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Description of Macronutrient Intake and Infectious Diseases Among Stunted Children in the Working Area of Kamal Health Center, Bangkalan Regency

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ABSTRACT

Background: Indonesia faces a triple burden of malnutrition, with persistent stunting driven by inadequate nutrient intake and infectious diseases as the main factors. This study aimed to describe macronutrient intake and the history of infectious diseases (acute respiratory infection and diarrhea) among stunted toddlers in working area of Kamal Health Center, Bangkalan Regency.

Methods: Descriptive cross-sectional design was employed involving 25 stunted toddlers at Kamal Health Center. Stunting was determined using height-for-age z-scores. Researcher interviews captured daily intake of energy, protein, fat, and carbohydrates, as well as past episodes of acute respiratory infection and diarrhea. Data were analyzed using frequencies and percentages.

Results: The sample comprised 52% girls and 48% boys, with the highest proportion (36%) aged 24–36 months. Energy intake deficits were present in 72% of children; protein in 84%; fat in 76%; and carbohydrates in 68%. All toddlers (100%) experienced at least one acute respiratory infection, while 56% reported a history of diarrhea. Among those with ARI, proportions with normal energy intake and light/moderate deficits were equal at 28%, and 36% had a moderate protein deficit. In children with diarrhea, 28.6% had normal energy intake, 28.6% had a light energy deficit, and 42.9% exhibited a light protein deficit.

Conclusion: Chronic deficits in protein and energy, coupled with recurrent infections, synergistically exacerbate stunting. Integrated interventions addressing nutrient adequacy and infection prevention are essential to reduce stunting prevalence. These findings highlight the imperative for strong policy backing and enhanced parental education. Accordingly, comprehensive programs should be rolled out nationwide.

INTRODUCTION

Currently, Indonesia is facing three burdens of nutrition problems (*triple burden*) including undernutrition (wasting, stunting), overnutrition (obesity), and micronutrient deficiencies[1–4]. This is in line with the National Medium-Term Development Plan (RPJMN) for 2020-2024[5] in the health sector which focuses on health promotion programs that focus on reducing the prevalence of maternal

mortality, mortality in toddlers, and reducing the prevalence rate for *stunted* and under-five *who are wasting*[6].

Stunting is a condition of failure to grow in children under five years old characterized by height for ages <–2 of elementary school, caused by chronic malnutrition and recurrent infections during the first 1,000 days of life (HPK)[7]. In stunted toddlers, macronutrient intake—including energy, protein, fat, and carbohydrates—as well as a history of infectious diseases such as Acute Respiratory Tract Infection (ARI) and diarrhea, play an important role in lowering immunity and slowing growth[8–10].

Internal factors that affect the nutritional status of toddlers include the adequacy of the quantity and quality of macronutrients and the history of infection, while external factors include education, family income, parenting, sanitation, and access to health services[11]. Although the health promotion program in the 2020–2024 RPJMN targets a reduction in the national prevalence of stunting, there are still few studies that describe macronutrient intake and the burden of infection at the health center level, especially in Bangkalan Regency.

Bangkalan District recorded 184 cases of ISPA in 2019, a relatively high figure considering that Bangkalan is a center of administration and economic activity factors that facilitate the transmission of respiratory pathogens. Meanwhile, in 2018 there were 49,752 cases of diarrhea recorded in all Bangkalan Regency[12]. Although these data are general, the high burden of respiratory and digestive tract infections suggests the same potential health problems in toddlers. In vulnerable groups such as stunted toddlers, repeated exposure to these infections risks exacerbating macronutrient deficits (energy, protein, fat, carbohydrates) and inhibiting the recovery process. Therefore, it is necessary to carry out specific mapping of cases of ISPA and diarrhea in stunted toddlers in the working area of the Kamal Health Center, as a basis for more focused nutrition intervention and infection prevention.

MATERIALS AND METHODS

This study is a descriptive study with a cross-sectional approach, conducted from December 2021 to May 2022 in the working area of Kamal Health Center, Bangkalan Regency. The population consisted of 25 stunted toddlers, and a total sampling technique was used, involving all members of the population as research subjects.

Data on nutritional status were obtained through anthropometric measurements using height-for-age index based on WHO growth standards to determine stunting status. Meanwhile, data on macronutrient intake and infectious diseases were collected through structured interviews using a questionnaire developed by the researchers. The questionnaire was tested for validity and reliability prior to use.

The variables observed in this study include macronutrient intake and infectious diseases (independent variables) and stunting status (dependent variable). Data were analyzed using descriptive statistics, presented in the form of frequency distribution tables. Ethical clearance was

obtained from the relevant health authority, and informed consent was obtained from each respondent's parent or guardian prior to data collection.

RESULT

Characteristics of Respondents by Gender

Table 1 Frequency Distribution by Gender

No	Genders	n	Presentase (%)
1	Male	12	48
2	Female	13	52
	Total	**25**	**100**

Source : Primary Data 2022

Based on table 1 The number of stunted toddlers with female sex is slightly more than boys, but the difference is not too large (4% difference). This shows that stunting occurs in both sexes in a relatively balanced manner, although in this study women are more dominant.

Characteristics of Respondents by Age

Table 2 Frequency Distribution by Age

No	Toddler Age	n	Presentase (%)
1	0 – 11 months	1	4
2	12 – 23 months	5	20
3	24 – 36 months	9	36
4	37 – 48 months	7	28
5	49 – 59 months	3	12
	Total	**25**	**100**

Source : Primary Data 2022

Based on Table 2, the most common age group for stunted toddlers is 24–36 months (36%), followed by 37–48 months (28%), and 12–23 months (20%). Meanwhile, the lowest proportion is found in the age group of 0–11 months (4%). This shows that the incidence of stunting is more common in toddlers over two years old, which can be an indication that chronic nutrition fulfillment problems are starting to have a real impact on that age.

Cross-tabulation of sex by age

Table 3 Cross-Tabulation of Sex by Age

Stunting Toddler Age	Gender of Stunting Toddlers				Total	
	Male		Female			
	n	%	n	%	n	%
0 – 11 months	1	8.3	0	0.0	1	4.0
12 – 23 months	2	16.7	3	23.1	5	20.0
24 – 36 months	4	33.3	5	38.5	9	36
37 – 48 months	3	25	4	30.8	7	28
49 – 59 months	2	16.7	1	7.7	3	12
Total	**12**	**100.0**	**13**	**100.0**	**25**	**100.0**

Source : Primary Data 2022

Based on Table 3, stunting toddlers are most commonly found in the age group of 24–36 months, both in boys (33.3%) and women (38.5%). This shows that this age is a stunting prone period for both sexes. Most age groups are dominated by female toddlers, except at 49–59 months which is more occupied by male toddlers. These data indicate that although the amount of stunting is relatively balanced between the sexes, there is a slight pronounced difference in age distribution between the two.

Characteristics of Respondents Based on Energy Intake Level

Table 4 Energy Intake Frequency Distribution

No	Energy Intake	n	Presentase (%)
1	Severe Deficit	4	16
2	Moderate Deficit	7	28
3	Mild Deficit	7	28
4	Normal	7	28
	Total	**25**	**100**

Sumber : Data Primer 2022

Based on Table 4, most stunted toddlers have a level of energy intake that is not enough for their needs, with details of 16% experiencing severe deficits, 28% moderate deficits, and 28% mild deficits. Only 28% of toddlers have energy intake in the normal category. This indicates that an imbalance in energy intake is one of the significant factors for the incidence of stunting in toddlers in the Kamal Health Center's work area.

Characteristics of Respondents Based on Protein Intake Level

Table 5 Frequency Distribution of Protein Intake

No	Protein Intake	n	Presentase (%)
1	Severe Deficit	4	16
2	Moderate Deficit	9	36
3	Mild Deficit	8	32
4	Normal	4	16
	Total	**25**	**100**

Source : Primary Data 2022

Based on Table 5, most stunting toddlers experience a lack of protein intake, with a moderate deficit proportion of 36% and a mild deficit of 32%. Only 16% of toddlers had normal protein intake, and the other 16% were in the weight deficit category. This data shows that the problem of lack of protein intake is quite significant and can be one of the risk factors for stunting incidence in the region.

Characteristics of Respondents Based on Fat Intake Levels

Table 6 Frequency Distribution of Fat Intake

No	Fat Intake	n	Presentase (%)
1	Severe Deficit	9	36
2	Moderate Deficit	5	20
3	Mild Deficit	5	20
4	Normal	6	24
	Total	**25**	**100**

Source : Primary Data 2022

Based on Table 6, it can be seen that most stunted toddlers have a severe deficit in fat intake (36%), followed by a moderate and mild deficit of 20% each. Only 24% of toddlers have a fat intake in the normal category. This indicates that lack of fat intake is also a significant nutritional problem and can affect children's growth and nutritional status.

Characteristics of Respondents Based on Carbohydrate Intake Level

Table 7 Frequency Distribution of Carbohydrate Intake

No	Carbohydrate Intake	n	Presentase (%)
1	Severe Deficit	1	4
2	Moderate Deficit	8	32
3	Mild Deficit	9	36
4	Normal	7	28
	Total	**25**	**100**

Source : Primary Data 2022

Based on Table 7, most stunted toddlers have a mild deficit in carbohydrate intake (36%), followed by a moderate deficit (32%). Only 4% of toddlers have a severe deficit, and 28% are in the category of normal carbohydrate intake. This suggests that most toddlers do not get optimal carbohydrate intake, even though weight deficits are relatively low compared to other macronutrient deficits.

Characteristics of Respondents Based on History of Infectious Diseases of ISPA

Table 8 Frequency Distribution of Infectious Disease History of Infectious Diseases

No	History of Infectious Diseases of ISPA	n	Presentase (%)
1	Sick	25	100
2	Not Sick	0	0
	Total	**25**	**100**

Source : Primary Data 2022

All respondents under five (100%) had a history of acute respiratory infection (ISPA). This data shows that ISPA is a common health problem among stunted toddlers in the study area and has the potential to be a risk factor for growth disorders.

Characteristics of Respondents Based on Diarrheal Infectious Disease History

Table 9 Frequency Distribution of Diarrheal Infectious Disease History

No	History Infectious Diseases Diarrhea	n	Presentase (%)
1	Sick	14	56
2	Not Sick	11	44
	Total	**25**	**100**

Source : Primary Data 2022

Based on Table 9, it is known that out of a total of 25 stunted toddlers who became respondents, as many as 14 toddlers (56%) had a history of diarrheal infectious diseases. Diarrheal infections can lead to significant loss of fluids and electrolytes, as well as impaired absorption of essential nutrients such as energy, protein, and micronutrients. This condition can worsen the nutritional status of children and inhibit growth, which ultimately contributes to the occurrence of stunting. The high proportion of stunted toddlers who experience diarrhea shows that infectious diseases, including diarrhea, are a factor that cannot be ignored in efforts to prevent and treat stunting.

Cross-Tabulation of Energy Intake With A History of ISPA Infectious Disease

Table 10 Cross-tabulation of Energy Intake and History of Infectious Diseases of ISPA

Energy Intake	History of Infectious Diseases of ISPA				Total	
	Sick		Not Sick			
	n	%	n	%	n	%
Severe Deficit	4	16.0	0	0	4	16.0
Moderate Deficit	7	28.0	0	0	7	28.0
Mild Deficit	7	28.0	0	0	7	28.0
Normal	7	28.0	0	0	7	28.0
Total	**25**	**100.0**	**0**	**0**	**25**	**100.0**

Source : Primary Data 2022

Based on the tabulation results, all toddlers who were studied had a history of ISPA infection. The highest energy intake in toddlers with ISPA was in the categories of normal, mild deficit, and moderate deficit, each of 28%. This shows that ISPA infection does not only occur in toddlers with energy deficits, but also in toddlers with relatively normal energy intake, so there may be other factors that play a role in the incidence of ISPA.

Cross-Tabulation Of Energy Intake With A History Of Diarrheal Infectious Diseases

Table 11 Cross-tabulation of Energy Intake and History of Diarrheal Infectious Diseases

Energy Intake	History of Diarrheal Infectious Diseases				Total	
	Sick		Not Sick			
	n	%	n	%	n	%
Severe Deficit	3	21.4	1	9.1	4	16
Moderate Deficit	3	21.4	4	36.4	7	28
Mild Deficit	4	28.6	3	27.3	7	28
Normal	4	28.6	3	27.3	7	28
Total	**14**	**100.0**	**11**	**100.0**	**25**	**100%**

Source : Primary Data 2022

Based on the tabulation results, toddlers who experienced diarrhea had the most energy intake in the normal and mild deficit categories, as many as 4 toddlers (28.6%) each. This shows that diarrhea can occur not only in toddlers with energy deficits, but also in toddlers with relatively normal energy intake, so there may be other factors that also affect the incidence of diarrhea.

Cross-Tabulation Of Protein Intake With A History Of Infectious Disease Of ISPA

Table 12 Cross-Tabulation of Protein Intake with History of Infectious Diseases of ISPA

Protein Intake	History of Infectious Diseases of ISPA				Total	
	Sick		Not Sick			
	n	%	n	%	n	%
Severe Deficit	4	16	0	0	4	16
Moderate Deficit	9	36	0	0	9	36
Mild Deficit	8	32	0	0	8	32
Normal	4	16	0	0	4	16
Total	**25**	**100%**	**0**	**0%**	**25**	**100%**

Source : Primary Data 2022

Based on the tabulation results, the majority of toddlers who experience ISPA have protein intake in the moderate deficit category as many as 9 toddlers (36%). Followed by the category of mild deficit as many as 8 toddlers (32%), severe deficit of 4 toddlers (16%), and normal also 4 toddlers (16%). This shows that most toddlers with ISPA experience a lack of protein intake, especially at moderate deficit levels, which can have an impact on the body's decreased resistance to infection.

Cross-Tabulation Of Protein Intake With A History Of Diarrheal Infectious Disease

Table 13 Cross-tabulation of Protein Intake with a History of Diarrheal Infectious Diseases

Protein Intake	History of Diarrheal Infectious Diseases				Total	
	Sick		Not Sick			
	n	%	n	%	n	%
Severe Deficit	1	7.1	3	27.3	4	16
Moderate Deficit	5	35.7	4	36.4	9	36
Mild Deficit	6	42.9	2	18.2	8	32
Normal	2	13.3	2	18.2	4	16
Total	**14**	**100%**	**11**	**100%**	**25**	**100%**

Source : Primary Data 2022

Based on the tabulation results, the majority of toddlers who experienced diarrhea had protein intake in the categories of mild deficit (42.9%) and moderate deficit (35.7%). This suggests that a lack of protein intake, especially at mild and moderate levels, has the potential to increase the vulnerability of toddlers to diarrheal infections.

DISCUSSION

Respondent Characteristics

Based on the results of the study, the gender of the Kamal Health Center in Bangkalan Regency was more women with a total of 13 toddlers (52%) and 12 boys under five (48%). However, men are more at risk of stunting because of faster growth, higher physical activity, and greater energy needs than women[13]. Based on the age characteristics of the respondents, most of them were in the age range of 24-36 months, as many as 9 *stunted* toddlers (36%). Stunting at the age of 24–36 months can occur because children have difficulty catching up with growth faltering during the first 1,000 days of life. This is usually caused by a lack of macronutrient intake due to improper parenting or a lack of mother's knowledge about proper feeding[13].

Respondent's Macronutrient Intake

Based on the results of the study, as many as 72% of stunted toddlers in the Kamal Health Center area experience a deficit in energy intake. This is due to a lack of protein, fat, and carbohydrate consumption, as well as an irregular diet. Small portions, low appetite, and improper parenting also affect the inadequacy of children's daily energy[14].

As many as 84% of stunted toddlers in the Kamal Health Center area experience a deficit in protein intake. This is due to the lack of consumption of animal and vegetable proteins, as well as improper parenting styles, such as unbalanced menus. Mother's low knowledge of the importance of protein also plays a role in the lack of adequate nutritional needs of children[15].

As many as 76% of stunted toddlers in the Kamal Health Center area experience a deficit in fat intake. This is due to the low consumption of fatty foods such as animal protein and the lack of oil

use in food processing. Fats are important as a source of energy, solvent vitamins, and providers of essential fatty acids that play a role in growth[16].

As many as 72% of stunted toddlers in the Kamal Health Center area experience a deficit in carbohydrate intake. This is due to insufficient portions of staple foods, irregular eating habits, and low carbohydrate-rich snacks. As we age, the need for carbohydrates increases, so the portion of meals must be adjusted to the age of the child[17].

Respondent's History of Infectious Diseases

Based on the results of the research, as many as 100% of stunted toddlers at the Kamal Health Center have a history of ISPA in the last three months. This is due to weak immunity and lack of hygiene, such as not washing hands before eating or after touching objects, making them susceptible to infection[18]. In addition, as many as 71.4% of stunted toddlers at the Kamal Health Center have experienced diarrhea in the last three months. Diarrhea can be caused by a mismatch in formula milk, misdosing, or consumption of sweetened condensed milk. In addition, the habit of not washing hands before eating, both by children and mothers, also increases the risk of diarrhea in toddlers[19].

Energy Intake with a History of Infectious Diseases of the ISPA

Based on the results of the study, most *stunting* toddlers have moderate and mild energy deficit levels with a history of ISPA infection disease as many as 7 toddlers (28%). Poor energy intake can cause worsening *stunting conditions* for children and the risk of children under five experiencing a higher incidence of ISPA compared to good energy intake. Consumption of nutritious, balanced and nutritious foods will strengthen the body's immunity. The condition of children who experience infectious disease with ISPA will experience a decrease in appetite so that if energy intake is not treated immediately by providing sufficient intake, it will worsen the condition *of stunting* in children[20].

Energy Intake with a History of Diarrheal Infections

The results showed that most of the stunted toddlers with a history of diarrhea had energy intake in the mild deficit category, namely 4 toddlers (57.1%). Diarrheal infections have a direct impact on the nutritional status of children because they cause fluid loss (dehydration), impaired nutrient absorption, and decreased appetite. When a child has diarrhea, the process of absorbing nutrients is disrupted so that energy from food cannot be utilized optimally. In addition, discomfort and nausea make children tend to refuse to eat, so energy intake decreases. If not treated immediately, this condition can worsen stunting. Lack of nutrient intake, especially energy, is one of the direct factors that cause growth inhibition. Prolonged or recurrent diarrheal infections can lead to more severe malabsorption, accelerate weight loss, and worsen the nutritional status of toddlers[21]. Therefore, the prevention of diarrhea is important in handling stunting.

Protein Intake with a History of Infectious Diseases of ISPA

The results showed that most of the stunted toddlers had moderate protein deficit intake and all (100%) had a history of ISPA. Long-term protein deficiency can worsen stunting, especially when the child has an infection. Protein plays an important role in forming antibodies, repairing body tissues, and supporting the healing process. When toddlers are sick, the need for protein increases, but it is often not enough. Therefore, the provision of animal and vegetable proteins needs to be increased during the child's infection so that the growth and development process is not hampered due to protein deficits that aggravate the impact of infection on the child's body[22].

Protein Intake with a History of Diarrheal Infectious Diseases

Most stunted toddlers with a history of diarrhea have protein intake in the mild deficit category (75%). Diarrhea can reduce appetite, so protein intake is also reduced, even though protein is needed to repair body tissues and fight infections. When a child is sick, the need for protein, especially from animal sources, increases and must be met so that growth is not stunted. Children under five need more protein than other age groups because they are in a period of rapid growth[23–25]. Protein also plays an important role in the formation of hormones, enzymes, and increases immunity. Insufficient protein intake is one of the direct causes of malnutrition, including stunting, especially if it occurs at the same time as infections such as diarrhea[21]. This study confirms that chronic deficits in protein and fat, combined with recurring infections, significantly contribute to stunting. These findings reinforce global calls for multi-sectoral interventions addressing both nutrition and disease prevention in early childhood

This research has several limitations. Cross-sectional descriptive designs cannot demonstrate a cause-and-effect relationship between macronutrient deficits, infections, and stunting. The number of samples is small (n=25) and only covers one area of the health center, so the results cannot be generalized. Data collected through interviews that rely on parental memories, is at risk of inaccuracy. In addition, important variables such as maternal education, parenting, and sanitation were not analyzed, so the factors causing stunting had not been thoroughly described. Follow-up research is recommended using an analytical approach and a wider range of variables.

The study has potential bias, especially recall bias because the history of illness was collected based on the parents' memories in the past three months. Social desirability bias is also possible, where parents give answers that are considered good, especially regarding diet and hygiene. The use of homemade questionnaires, even though they have been tested for validity and reliability, is still at risk of misinterpretation between respondents. In addition, all respondents are puskesmas patients, which can cause selection bias and do not represent all stunted toddlers, especially those who do not have access to health services.

CONCLUSION

This study shows that the majority of stunted toddlers in the Kamal Health Center work area experience a deficit of macronutrients, especially protein and fat. In addition, most toddlers have a history of infectious diseases, particularly ISPA and diarrhea, which have the potential to worsen nutritional conditions. These findings confirm a synergistic relationship between macronutrient deficiency and recurrent infections to stunting incidence. The vulnerable age of 24–36 months is a group that needs special attention in child nutrition and health intervention efforts.

SUGGESTION

Efforts are needed to improve nutrition education by health workers, especially through Posyandu activities, with a focus on the importance of protein and fat intake for toddlers. Parents are expected to pay more attention to age-appropriate feeding and maintain hygiene to prevent infections such as ISPA and diarrhea. Local governments need to integrate nutrition and infection prevention programs in primary health services, especially for children aged 24-36 months who are prone to stunting. Further research is recommended using an analytical approach to examine the relationship between macronutrient deficiency and infection to stunting incidence in more depth. These findings are crucial for health policymakers and practitioners to implement more targeted, age-sensitive nutrition and infection control programs.

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