlers. The technique for selecting research subjects used a purposive sample of 48 toddlers. Data collection of food intake used a 2x24-hour food recall form, and underweight data used anthropometric measurements of BB/U. The data analysis technique was descriptive, using the Spearman rank correlation test and the logistic regression test. The results showed a relationship between energy intake ($p = 0.003$), carbohydrate intake ($p = 0.004$), protein intake ($p = 0.005$), and fat intake ($p = 0.025$) with the incidence of underweight in toddlers. The logistic regression test analysis showed that energy, carbohydrate, protein, and fat intake were not significantly related to the incidence of underweight.

Keywords: macronutrients, underweight, toddler

INTRODUCTION

Toddlers in Indonesia are affected by several significant nutritional problems that have been extensively documented and studied, including stunting, wasting, and underweight. Underweight itself needs attention because underweight is the beginning of chronic dietary issues, and if left unchecked, it can cause death (WHO, 2024). Toddlers are an age group that is prone to experiencing nutritional problems, one of which is underweight.(Fitriyah & Setyaningtyas, 2021). Underweight is a condition of a child's weight below the normal average range of his age group. (Kemenkes, 2023). Underweight in toddlers can cause impaired physical development and growth, as well as the onset of intellectual disorders. In addition, undernourished toddlers also cause the body to be susceptible to infectious diseases, decreased productivity of daily activities, and increased risk of chronic diseases. (Supardi et al., 2023).

Based on data from the 2023 Indonesian Health Survey (SKI), the prevalence of underweight toddlers in Indonesia reached 12.9%, while underweight toddlers in North Sumatra in 2023 were

10.3%. Meanwhile, the prevalence of underweight toddlers in Deli Serdang Regency in 2023 is 24.3%, which is an increase from the previous year, which was 15% (Kemenkes RI, 2023).

The increased prevalence, if left unchecked, will impact the health of toddlers, such as cough, flu, fever, and diarrhea, which, if left unchecked for a long time, can interfere with children's growth. Therefore, it is necessary to prevent underweight in toddlers by providing adequate and balanced food intake, a varied menu, a regular meal schedule, and proper rest.(Kemenkes, 2023). Infectious diseases, parenting, and food consumption patterns affect underweight. (Samino et al., 2020).

Food intake is a direct cause of underweight in toddlers. Inadequate food intake can occur due to unbalanced and inappropriate nutrient intake. Food intake in the form of energy and macronutrients is related to the incidence of underweight. (Supardi et al., 2023). Macronutrients function to provide the energy needed by the body. Macronutrients, consisting of carbohydrates, proteins, and fats, are not balanced with the body's needs. In that case, it can trigger changes in tissues and body mass, impacting toddlers' growth and development. (Nurhayati et al., 2020). Research by Fitriyah & Setyaningtyas (2021) shows that underweight toddlers have a lower adequate intake level than toddlers with good nutritional status. In line with the results of research by Sari et al. (2021), it is stated that the amount of macronutrient intake influences the nutritional status of toddlers. Toddlers need sufficient nutrition because they experience rapid growth during that period. An imbalance in the intake of macronutrients that enter the body, which lasts for a long time, can result in weight loss, not due to age or underweight conditions. (Rahman et al., 2021).

Based on the results of observations that have been carried out in November 2023 at the Bangun Sari Indah 6 Posyandu Tanjung Morawa District, there are four toddlers out of 20 toddlers who are measured to be underweight (20%) and three toddlers at risk of underweight (15%). This shows that the percentage of underweight events in the posyandu is greater than the national prevalence (12.9%) in underweight events. Based on the background of the problem, the researcher wanted to find out the relationship between macronutrient intake and the incidence of underweight in toddlers at Posyandu Bangun Sari Indah 6.

METHOD

The study used a cross-sectional research design. The research was carried out in August 2024 at the Posyandu Bangun Sari Indah 6, Tanjung Morawa District. The population in this study is all toddlers aged >6-59 months who are registered at Posyandu Bangun Sari Indah 6, which amounts to 135 toddlers. The sampling technique was purposive sampling with a total sample of 48 toddlers. The inclusion criteria include mothers with toddlers aged > 6 months to 59 months, mothers willing to be respondents, mothers with no problems communicating, toddlers cared for by their families, and mothers recommended by posyandu midwives. The exclusion criteria in this study are mothers who cannot be met if an appointment has been made 2 times.

The free variables in this study are macronutrients in the form of energy, protein, carbohydrates, and fats collected through interviews using a 2x24-hour food recall form and then obtained using Nutrisurvey. Energy intake is categorized based on Energy Adequacy Level (EAL) into very low (<70% EAL), less (70-100% EAL), normal (100-<130% EAL), and more (≥130% EAL). Protein intake is categorized based on Protein Adequacy Level (PAL) into very low (<80% PAL), less (80-100% PAL), normal (100-<120% PAL), and more (≥120% PAL). Carbohydrate and fat intake are categorized into low (<EAR) and adequate (≥EAR). The bound variable was the incidence of underweight, which was categorized into underweight (<-2 SD) and not underweight (≥-2 SD)

The data that has been collected is then processed and analyzed using the SPSS application. Univariate analysis was conducted to obtain the frequency distribution based on the characteristics of toddlers, families, macronutrient intake, and underweight events. A bivariate analysis was performed using the Spearman Rank test to see the relationship between each variable. Multivariate analysis was carried out to see the relationship among the variables using a logistic regression test.

RESULTS AND DISCUSSION

1. Univariate Analysis

The results of this study show that most toddlers are in the age range of 12-23 months, which is 19 people (39.6%), and most of them are female, which is 25 people (52.1%). The majority of mothers are in the age range of 25-29 years, which is 19 people (39.6%), most of the mothers have a high school education (SMA) as many as 34 people (70.8%), most of the mothers do not work as many as 33 people (68.8%). The intake of macronutrients in toddlers, namely energy intake, was mainly in the inferior category as many as 27 people (56.2%), protein intake in the excess category as many as 24 people (50%), carbohydrate intake in the underserved category as many as 28 people (58.3%), and fat intake in the underserved category as many as 33 people (68.8%).

Table 1. Characteristics of the Research Sample

Characteristics	Amount	
	N	**%**
Toddler's Age		
6-11 months	9	18,8
12-23 months	19	39,6
24-35 months	10	20,8
36-47 months	5	10,4
48-59 months	5	10,4
Toddler's Sex		
Male	23	47,9

Female	25	52,1
Mother's Age		
19-24 years	5	10,4
25-29 years	19	39,6
30-34 years	15	31,2
35-39 years	3	6,3
40-44 years	6	12,5
Mother's Education		
Graduate from Elementary School	2	4,2
Graduate from Secondary School	5	10,4
Graduate from High School	34	70,8
Graduate from the University	7	14,6
Mother's Occupation		
Not Working	33	68,8
Civil Servant	1	2,1
Private Sector Worker	2	4,2
Businessman	9	18,7
Labour	3	6,2
Underweight Incidence		
Underweight	9	18,8
Not Underweight	39	81,2
Macronutrient Intake		
Energy		
Very Lacking	27	56,2
Lacking	20	41,7
Normal	1	2,1
Protein		
Very Lacking	7	14,6
Lacking	13	27,1
Normal	4	8,3
Excessive	24	50
Carbohydrate		
Insufficient	28	58,3
Sufficient	20	41,7
Fats		
Insufficient	33	68,8

Sufficient	15	31,2

2. Bivariate Analysis

The bivariate analysis results related to the relationship between macronutrient intake (energy, protein, carbohydrates, and fat) and the incidence of underweight in toddlers can be seen in Table 2 below.

Table 2. The Correlation between Macronutrient Intake and the Incidence of Underweight

Macronutrients Intake	Underweight Incidence				p-value
	Underweight		Not Underweight		
	n	%	n	%	
Energy					
Very Lacking	9	18,75	18	37,5	
Lacking	0	0	20	41,67	0,003
Normal	0	0	1	2,08	
Protein					
Very Lacking	5	10,42	2	4,17	
Lacking	0	0	13	27,08	0,005
Normal	3	6,25	1	2,08	
Excessive	1	2,08	23	47,92	
Carbohydrate					
Insufficient	9	18,75	19	39,58	0,004
Sufficient	0	0	20	41,67	
Fats					
Insufficient	9	18,75	24	50	0,025
Sufficient	0	0	15	31,25	

3. The Correlation between Energy Intake and the Incidence of Underweight

The results of the Spearman Rank statistical test showed that there was a significant relationship between energy intake and the incidence of underweight in toddlers, with a value of p=0.003 (p≤0.05), so it can be interpreted that the better the energy intake, the lower the incidence of underweight. This is in line with the research. of Kumala et al., (2023) and the research of Werdani & Syah, (2023). The research results have shown that energy intake is significantly related to the incidence of underweight. Low energy intake for toddlers due to daily needs will result in underweight, and vice versa. If energy intake is sufficient and as needed, it can maintain normal nutritional status (Kumala et al., 2023).

Judging from the results of the average percentage of the overall Energy Adequacy Rate (AKE) of toddlers in this study, a percentage of 65% was obtained, where this figure still did not reach the normal AKE percentage figure that had been set, which was 100% - <130% AKE. In this study, most toddlers consumed food in amounts, frequencies, and types that were not typical, so they had less intake than their needs. Some toddlers also change staples by only eating snacks. Insufficient energy intake and not according to daily needs can cause an imbalance. Energy imbalances that occur continuously can result in nutritional problems. (Febriani et al., 2019). If insufficient energy intake, the body will respond by increasing reserve energy from muscles and fat. This condition will inhibit growth, so that the body experiences weight loss. (Anwar & Setyani, 2022). This weight loss can result in an underweight condition.

4. The Correlation between Protein Intake and the Incidence of Underweight

The results of the Spearman Rank statistical test showed that there was a significant relationship between protein intake and the incidence of underweight in toddlers, with a value of p=0.005 (p≤0.05), so it can be interpreted that if protein intake is better, the incidence of underweight will be lower. This is in line with research by (Kumala et al., 2023) This study states that protein intake significantly correlates with the incidence of underweight in toddlers in the work area of the Purnama Health Center. This is in line with the results of research by Anwar & Setyani, (2022) This study stated that protein intake is significantly related to underweight (p<0.001). Fulfilling protein needs from the right food is necessary to increase weight and improve nutritional status (Anwar & Setyani, 2022).

Based on the 2x24-hour food recall interview results, most of the toddlers who consume food ingredients that are animal protein sources are in the form of chicken, eggs, shrimp, fish, and vegetable protein in the form of tofu. Most toddlers also get protein intake from formula milk and UHT milk. The high number of toddlers with protein intake is more because, in addition to eating side dishes, toddlers also consume milk with a frequency of 3-4 times a day. Therefore, most of the toddlers in this research have high protein intake. Toddlers who are not underweight have excessive protein intake. This is supported by research. by Febriani et al., (2019) which stated that toddlers with more protein intake will have a good nutritional status.

Protein consumption plays a vital role in the repair and formation process of cells and tissues (Anwar & Setyani, 2022). If the body lacks protein, the available protein will be prioritized for maintaining cells in essential organs, so that growth and development will be disrupted. This will cause weight loss and result in underweight conditions. (Hardiansyah & Supriasa, 2017).

5. Relationship between Carbohydrate Intake and the Incidence of Underweight

The Spearman Rank statistical test results showed a significant relationship between carbohydrate intake and the incidence of underweight in toddlers, with a value of p=0.004 (p≤0.05).

This is in line with research by Febriani et al., (2019) which shows that carbohydrate intake has a significant relationship with the incidence of malnutrition (BB/U) in toddlers in Panorama Village, Bengkulu City. Toddlers who consume less carbohydrates than they need are more likely to experience malnutrition than toddlers who consume enough carbohydrates.

Carbohydrates consumed as needed will affect overall energy intake. This is because carbohydrate-rich foods account for 60% of the body's energy needs. (Febriani et al., 2019). If the consumption of carbohydrates can meet the body's needs, then breaking down energy reserves from other sources of macronutrients is unnecessary. Instead, the body will activate the protein and fat catabolism pathways to produce energy if carbohydrate intake is low. If the body lacks ATP, it will obtain ATP from glycogen reserves and carbohydrate reserves, as well as from cellular proteins if needed (Werdani & Syah, 2023). As a result, it can trigger weight loss in toddlers, resulting in underweight conditions.

Carbohydrate intake in toddlers in this study was mostly lower. Based on the food recall interview results, the high number of toddlers with low carbohydrate intake is caused by the fact that most toddlers consume only 1/2 – 1 large spoon of rice in one meal. In contrast, rice is the food ingredient that contains the most carbohydrates in this study. In addition, based on the results of the recall interviews, some toddlers ate with a frequency of 2x a day (48%), and some even prefer to eat snacks such as wafers, biscuits, packaged fries, and packaged chips rather than eating staple foods.

6. The Relationship between Fat Intake and the Incidence of Underweight

The results of the Spearman Rank statistical test showed that there was a significant relationship between carbohydrate intake and the incidence of underweight in toddlers, with a value of p=0.025 (p≤0.05), so it can be interpreted that the better the amount of carbohydrate intake, the lower the incidence of underweight. The results of this study are in line with the research of Listyawardhani & Yunianto, (2024) and the research of Anwar & Setyani, (2022) which stated that fat intake is significantly related to the incidence of underweight. Lack of fat consumption also reduces essential fat reserves, so there is a risk of nutritional problems.

In this study, most of the toddlers had less fat intake. Based on the 2x24-hour food-recall results, it is known that the source of fat intake includes formula milk, cooking oil, and snacks such as wafers or sponges. In addition, most toddlers consume side dishes and vegetables that are boiled or steamed, so toddlers with underweight or non-underweight conditions have less fat intake. Lack of fat intake from food can result in a lack of calories or energy needed for the body's metabolic activities and processes. This will cause a change in body mass and tissues and disrupt the absorption of fat-soluble vitamins. (Diniyyah & Nindya, 2017). On the other hand, if the intake of fat is sufficient, it can support the development process and help gain weight, thus avoiding underweight conditions. (Kumala et al., 2023). This is because fat that functions as an energy reserve will store

these reserves in adipose tissue, so if the fat intake is sufficient, then the fat reserve is not used by the body as an energy source, thus affecting body weight. (Rismawanti, 2016).

7. Multivariate Analysis

The results of the multivariate analysis using logistic regression tests on macronutrient variables, namely energy, protein, carbohydrates, and fats, with underweight incidence can be seen in Table 3 below.

Table 3. Results of Logistic Regression Test Analysis

Variable	p-value	Odd Ratio	95% CI
Energy Intake	0,122	0,872	0,733 – 1,037
Protein Intake	0,078	1,058	0,994 – 1,126
Carbohydrate Intake	0,179	0,978	0,946 – 1,010
Fat Intake	0,563	0,958	0,828 – 1,108

After a simultaneous logistic regression test analysis was carried out on the variables of energy, protein, carbohydrates, and fat intake with underweight work, it was found that none of the variables had a statistically significant relationship with the incidence of underweight. This is suspected to be due to the increased complexity of the model in the energy, protein, carbohydrate, and fat variables, which, when tested simultaneously with the underweight variable, can hide the direct relationship between each variable. This research is supported by previous research by Anggraeni & Sudiarti,(2023), which showed the results of a multivariate analysis of carbohydrate, protein, and fat intake that was not statistically significant with the incidence of underweight in children aged 6-59 months in Depok City. However, this study's results contradict those from a previous study. Firman & Mahmudiono, (2019) stated that following multivariate analysis on the variables of energy, carbohydrates, protein, and fat intake with the nutritional status of toddlers (BB/U), the influential variables were energy and fat intake. This is because the nutritional status of toddlers (BB/U) is influenced by energy and fat intake.

The relationship between the macronutrient variables and the incidence of underweight in this study was not found due to the uneven distribution of consumption from respondents. This is known from the results of the intake calculation, where the majority of energy intake is very lacking, carbohydrates and fats are lacking, while protein is in excess. Protein intake plays a vital role in determining whether a person is underweight. Lack of energy, carbohydrates, and fat intake can cause the body to use protein as a source of energy reserves, so that when the protein intake of the respondents is mostly good, most of the respondents are not underweight. (Herawati, 2023). In line with research by Ristanti et al., (2024) which states that protein has a role in improving nutritional status, supporting growth, muscle development, and bone health, so protein intake can help avoid

being underweight and maintain weight. In addition, the insignificant results in this study may be due to other variables that affect underweight that the researchers did not study, such as disease infection variables, sanitation, hygiene, socioeconomics, food security, maternal knowledge, and access to health services. (Natalina et al., 2023).

CONCLUSION

Toddlers who experienced underweight incidents at Posyandu Bangun Sari Indah 6 were 18.8%. Most of the energy intake in toddlers in this study was in the very low category, carbohydrate intake and low fat intake, while most of the intake of toddlers was in the moderate category. The results showed a significant relationship between energy intake and underweight events, protein intake with underweight events, carbohydrate intake with underweight events, and fat intake with underweight events. No significant relationship was found between energy, protein, carbohydrate, and fat intake and the incidence of underweight together in the logistic regression test. The suggestions related to this study are the need for interventions such as counseling related to the prevention and control of underweight risk factors to reduce the incidence of underweight events.

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