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A Multiple Logistic Regression Analysis of Household Food and Nutrition Insecurity in Stunting and Non-Stunting Toddlers

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Abstract

Stunting, wasting, and underweight are growth disorders in children under 5 years of age due to malnutrition in Indonesia. The level of macronutrient intake is a risk factor that directly influences stunting and wasting. Food insecurity is associated with poverty, malnutrition, and hunger. This study aimed to analyze food and nutritional insecurity in households with stunting and non-stunting toddlers, using a multivariate model. This study used a comparative cross-sectional design. Using the Lemeshow formula, 142 samples were obtained from a population of 822 children under five. Food insecurity was measured using the Food Insecurity Experience Scale (FIES), diversity using IDDS, and macronutrient intake using 2x24-hour food recall. Stunting, wasting, and underweight were measured based on anthropometry. Bivariate analysis was performed using multivariate logistic regression analysis. Food insecurity, energy intake, protein intake, carbohydrate intake, underweight, and maternal nutritional knowledge had a significant relationship with the incidence of stunting in toddlers. These results also showed that the underweight variable was the most dominant cause of stunting because it had the highest OR value of 18.572. The OR value showed that underweight toddlers were 18.572 times more likely to have a stunting nutritional status. Toddlers categorized as underweight face an 18.572 times higher likelihood of experiencing stunting in their nutritional status.

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Household Food Insecurity;
Food Diversity;
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Introduction

Globally, an estimated 148.1 million children under 5 years old were stunted, representing 22% of this age group. Additionally, another 45.4 million children under five, or 6.8% of the population, were classified as wasted. The study also revealed that Asia and Africa had the highest rates of child stunting, at 52% and 43% respectively.[1] In Southeast Asia, children

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under 5 years old are disproportionately affected by malnutrition. Stunting prevalence in this subregion is the second highest in Asia with sufficient data, reaching 27.4%. Wasting is also more common in Southeast Asia, affecting 8.2% of children under five, exceeding the global average of 6.7%.[2] Chronic malnutrition in children, often worsened by frequent illnesses, infections, and unhealthy environments, can lead to stunting. This condition is linked to delays in developing motor skills and reaching their full intellectual potential.[3,4] Indonesia is currently facing the problem of malnutrition. Stunting, wasting, and underweight are growth disorders in children under five years of age due to malnutrition or malnutrition. Based on the results of basic health research in 2018, the prevalence of stunting problems among toddlers was 30.79%, the prevalence of wasting was 10.19%, and the prevalence of underweight was 17.68%.[5] Based on the Indonesian National Nutrition Status Survey results in 2019, the prevalence of stunting was 27.7%; in 2021, it was 24.4%, while in 2022, stunting in under five children experienced a decrease of 2.8%, so that the stunting rate in 2022 was 21.6%. There are 18 provinces with high prevalence (30-40%), and according to 2021 SSGI data, the prevalence of stunting in West Java Province has reached 24.5%, slightly above the national average stunting rate of 24.4%.[6]

Stunting is a condition of failure to thrive in children under five years of age due to chronic malnutrition, especially in the first 1,000 days of life.[7] A lack of nutritional intake causes failure to thrive in children under five for a long time and the occurrence of recurrent infections, which are influenced by inadequate parenting patterns, especially in the first thousand days of life. Wasting is an important health problem because it is closely related to the incidence of mortality and morbidity due to acute malnutrition, which is characterized by significant weight loss (WAZ).[8] The level of intake of macro-and micronutrients is a risk factor that directly influences stunting and wasting is the level of intake of macro and micronutrients.[9]

Household food insecurity is increasingly recognized as a global health problem, particularly in sub-Saharan Africa and ASEAN.[10,11] ASEAN countries face constraints in terms of limited agricultural resources and land degradation, which pose significant challenges to food production and sustainability.[11] Food insecurity is an important, but often overlooked, factor that affects people's health. Individuals who are food insecure are susceptible to illnesses due to micronutrient deficiencies. Food insecurity is associated with poverty, malnutrition, and hunger. Hunger is an uncomfortable or painful sensation that is caused by insufficient food intake. The lack of adequate nutrition is caused by poverty.[12] To date, no study has simultaneously measured chronic and hidden hunger and its relationship with household food insecurity in Indonesia. This study aims to address this gap by providing a comprehensive analysis of the problem. Indonesia faces a significant challenge in addressing hunger and malnutrition. The findings of this study will provide valuable insights into the extent of the problem of hunger and malnutrition in Indonesia. This study is novel in its approach to measuring chronic and hidden hunger simultaneously and its focus on the relationship between hunger and food insecurity at the household level. The findings of this study will be of significant value to the government, policymakers, and other stakeholders working to address hunger and malnutrition in Indonesia.

Objective

Therefore, it is important to understand the relationships between these variables. This research aims to analyze a multivariate model of food insecurity at the household level and chronic hunger among stunted and non-stunted children in the city of Tasikmalaya.

Method

This study used a comparative cross-sectional study design. The population in this study was toddlers aged 2-5 years in the Karanganyar sub-district, Kawalu District, as the area with the highest prevalence of stunting (26.42%) had 822 toddlers. The sample size was determined using the Lemeshow formula (1991) and 68 people for the stunting group and 68 people for the non-stunting group, respectively. Thus, a total of 136 people (+10% dropout) were included, so the total number of samples needed was 142. Proportional stratified random sampling was used. Inclusion Criteria: 1) Respondents are mothers with toddlers; 2) Is a toddler in healthy condition; 3) Stunting toddlers for the first group and non-stunting toddlers for the comparison group; 4) Willing to become a research respondent by signing informed consent. Exclusion

Criteria: Toddlers experiencing infectious diseases, such as: diarrhea, typhus, tuberculosis, fever, at the time of data collection.

The data collected included socioeconomic characteristics, food insecurity, macronutrient intake, food diversity, parenting patterns for toddlers, access to health services, and anthropometric data (wasting, underweight, and stunting). Food insecurity at the household level was measured using the Food Insecurity Experience Scale (FIES) questionnaire.[13,14] Data on respondents' food intake were collected through interviews with respondents using the 2 × 24 h food recall method. Data on parenting patterns of toddlers were measured using a parenting style questionnaire adopted from CEBU-RSUP Dr. Sardjito Yogyakarta. This questionnaire has been used in research by Masita *et al*. (2018)[15] and has been tested for validity and reliability. Data on access to health services were measured using a questionnaire consisting of 4 questions containing distance, travel time, and ease of transportation.[16] Food diversity intake data were measured using the IDDS (Individual Dietary Diversity Score) method with the help of a 24-hour recall form. Body weight was measured using Omron brand scales with an accuracy of 0.1 kg for two repetitions. For height, a Metritis brand stadiometer was used.

Data analysis consisted of data preparation, editing, and cleaning. The data preparation consisted of building a file structure for data entry. Data editing will be performed if there is a discrepancy between the contents of the questionnaire and the data entry file. Data cleaning was performed using the extreme data. Quantitative data were processed and analyzed using the IBM Statistical Package for Social Sciences (SPSS) program. Descriptive and inferential statistics were used to analyze the data. Descriptive analysis included the following: (1) basic statistical estimates (mean and standard deviation) for all quantitative variables and (2) estimate proportions for all categorical variables. Univariate analysis was used to describe the frequency distribution of independent variables, dependent variables, and descriptions of respondent characteristics. Bivariate (non-parametric) analysis is used to answer Objective 3, namely, testing the relationship between the independent variable and the dependent variable using the chi-square test or Fisher Exact Test/Continuity Correction because it uses categorical data. Logistic regression was used to analyze the factors that influenced the determinants of stunting.

Results

Table 1 shows that more toddlers are aged 36 - 47 months (38%). Most of the toddlers were female (52.1%). More often than not, toddlers are not their first children (76.1%). Most toddlers did not have a history of worms (97.9%). Based on the characteristics of the mother's age, the majority is in the range of 26 – 35 years which is included in the early adulthood category (44.4%). The highest number of mothers' last education was elementary school (48.6%), with the highest income level being low income or below the minimum wage (69%).

Table 1: Frequency Distribution of Mother and Toddler Characteristics (n=142)

Variables	n	%
Toddler Ages (month)		
24 – 35	49	34.5
36 – 47	54	38.0
48 – 59	39	27.5
Gender		
Male	68	47.9
Female	78	52.1
The first child		
Yes	34	23.9
No	108	76.1
Mother’s Age (Years)		
17 – 25 (late teens)	22	15.5
26 – 35 (early adulthood)	63	44.4
36 – 45 (late adulthood)	47	33.1
> 45 (elderly)	10	7.0
Mother's Education		
Didn't finish elementary school	1	0.7
Elementary school	69	48.6
Junior high school	42	29.6
Senior high school	30	21.1
Family Income		
Low (< MSE)	98	69.0
High (≥ MSE)	44	31.0

Table 2 shows that the most food insecurity falls into the moderately vulnerable category (27.5%). The secure category is (28.9%), while the vulnerable category is (27.5%). Most food diversity falls into the

medium category (44.4%). The high category was (33.1%), while the low category was (22.5%). Most toddlers have low energy intake (58.5%). Based on carbohydrate intake, most were in the deficient category (55.6%), fat intake in the deficient category was (50%), and protein intake was mostly in the normal category (88%).

Table 2: Bivariate Analysis Nutritional Status Toddler (Stunting and Non-Stunting)

Variables		Toddler				Total		P Value	OR (95% CI)
		Stunting		Non-Stunting					
		n	(%)	n	(%)	n	(%)		
Food Insecurity									
1	Vulnerable	23	59	16	41	39	100	0,007	-
2	Moderate vulnerable	36	58,1	26	41,9	62	100		
3	Secure	12	29,3	29	70,7	41	100		
Food Diversity									
1	Low	23	71,9	9	28,1	32	100	0,016	-
2	Medium	26	41,3	37	58,7	63	100		
3	High	22	46,8	25	53,2	47			
Energy Intake									
1	Less	49	59	34	41	83	100	0,029	-
2	Normal	12	33,3	24	66,7	36	100		
3	More	10	43,5	13	56,5	23	100		
Carbohydrate Intake									
1	Less	47	59,5	32	40,5	79	100	0,019	-
2	Normal	9	30	21	70	30	100		
3	More	15	45,5	18	54,5	33	100		
Protein Intake									
1	Less	22	66,7	11	33,3	33	100	0,029	2,449 (1,083-5,540)
2	Normal	49	45	60	55	109	100		
Fat Intake									
1	Less	43	60,6	28	39,4	71	100	0,042	-
2	Normal	10	40	15	60	25	100		
3	More	18	39,1	28	60,9	46	100		
Access Health Services									
1	Difficult	18	75,0	6	25,0	24	100	3,679	1,364 (1,364-9,927)
2	Easy	58	44,9	65	55,1	118	100		
Wasting Status									
1	Yes	9	64,3	5	35,7	7	100	0,260	-
2	No	62	48,4	66	51,6	135	100		
Underweight Status									
1	Yes	27	87,1	4	12,9	31	100	0,000	10,278 (3,365-31,402)
2	No	44	39,6	67	60,4	111	100		
Mother's Parenting Style									
1	Not Good	22	75,9	7	24,1	29	100	0,004	4,105 (1,622-10,387)

2	Good	49	43,4	64	56,6	113	100		
Mother's Nutrition Knowledge									
1	Not Good	61	55,5	49	44,5	110	100	0,027	2,736 (1,186-6,323)
2	Good	10	31,3	22	68,8	32	100		

Logistic regression modeling was carried out to determine the most dominant variables associated with the incidence of stunting in toddlers, which was carried out in stages:

Selection of Model Candidates

The selection of candidate variables included in the model was carried out using bivariate analysis of each independent variable and dependent variable. Variables were entered into variable modeling with a p-value of ≤ 0.25.

Based on Table 3, food insecurity, food diversity, energy intake, fat intake, carbohydrate intake, protein intake, underweight, maternal parenting patterns, and maternal nutritional knowledge are included in the multivariate model.

Table 3: Results of Bivariate Analysis of Independent Variables with Dependent Variables

Variables	P value	Multivariate Candidate
Food Insecurity	0,007	Included in modeling
Food Diversity	0,016	Included in modeling
Energy Intake	0,029	Included in modeling
Fat Intake	0,042	Included in modeling
Carbohydrate Intake	0,019	Included in modeling
Protein Intake	0,047	Included in modeling
Access Health Services	0,014	Included in modeling
Wasting	0,441	Not included in the modeling
Underweight	0,000	Included in modeling
Mother's Parenting Style	0,004	Included in modeling
Mother's Nutrition Knowledge	0,027	Included in modeling

Multivariate Modeling of Factors Causing Stunting Events

The variables included in the candidate model were then analyzed simultaneously with the dependent variable. Variables with a p-value > 0.05 will be removed in stages starting from the variable with the largest value so that the variables that will enter the next model are variables with a p-value ≤ 0.05.

Based on the analysis of the four models in table 4, an explanation of the factors related to the incidence of stunting: Food insecurity appears consistently as a significant risk factor for stunting across all models. Toddlers in food insecure households are more likely to experience stunting. Underweight is also a significant factor in Models 1 and 3, suggesting a link between a mother's nutritional status and her child's growth. Mother's parenting style emerges as a significant factor in Models 1, 3, and 4, highlighting the potential influence of parenting practices on child development. Food diversity, energy intake, protein intake, access to health services, and mother's nutritional knowledge (included in Model 2) did not show a significant association with stunting in this study. This may be due to specific characteristics of the population studied or require further investigation. Carbohydrate intake appears significant in Model 4, but not in others. This inconsistency warrants further exploration

Table 4: Results of Multivariate Model Analysis of Stunting Incidence

No	Variables	Multivariate Model 1	Multivariate Model 2	Multivariate Model 3	Multivariate Model 4
1	Food insecurity	0,034	0,034	0,026	0,024
2	Food diversity	0,580	0,569	-	-
3	Energy intake	0,518	0,384	0,356	-
4	Fat Intake	0,731	-	-	-
5	Carbohydrate intake	0,077	0,077	0,064	0,023
6	Protein Intake	0,235	0,135	0,134	0,139
7	Access Health Services	0,085	0,074	0,056	0,060
8	Underweight	0,000	0,000	0,000	0,000
9	Mother's parenting style	0,000	0,000	0,000	0,000
10	Mather’s nutritional knowledge	0,089	0,088	0,092	0,068

Table 5: OR Changes

Variables	Exp(B) 1	Exp(B)2	OR Changes
Food insecurity	1,891	1,892	0,056
Food diversity	1,189	1,195	0,503
Energy intake	1,238	1,298	4,841
Fat Intake	1,107	-	-
Carbohydrate intake	1,650	1,650	-0,031
Protein Intake	1,969	2,149	9,149
Access Health Services	2,954	3,052	3,312
Underweight	11,264	11,391	1,121
Mother's parenting style	7,479	7,567	1,175
Mother’s nutritional knowledge	2,556	2,567	0,443

Table 6: Final Model of Multivariate Analysis of Stunting Incidents in Toddlers

No	Variables	β	p-value	aOR	95% CI
1	Food Insecurity	-	0,002	-	-
2	Energy Intake	-	0,020	-	-
3	Protein Intake	-2,196	0,009	0,111	0,022-0,571
4	Carbohydrate intake	-	0,005	-	-
5	Underweight	2,922	0,000	18,572	4,617-74,715
6	Mother’s nutritional knowledge	1,475	0,008	4,373	1,459-13,101

Final Model Preparation

Based on Table 6, it is known that the variables food insecurity, energy intake, protein intake, carbohydrate intake, underweight, and maternal nutritional knowledge have a significant relationship with the incidence of stunting in toddlers. These results also showed that the underweight variable was the most dominant cause of stunting because it had the highest OR value of 18.572. The OR value showed that underweight toddlers were 18.572 times more likely to have a stunting nutritional status.

Discussion

Poverty and food insecurity are basic determinants of malnutrition, including stunting. At the household level, food insecurity, poor parenting patterns,

unhealthy environments, and lack of access to health services are direct causes that are influenced by basic causes, and in turn, influence direct causes at further levels. Many factors influence the food insecurity of Sub-Saharan African households, whose pattern is almost the same as in Indonesia, namely the gender of the head of the household; age, educational status, household size, income, poverty and food prices are the main determining factors proven to influence household food security status and cause malnutrition in children.[17] It is generally understood that food insecurity is related to several factors, namely the unavailability of food in sufficient quantities of appropriate quality, lack of access to nutritious food, lack of clean water, poor environmental sanitation, and inadequate access to health services.[18,19]

Immediate causes at the next level are inadequate food intake, infections, and diseases that can affect food utilization. All these factors ultimately determine an individual's nutritional status and the extent to which they suffer adverse health impacts from chronic or hidden hunger. The main factor in the occurrence of stunting in toddlers is inadequate nutritional adequacy in the long term, which is exacerbated by infectious diseases that occur continuously.[20] Disturbed linear growth can be caused by the body's adaptation to low intake, resulting in inadequate nutritional adequacy, which can then disrupt the body's metabolism and hamper cell or tissue formation.[21]

Energy and protein consumption are factors that directly influence the nutritional status of toddlers. A continuous lack of energy and protein intake can cause a decrease in the body's immunity and damage to the mucosa, which can lead to several disease incidents.[22] Inadequate food intake associated with skipping meals and increased nutritional requirements in children aged 5 years are the reasons for the high chance of disease in this group.[23] Body health can be influenced by the level of nutrient consumption in food with high-quality dishes. The quality of the dish shows the respective amounts of all nutrients, so that the quality and quantity will lead to the best nutritional health conditions and adequate consumption. On the other hand, inadequate consumption can have an adverse impact, causing a decline in health and malnutrition, and can affect a person's nutritional status, so it can have implications for underweight nutritional status in toddlers.[24]

Nutrient consumption can affect the nutritional status of toddlers.[25] Toddlers with sufficient levels of energy and protein consumption and meeting the body's needs will have good nutritional status, while toddlers with low energy and protein intake will have an impact on chronic energy deficiencies and protein energy deficiencies that will occur. Barriers to the growth and cognitive development of toddlers. An imbalance in the level of consumption of macronutrients such as energy, carbohydrates, fat, and protein to the body's needs over a long period of time can influence changes in tissue and body mass which will result in weight loss (underweight) and if the low consumption level lasts for a long time it will increase the risk of stunting.[26,27]

Underweight in children might indicate a nutritional problem that reflects both wasting and stunting.[28] Stunting, which is based on a child's height and age, is a measure of chronic nutritional deficiency. Wasting, which is based on a child's weight and height, is a measure of acute nutritional deficiency. Underweight, based on weight and age, is a composite measure of both the acute and chronic status. Nutritional deficiencies are complex and can have several adverse effects including stunted growth.[29] Food insecurity, underweight, and the mother's parenting style are important factors that can influence a child's growth and development.[30–32] Comprehensive interventions to address stunting and wasting need to consider these factors. Mothers play an important role in preventing stunting in childhood, especially during the "golden phase". This phase begins even before conception and continues throughout the child's early development. Focusing on a mother's nutrition before pregnancy helps prepare her body for optimal fetal development during pregnancy and remains important for a child's growth throughout infancy, toddlerhood, and adolescence.[33] Social, economic, and food assistance (such as the Family Hope Program, Non-Cash Food Assistance, Food Fortification Program, and Community-Based Total Sanitation Program) from the government is one of the efforts to prevent food insecurity and stunting.[34–37] However, there are still some challenges that need to be addressed to improve the effectiveness of the program.

However, there were limitations to the study, particularly in the assessment of food intake variables. The respondents had difficulty answering and remembering the food or drinks consumed by their children, especially in converting the amount of food consumed from household size to grams. However, the researchers still tried to maintain the validity of the data by using a conversion tool to convert household size to grams.

Conclusion

Variables such as food insecurity, energy intake, protein intake, carbohydrate intake, underweight status, and maternal nutritional knowledge were significantly associated with the prevalence of stunting among toddlers. Among these, underweight emerged as the most influential factor contributing to stunting, as evidenced by its highest Odds Ratio (OR) value. Toddlers categorized as underweight face an 18.572 times higher likelihood of experiencing stunting in their nutritional status. It is recommended that the government take proactive measures to enhance food security across regions, ensuring that households have consistent access to ample food supply. This initiative aims to enable individuals to fulfill their energy, carbohydrate, and protein requirements. Moreover, there is a need to enhance maternal nutritional knowledge to prevent toddlers from experiencing underweight. If left unaddressed over the long term, underweight conditions can lead to stunting of toddlers.

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Conflict of Interest

The authors declare no conflict of interest.

Authors' Contribution

Iseu Siti Aisyah: research concept, collecting data, and writing the research results section.

Ali Khomsan: research concept, drafting the manuscript, and writing the discussion section.
Ikeu Tanziha: research concept, analyzing data, and writing method section.
Hadi Riyadi: research concept, interpreted the data, and translated the manuscript into English.

Ethics Statement

This research has received approval from the IPB University Ethical Commission with number: 855/IT3.KEPMSM-IPB/SK/2023.

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