

Differences in the Consumption of Macro and Micro Nutrients among Stunted Toddlers in Bengkulu City

Desri Suryani¹, Arie Krisnasary¹, Bintang Agustina Pratiwi^{2,4}, Yandrizal^{3,4}

¹Department of Midwifery, Poltekkes Kemenkes Bengkulu, Bengkulu, Indonesia

²Faculty of Public Health, Universitas Dipenogoro, Central Java, Indonesia

³Bengkulu Provincial Health Training Technical Implementation Unit, Bengkulu, Indonesia

⁴Universitas Muhammadiyah Bengkulu, Bengkulu, Indonesia



 Corresponding author: desrisuryani97@gmail.com



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ABSTRACT

Introduction: Stunting remains a significant public health concern in Indonesia, with Bengkulu City reporting a prevalence of 12.9% in 2022. Consumption of macro and micronutrients is a factor directly related to toddlers' nutritional status. **Objective:** This study aimed to investigate the differences in macro and micronutrient consumption among stunted toddlers in Bengkulu City. **Methods:** A mixed-method approach with a sequential explanatory design was employed, involving 50 stunted toddlers and their mothers. Quantitative data were collected using a Food Frequency Questionnaire (FFQ), while qualitative data were obtained through interviews with six mothers. **Results:** The results showed no significant differences in the consumption of energy, carbohydrates, protein, fat, and zinc between toddlers with severe stunting and stunting. However, a significant difference was found in iron consumption ($p=0.048$), with severely stunted toddlers consuming less iron compared to stunted toddlers. Interviews revealed similar dietary patterns among mothers of both groups, with rice as the staple food and limited fish consumption. **Conclusion:** The findings suggest monitoring iron-rich food consumption in stunted children is essential. Strengthening family empowerment programs, expanding educational initiatives on iron consumption, and regular nutritional monitoring are recommended to address stunting. Promotion of affordable, iron-rich foods and monitoring of iron intake by mothers and health workers are crucial in the treatment of stunting.



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INTRODUCTION

The World Health Organization (WHO) categorizes stunting, defined as low height according to age, as a type of malnutrition. Reports from UNICEF, WHO, and the World Bank have highlighted persistent concerns about malnutrition rates in children under the age of five. Despite a 20% decline over the span of a decade, stunting remains a dominant and worrying global problem. In 2020, globally, 22% (149.2 million) of children under five were identified as stunted. Particularly in Asia, stunting affects 50% of children, with Southeast Asia showing the highest incidence rate of 27.4% (Unicef & WHO, 2020).

The stunting rate in Indonesia in 2021 reached 24.4% (SSGI 2021). Although there has been a decrease from the previous figure in 2019, of 27.7%, this figure still needs to be worked on to achieve the target of reducing stunting to 14% by 2024. Data from 2019 to 2021 documented in SSGI shows that stunting cases occur before birth and have increased significantly, especially in children aged 6 months to 12 months, from 13.8% to 27.2% (SSGI 2019). This information confirms the importance of adequate nutritional intake for mothers since pregnancy, during breastfeeding, and also the importance of nutrition in the MP-ASI period for toddlers. Meanwhile, in Bengkulu Province in 2022, the prevalence of stunting is 19.8% and Bengkulu City is 12.9% (Kemenkes, 2023; Kemenkes RI, 2021a, 2021b).

Stunting is caused by a variety of factors, the main direct cause of which is lack of nutrition in the long term or frequent exposure to repeated infections. Long-term impacts include reduced cognitive development, academic achievement, increased susceptibility to disease, and decreased future economic productivity. This condition is expected to put significant pressure on the socio-economic structure and national health system (Akombi et al., 2017; Beal, Tumilowicz, Sutrisna, Izwardy, & Neufeld, 2018; Chowdhury et al., 2020; Rita et al., 2022).

Mothers as parents are directly related to paying attention to the baby's diet, so mothers must know the nutrients from the food given to meet the nutritional needs of children (Agyen, Annim, & Asmah, 2024). Especially children who have experienced stunting. Mothers find it difficult when feeding stunted children and really need support from others (Kurnia, Krisnana, & Rahmadhani, 2021).

Animal-source foods have been suggested as a strategy to increase intake of macro and micronutrients in young children. In this food category, they offer many micronutrients such as iron, vitamins A and B, zinc, calcium, and iodine. Animal-source foods also provide essential amino acids that are often deficient in many children living in low- and middle-income countries. Typically, food sources of animal include dairy products, meat, eggs, insects, and seafood. These foodstuffs play an important role in achieving food diversity, serving as indicators to evaluate food quality and micronutrient adequacy (Adesogan, Havelaar, McKune, Eilittä, & Dahl, 2020).

There are differences in food diversity between stunted and non-stunted children (Motadi, Zuma, Freeland-Graves, & Gertrude Mbhenyane, 2023). However, other studies have found that there is no difference between the diet of stunted and non-stunted toddlers (Leunupun, Margawati, & Ediati, 2021; Permatasari, Chadirin, Ernirita, Elvira, & Putri, 2023; Suryani, Kusdalinah, Krisnasary, Simbolon, & Angraini, 2022). If based on the age group, the incidence at 0-6 months shows no relationship between the consumption of energy, protein, iron, and calcium and the incidence of stunting. However, when children aged 10-18 months, it is seen that iron and calcium consumption is associated with stunting (Gurang, Briawan, & Widodo, 2023). Dietary diversity is not related to the nutritional status of toddlers.

The diet of stunting and severe stunting toddlers has no difference (Rahmawati, Ranggauni Hardy, & Anggraeni, 2020). The food consumed by toddlers needs to be considered for its nutrient content; this is done to determine the adequacy of nutrients for toddlers. The habit of consuming instant food is related to the nutritional status of toddlers, toddlers who are used to consuming instant food are more at risk of experiencing severe stunting nutritional status (Nurbaya, Bidayah, & Irwan, 2023).

Previous research conducted in Bengkulu Province found no difference in the nutritional consumption patterns of stunted and severely stunted toddlers between cities and villages (Suryani et al., 2022). This study will examine the differences in macro and micronutrient consumption in stunted children in urban areas.

METHODS

This study used a mixed method with a *Sequential Explanatory approach*. Quantitative data is collected first and then followed by qualitative research to strengthen quantitative research findings. The research was conducted in Bengkulu City during May – June 2023. Research sampling using the total population method of 50 people. Where during the research data collection period there were 50 toddlers with stunting status. Data was collected using FFQ (*Food Frequency Questioner instrument*). After all the data is collected, a data normality test is carried out. Some of the variables measured are energy, carbohydrates, protein, fat, zinc and iron and stunting status. The results of the statistical test of the data normity test showed that the data were abnormally distributed on all variables (data normality test result score <0.05). So that bivariate analysis uses a non-parametric test (*Mann-Whitney*).

For qualitative data, it was conducted by conducting interviews with 6 mothers recommended by health workers. The stage of selecting informants is to determine the criteria for informants to be interviewed with the criteria of having stunted children under five years old, living in the health center area where the research is located, and willing to conduct interviews. Then the researcher will ask health workers to find informants to be interviewed. The information collected is related to the diet given by the mother. Data collection using interview guidelines. The interview results are arranged in interview transcripts, then reduced by incorporating them into the interview matrix and identifying the theme or keyword of each finding. The researcher then interprets the data and draws conclusions based on this matrix.

RESULTS

The results found that most mothers aged 20-35 years (72.0%), had low education (80.0%), did not work (80.0%), income less than UMP was < Rp. 2,300,000 (64.0%) and deliSevere in a normal way (60.0%) (Table 1).

Table 1. Characteristics of mothers who have stunting toddlers in Bengkulu City

Characteristic	Frequency	Percentage (%)
Age		
<20 and > 35 Years	14	28.0
20 – 35 Years	36	72.0
Education		
Low	40	80.0
High	10	20.0
Work		
Not Working	40	80.0
Informal	8	16.0
Formal	2	4.0
Family Income		
< 2.300.000	32	64.0
≥ 2.300.000	18	36.0
Birth attendant		
Caesar	20	40.0
Normal	30	60.0

Table 2. Distribution of Macro and Micro Nutrient Consumption in Stunting Toddlers in Bengkulu City

Variables	Severe Stunting		Stunting	
	Mean	SD	Mean	SD
Energy	669.41	278.89	822.23	392.32
Carbohydrates	83.61	39.69	98.12	59.53
Protein	18.98	4.54	20.67	10.10
Fat	18.46	11.73	25.00	13.86
Zinc	2.61	0.93	2.77	0.78
Iron	3.71	1.85	5.65	4.18

Table 2 shows that the average consumption of energy, carbohydrates, proteins, fats, zinc and Iron of toddlers with very short nutritional status is less when compared to toddlers with short status.

Table 3. Statistical test results of differences in consumption of macronutrients and micronutrients in Bengkulu City

Variables	Severe Stunting	
	Mean Rank	Sig
Energy	333.50	0.201
Carbohydrates	296.50	0.610
Protein	274.50	0.959
Fat	336.50	0.180
Zinc	291.50	0.684
Iron	367.00	0.048

The results of statistical tests showed that there was no difference in energy consumption (p value = 0.201), carbohydrates (p value = 0.610), protein (p value = 0.959), fat (p value = 0.180) and zinc (p value = 0.684) between toddlers with Severe Stunting and Stunting nutritional status. And there is a difference in Iron consumption (p value = 0.048) between Severe Stunting and Stunting toddlers.

Table 4. Results of interviews with mothers of toddlers

Question	Initials					
	ATR	ANJ	SS	FRN	VIO	BIL
How many times a day does the mother feed the toddler	3 times/Day	3 times /Day	3 times /Day	3 times /Day	3 times /Day	3 times /Day
What types of staple foods are used for a child's meals a day?	carbohydrates, rice, corn and sweet potatoes	Rice	Rice and bread	Rice	Rice	Rice and Bread
What kind of vegetables are used to eat a child a day	Spinach, carrots, potatoes, kale	Spinach, carrots, potatoes, kale	Potatoes, carrots and kale	Carrots, potatoes, broccoli, kale and spinach	Spinach, carrots, potatoes, kale	Wotel and potatoes
How many times the child is given food sources of fish	2 times/week	1 times/week	2 times/week	almost every Severe day such as chicken,	1 times/week	4 times/week

Question	Initials					
	ATR	ANJ	SS	FRN	VIO	BIL
				fish and chicken liver		

Based on the results of interviews related to consumption patterns, all mothers feed 3 times per day and give rice as a staple food. For types of vegetables vary such as spinach, kangkong, carrots, potatoes, broccoli. In consuming fish-sourced foods varies from 1 time per week to Severe day. When viewed from the results of interviews with mothers, the eating habits of mothers who have children with Stunting and Severe Stunting are the same. Then for the types of staple foods that are often consumed are rice, for vegetables Carrots, potatoes, kale and spinach. Mothers very rarely give their children fish, only one mother gives fish four times a week, two mothers 2 times a week and 2 mothers 1 time a week.

DISCUSSION

There was no difference in energy in the Stunting and Severe Stunting groups statistically. Supported by the findings of Domili's research (2020) which found that there was no difference in average energy between stunting and severe stunting groups (Domili, Ruhmayanti, Tumenggung, Misnati, & Hineho, 2020). However, if you look at the average energy score in the Severe Stunting group, it is less than in the Stunting group.

Statistically there was no difference in carbohydrate consumption between Stunting and Severe Stunting children. But if we look closely, there is an average difference of 296.50 between children with Stunting and Severe Stunting nutritional status. In line with previous research, but in previous studies conducted on two groups with stunting and non-stunting categories. The study found that there was no association between carbohydrate consumption and the incidence of stunting (Suryani et al., 2022). ESevere day the child consumes the staple food of rice.

The protein consumption of Stunting and Severe Stunting toddlers showed no difference statistically. However, if you look at the average score, protein consumption in the Severe Stunting group is less than the Stunting group. In line with the findings of previous studies which stated that statistically there was no difference in protein consumption between groups (Domili et al., 2020). Protein quality needs to be considered, protein quality is measured by the *Digestible Indispensable Amino Acid Score* (DIAAS), there is a significant inverse correlation between complementary food DIAAS and stunting ($r=-0.66$, $p=0.044$). The addition of eggs or milk to nationally representative complementary foods theoretically increases DIAAS from 80 to 100 (Shivakumar et al., 2019). The interview results also found that consumption of fish-sourced foods at least once a week.

There was no statistically different in fat consumption in children with Stunting and Severe Stunting status. Fat consumption in stunted toddlers is less than those who are not stunted. Although statistically fat consumption is also not associated with the incidence of stunting (Suryani et al., 2022).

There was no difference in zinc consumption between children with Stunting and Severe Stunting nutritional status, in line with other studies that found no difference in average zinc consumption between stunted and non-stunted children (Limardi, Hasanah, & Utami, 2022). In other studies there is an interrelated relationship where zinc deficiency generally occurs in groups that are already malnourished (Ahsan et al.,

2021).

There is a difference in consumption of Fe nutrients between Stunting and Severe Stunting children. In line with previous research that found that Fe consumption is associated with stunting, children who consume less Fe nutrients are 7.00 times more likely to be stunted when compared to children who consume Fe (Amaliyah, Budiastutik, & Dewintha, 2020). The average consumption of Fe in Severe Stunting children is less when compared to Stunting children. In addition to Fe consumed by children, mothers who since pregnancy consume less Fe tablets also have an impact on the fetus. Previous research proved that children of mothers who did not consume Fe as much as 25% with Severe Stunting nutritional status at the age of 0-23 months and 41.7% at the age of 24-59 months (Indria Nuraini, Retno Setyo Iswati, & Aisyah, 2022).

Pada Iron plays a crucial role in neurodevelopmental processes such as energy production, myelination, and neurotransmitter function. Iron deficiency during these critical periods can affect a child's cognitive, motor, and emotional development. In later stages, it will affect a child's learning ability and overall developmental potential. (McCann, Perapoch Amadó, & Moore, 2020). Children aged 12 -23 months are at great risk of developing anemia deficiency (Alaofè, Burney, Naylor, & Taren, 2017). It can be seen from the research findings that the average iron consumption between stunted and very stunted children is very small, iron is very beneficial for toddlers. Iron deficiency affects tissue growth because iron is needed for DNA synthesis and other body functions. Conversely, stunting can worsen anemia because children with stunting tend to experience chronic malnutrition, including low iron intake. the prevalence of anemia and stunting is very high in developing countries, such as Indonesia, due to low nutritional intake, low maternal education levels, and limited access to nutritious food (Oktarina, Dilantika, Sitorus, & Basrowi, 2024).

Infant feeding practices are not associated with stunting (Nurbaya et al., 2023), This means that stunting toddlers and not stunting are not influenced by consumption factors alone. When viewed from the results of interviews with mothers, the dietary habits of mothers who have Stunting and Severe Stunting children are the same. There may be other factors that are not studied deeply in this study so that the weakness of this study is how the processing process that mothers do on nutrient levels in food.

This study has several limitations that need to be noted. First, the sample size used in this study was relatively small (50 people), which limits the ability to generalize these findings to a wider population. Second, the food consumption data used in this study relied on self-reported methods through the Food Frequency Questionnaire (FFQ), which may contain biases such as inaccuracy in recalling dietary patterns or social adjustment in reporting food consumption. These limitations may affect the reliability and validity of the data obtained. The findings of this study suggest the importance of monitoring iron-rich food consumption in children with stunting and severe stunting nutritional status. Therefore, it is recommended that policy makers strengthen family empowerment programs targeting children at risk of stunting, by providing greater access to iron-rich foods such as red meat, green vegetables, and nuts. For health workers, educational programs that focus on the importance of iron consumption for pregnant women and young children need to be expanded, with a community-based approach that facilitates the provision of iron supplements. In addition, regular nutritional monitoring through integrated health posts or community-based health services is needed to ensure adequate iron intake.

CONCLUSIONS

Promotion programs for the consumption of high iron foods, such as green vegetables, red meat, and nuts, need to be strengthened, with a focus on providing affordable food for families at risk of stunting. Consumption of foods containing iron needs to be monitored by mothers and health workers in efforts to treat stunting.

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