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Stunting Reduction Policy Targets in The Community: Does Dietary Diversity Matter?

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ABSTRACT
The prevalence of stunting in children under five remains a global and national public health challenge. Although various policies have been targeted to reduce stunting cases in the community, dietary diversity plays a key role in determining the quality of children's nutritional intake and preventing chronic malnutrition. Information on what dietary diversity is important is needed so that appropriate stunting reduction policy targets can be determined. This study aims to determine the relationship between dietary diversity and the dominant factors associated with the prevalence of stunting. The study design used correlation analysis with a cross-sectional approach. The study population was all children under five and families in stunting locus villages in the UPTD Trawas Health Center area of Mojokerto Regency, totaling 1734 people. Sampling was carried out using proportional cluster sampling with a total of 315 people. Data were obtained through a dietary diversity questionnaire measured by the DDS, and stunting incidence was measured by the Height/Age index (HAZ). Bivariate analysis used chi-square, and multivariate analysis used multiple logistic regression. The results showed a relationship between dietary diversity and stunting (P 0.001, OR 6.532, CI 3.158-13.510). There was an association between consumption of vitamin A-rich fruits and vegetables (P 0.037, OR 4.221), meat and fish consumption (P 0.002, OR 5.101), egg consumption (P 0.039, OR 4.145), and milk consumption (P 0.048, OR 1.938) and stunting in children under five. Meat and fish consumption were the dominant variables influencing stunting (P 0.020, AOR 4.205). This study recommends that policymakers, particularly the Ministry of Health, prioritize dietary diversity in efforts to reduce stunting, with a primary focus on ensuring adequate animal protein intake.

INTRODUCTION

Stunting in children under five is a serious problem focused on in the Sustainable Development Goals (SDGs) and a global public health challenge in the 21st century. SDG 2 aims to end all forms of malnutrition, including addressing stunting in children under five by 2030, but this target has not been met globally (1). Although various policies have been targeted to reduce stunting in the community, dietary diversity plays a key role in determining the quality of children's nutritional intake and preventing chronic malnutrition. Stunting reduction policies often focus solely on food quantity or calories, rather than on nutritional quality and completeness. This raises the urgency of examining whether the Dietary Diversity Score (DDS) is a more accurate determinant of malnutrition in children under five (2).

Nutritional issues contribute to more than one-third of all deaths among children under five globally. UNICEF reported that in 2022, 22.3% of children under five were stunted (3). The Southeast Asian region contributes more than a quarter of the number of children experiencing stunting worldwide (4). The results of the 2018 Riskesdas showed that 30.8% of children under five still experienced stunting (5). One of the nutritional problems faced by several developing countries is the lack of dietary diversity (6). Rural areas in the Trawas Community Health Center

UPTD area, Mojokerto Regency, were designated as stunting locus villages because they were villages with the highest stunting rates (11.5%), thus becoming the focus of stunting management in Mojokerto Regency (7). The results of observations on January 7, 2026, in Sukosari Village, Trawas, Mojokerto Regency, on children under five with stunting, found that the majority of children under five ate rice and vegetable soup/soy sauce only, minimal fruit and animal protein, and the menu was dominated by fried foods and flour. These observations indicate a lack of dietary diversity and nutritional quality in the diets of stunting.

Inadequate dietary diversity impacts nutritional quality and can lead to inadequate daily nutrient intake. This inadequate nutrient intake inhibits growth and triggers malnutrition, which increases the risk of stunting (6,8). Stunting negatively impacts morbidity and mortality among children under five. Children under five are at greater risk of developmental delays and an increased risk of infectious and non-communicable diseases (9). Poor dietary diversity and malnutrition compromise children's growth. Children with growth disorders, such as stunting, are more likely to have poor cognitive abilities and educational achievement, lower economic status, and an increased risk of nutrition-related chronic diseases in adulthood (8,10). Stunting is associated with impaired linear growth, cognitive deficits, gut dysbiosis, endocrine disorders, anemia, and an increased risk of chronic diseases later in life (11). Childhood stunting has long-term consequences; its impact not only persists throughout life but also passes short stature down through generations (12).

Increasing dietary diversity among children is necessary to reduce the risk of malnutrition (12). Evidence linking dietary diversity to the incidence of stunting in villages designated as stunting locus remains limited. Stunting intervention efforts are often delayed because many underlying causes were previously unknown (13). Previous research in Trawas District, Mojokerto Regency, indicated that dietary intake was the dominant factor associated with stunting. Limitations in earlier studies, which focused primarily on food quantity while overlooking nutrient variety, coincided with persistently high stunting prevalence (14). Given the urgency of addressing stunting, policy targets must be effective and precisely aimed. Therefore, analyzing dietary diversity among stunted children is considered necessary to support SDG 2 goals through targeted nutrition policies for stunting (2). This study aims to analyze the relationship between dietary diversity, dominant factors, and the prevalence of stunting in designated stunting locus villages in Trawas District, Mojokerto Regency. This research serves as a follow-up study to assess intake quality specifically by measuring nutritional adequacy rather than mere satiety using the Dietary Diversity Score (DDS). The findings are expected to refine policies and intervention strategies aimed at reducing stunting among children under five, particularly in areas identified as stunting locus.

METHODS

Research Design

The study used correlation analysis with a cross-sectional approach. The study population was all 1.734 children under five in the Trawas Community Health Center (UPTD) area, Mojokerto Regency, East Java, Indonesia. Proportional cluster sampling was used. The sample size was calculated using the Lemeshow formula with a 5% margin of error (e). The sample size consisted of 315 children under five and their families in the Trawas Community Health Center (UPTD) area, Mojokerto Regency. Next, six villages identified as stunting loci were randomly selected for the study, comprising a total of 746 children under five. Subsequently, the proportion of the sample size per village was calculated: 82 respondents for Trawas Village, 53 respondents for Tamiajeng

Village, 35 respondents for Belik Village, 79 respondents for Penanggungan Village, 24 respondents for Sugeng Village, and 42 respondents for Seloliman Village. The total sample size was 315 respondents.

Data Collection

All research teams conducted a consensus meeting before data collection. Data collection was conducted directly (primary data). Questionnaire A included questions on age, gender, family income, and maternal education. Questions on age included the child's age in months. Gender was categorized as male or female. Family income was asked about the average monthly family income. Maternal education was asked about the formal education completed by the mother.

Questionnaire B consists of a dietary diversity questionnaire comprising nine questions. Dietary consumption quality was assessed using the Dietary Diversity Score (DDS) approach. The questionnaire utilized the FAO-developed DDS tool, administered via a single 24-hour dietary recall. Dietary diversity was calculated based on the consumption of nine food groups: starchy staples; green leafy vegetables; vitamin A-rich fruits and vegetables; other fruits and vegetables; organ meats; meat and fish; eggs; legumes, nuts, and seeds; and milk and dairy products. The specific food items within these nine categories were adapted to reflect local dietary habits. A pilot study of the dietary diversity questionnaire was conducted with ten families having children under five in Sukosari Village, Trawas District, Mojokerto Regency, as the village shared similar characteristics with the study site. Validity test results indicated that all questions were valid (calculated r > table r).

The dietary assessment instrument demonstrated reliability, with a Cronbach's alpha value of 0.821. The DDS was calculated by assigning a score of 1 if a food item was consumed in a quantity of one tablespoon or more, and a score of 0 if the amount was less (i.e., <10 grams). Scores across all food groups were then summed, resulting in a range of 0 to 9. The DDS was categorized into two groups: scores ≥ 6 (good) and scores < 6 (poor). A higher score indicates greater dietary diversity (Fayasari, 2020). Stunting incidence was measured based on the Ministry of Health's (2020b) height-for-age (TB/U) anthropometric standards. Height measurements for children under five were taken using a length or height measuring device with 0.1 cm precision, featuring a tape that could be easily extended and retracted to its original position.

Data Processing

The collected data were processed using IBM SPSS Statistics 25. Univariate analysis was performed to describe the research variables, including children under five years of age, gender, family income, dietary diversity, and stunting incidence. The results of the variable analysis were presented using categorical data, namely frequencies and percentages. Children under five age were categorized by year in months. Gender was categorized as male and female. Family income was categorized using the Mojokerto Regency Regional Minimum Wage (RMW) standard, categorized as high and low. Maternal education was categorized as primary education (SD-SLTP) and secondary-higher education (SLTA-PT). Dietary diversity was categorized as a score of ≥ 6 (good) and a score of <6 (less). Measurement of stunting prevalence (Height/Age) based on the Ministry of Health's anthropometric standards was categorized as <-2 standard deviations (stunting) and ≥-2 standard deviations (non-stunting).

Bivariate analysis using the Chi-Square test was conducted to determine the relationship between dietary diversity and stunting prevalence. The Odds Ratio (OR) was used with a 95% confidence interval (CI) and a significance level of P < 0.05. Bivariate analysis using the chi-square

test was conducted to determine the incidence of stunting in children under five as the dependent variable based on its relationship with the independent variables. The OR was used with a 95% confidence interval (CI) and a significance level of $P < 0.05$.

Next, a multivariate analysis was conducted to determine the most significant and dominant relationship between dietary diversity and stunting using multiple logistic regression. Multiple logistic regression was conducted by selecting variables deemed important for inclusion in the model. If a variable in the multivariate model had $P > 0.05$ and a change in the OR value < 10%, then that variable should be removed from the model gradually, starting with the highest p-value. The results are presented as adjusted odds ratios (OAR) and 95% confidence intervals (CI). Subsequently, interaction testing and final multivariate modeling were conducted. Based on the study's multivariate analysis results, the variables retained and selected for the final model were meat and fish consumption and egg consumption, whereas the variables for vitamin A-rich fruits and vegetables were excluded from the final model.

Ethics

The study received ethical approval from the Ethics Committee of Universitas Bina Sehat PPNI Mojokerto (Approval No. 199/KEP/UBS-PPNI/VI/2026).

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RESULTS

Table 1. Characteristics of Respondents in Trawas District, Mojokerto Regency (n=315)

Respondent Characteristics	n	%
Age		
6-24 months	39	12.4
25-59 months	276	87.6
Gender		
Female	153	48.6
Male	162	51.4
Family Income		
Low	174	55.2
High	141	44.8
Education		
Primary	26	8.3
Intermediate-High	289	91.7
Dietary Diversity		
Good	88	27.9
Less	227	72.1
Stunting Prevalence		
Stunting	38	12.1
Not Stunting	277	87.9

Data Source: Primary Data, 2026

Based on Table 1, the characteristics of children under five are found to be mostly between the ages of 25-59 months (87.6%), male (51.4%), low family income (55.2%), and maternal education level of secondary to higher (91.7%). Dietary diversity is mostly low (72.1%). Meanwhile, the prevalence of stunting in Trawas District, Mojokerto Regency in 2026 was 12.1%

Table 2. Bivariate and Multivariate Analysis of Dietary Diversity and Stunting Prevalence in Children Under Five (N=315)

Variable	Prevalence of Stunting				Bivariate Analysis			Multivariate Analysis		
	Stunting		Non Stunting		OR	CI	P value	AOR	CI	P value
	n	%	n	%						
Dietary Diversity										
Good	5	5.7	83	94.3	6.532	3.158 - 13.510	0001			
Less	33	14.5	194	85.5						
Types of Food Variety:										
Starch Staple Food										
Good	23	11.0	186	89.0	0.750	0.374 - 1.506	0.531			
Less	15	14.2	91	85.8						
Green Vegetables										
Good	19	10.8	156	89.2	0.972	0.543 - 1.965	0.083			
Less	17	12.2	123	87.8						
Fruits and vegetables are rich in vitamin A										
Good	24	23.1	80	76.9	4.221	2.079-8.573	0.037	1.672		
Less	14	6.6	197	93.4						
Other Fruits and Vegetables										
Good	21	13.0	140	87.0	2.029	0.612-2.390	0.709			
Less	17	11.0	137	89.0						
Innards										
Good	20	11.4	155	88.6	0.875	0.433 - 1.725	0.832			
Less	18	12.9	122	87.1						
Meat and Fish										
Good	21	28.0	54	87.0	5.101	2.520 - 10.326	0.002	4.205	0.452 - 9.156	0.020
Less	17	7.1	223	89.0						
Egg										
Good	22	24.2	69	75.8	4.145	2.060 - 1.865	0.039	2.769	0.092 - 6.403	0.037
Less	16	7.1	208	92.9						
Legumes, nuts, and seeds										
Good	17	9.5	162	90.5	0.575	0.290 - 1.137	0.153			
Less	21	15.4	115	84.6						
Milk and milk products										
Good	14	8.7	147	91.3	1.938	0.963 - 3.904	0.048			
Less	24	15.6	130	84.4						

Data Source: Primary Data, 2026

Table 2 in the bivariate analysis shows that children under five with good dietary diversity are less likely to experience stunting (94.3%). There is a relationship between dietary diversity and the incidence of stunting (P 0.001, OR 6.532, CI 3.158-13.510). Meanwhile, the results of the study on the type of food variety found a relationship between the consumption of fruits and vegetables rich in vitamin A (P 0.037, OR 4.221), consumption of meat and fish (P 0.002, OR 5.101), consumption of eggs (P 0.039, OR 4.145), and consumption of milk (P 0.048, OR 1.938) with the incidence of stunting in children under five. The final modeling of the multivariate test showed a

relationship between the consumption of meat, fish (P = 0.020), and eggs (P = 0.037) with the incidence of stunting in children under five. Meanwhile, starchy staple foods, fruits and vegetables rich in vitamin A, other fruits and vegetables, offal, legumes/nuts/seeds, and milk were confounding variables. Meat and fish consumption is a dominant variable associated with stunting (p = 0.020). After controlling for egg intake, stunted children under five with inadequate meat and fish intake had four times higher odds (AOR 4.205) of being stunted compared to those with adequate meat and fish intake.

DISCUSSION

Dietary Diversity

Research results show that the majority of children under five years old's dietary diversity is insufficient (72.1%). Low dietary diversity has a very strong causal relationship as one of the main triggers of stunting in children under five. Low dietary diversity is strongly linked to the incidence of stunting in children under five, serving as one of the primary triggers. Children under five are recommended to consume at least six types of food daily. Dietary diversity is calculated based on the presence of nine food groups: starchy staple foods, green vegetables, fruits and vegetables that are sources of vitamin A, other fruits and vegetables, organ meats, meat and fish, eggs, legumes, nuts and seeds, and milk and milk products (15). Dietary diversity is crucial for reducing stunting and achieving the global nutrition target of being stunting-free by 2030 (16).

Dietary diversity is a nutritional indicator positively associated with diet quality, micronutrient adequacy, and child growth (17). Dietary diversity is one of the factors associated with the occurrence of nutritional problems (18). Research in rural Bangladesh indicates a low average dietary diversity, with an average DDS of 3.7, and 40% of children under five suffer from stunting (19). Observations at the study site revealed that the average children under five consumed 3-4 types of diverse foods, ate only rice and vegetable soup/soy sauce, rarely ate fruit, and consumed little animal protein, with a menu dominated by fried foods and carbohydrates. This lack of dietary diversity is a predictor of stunting. The less diverse the diet, the lower the nutritional quality, and the higher the risk of stunting.

Lack of dietary diversity in children under five results in chronic deficiencies in essential micronutrients (vitamins and minerals) and animal protein. This condition triggers "hidden hunger," where the child appears full from a carbohydrate-calorie perspective, but their body cells and bones suffer from severe malnutrition that halts linear growth (stunting). Inadequate vitamin and mineral intake, poor dietary diversity, and a lack of animal protein are all causes of stunting (20). Increasing children's dietary diversity is needed to reduce the risk of malnutrition (12). High malnutrition, especially stunting in rural areas, is associated with an increased need for dietary diversity at the age of 2 years, so healthy eating patterns need to be instilled from childhood (19).

Stunting

The study results showed a stunting prevalence of 12.1%. This prevalence is higher than the stunting prevalence at the Trawas Community Health Center (7) and the stunting prevalence in Mojokerto Regency (21). The occurrence of stunting is related to age. The study showed that the majority of respondents were aged 24-59 months (87.6%). This aligns with the results of a study by Permanasari et al. (2021), which stated that symptoms of stunting are most evident at 24 months of age. Risk factors for severe stunting are more prevalent in older children (23). Children aged 24-59 months are at higher risk of stunting than those aged 0-23 months. Child age (AOR 0.250, 95% CI 0.104-0.598, P 0.002) is associated with stunting in children under five (24).

The risk of severe stunting is more frequently detected and clearly visible in older children (24-59 months) because stunting is a manifestation of chronic (long-term) malnutrition, the effects of which accumulate over time.

The risk of stunting is associated with male gender. The characteristics of the study respondents showed a higher prevalence of stunting in boys than in girls (51.4% vs. 46.6%). Risk factors for severe stunting are higher in boys. Boys are more susceptible to infection and malnutrition (25,26). Male children under five tend to be more physically active, enjoy exploring, and play outdoors or on the floor/ground. This high level of outdoor activity increases the risk of infections such as acute respiratory infections (ARI), diarrhea, and parasitic worm infestations which are associated with impaired nutrient absorption and the risk of stunting.

The risk of stunting is associated with low socioeconomic status. The characteristics of respondents in the study showed a higher prevalence of stunting in low-income families (below the minimum wage), at 55.2%. This is consistent with previous research that found risk factors for severe stunting are associated with lower wealth quintiles (27–29). Children living in rural areas and poor households are particularly vulnerable to stunting (30). Low income is associated with stunting because it limits a family's ability to meet the basic needs for a child's growth and development. This condition limits families' purchasing power to meet balanced nutritional intake, hinders access to clean water, proper sanitation, and adequate health care services for mothers and children.

The Relationship Between Dietary Diversity and Stunting Prevalence

The results of this study indicate that children under five with a good diet are less likely to experience stunting (94.3%). There is a relationship between dietary diversity and stunting (P 0.001, OR 6.532, CI 3.158-13.510). This is consistent with previous research that found a relationship between dietary diversity and stunting. Stunting in children is related to the quality of the diet obtained from the diversity of foods consumed (31–34). Research by Prasetyo et al. (2023) also suggests that lower dietary diversity scores are found in children under five experiencing malnutrition. Micronutrient deficiencies are caused by inadequate dietary intake and increased needs. This condition is particularly relevant for children under five because they are in a growth and development phase, thus having varying nutritional needs. Providing a variety of foods will help meet all the nutritional needs of children under five, as no single food contains all nutrients.

The study also found that there was a relationship between the consumption of vitamin A-rich fruits and vegetables (P 0.037, OR 4.221), meat and fish consumption (P 0.002, OR 5.101), egg consumption (P 0.039, OR 4.145), and milk consumption (P 0.048, OR 1.938) and stunting in children under five. Children require adequate protein, vitamins, and minerals to support their growth. Malnutrition in children under five is directly caused by children not receiving sufficient, balanced nutrition (35). The absence of dairy products, eggs, fruits, and vegetables consistently contributes to acute malnutrition, underweight, and even severe, irreversible stunting (difficult to correct) later in life (36). The risk of stunting is higher in groups with the lowest milk and meat consumption (6). Animal-based protein (meat, fish, eggs) and vitamin A from fruits and vegetables have been shown to significantly reduce the risk of stunting. These micronutrients maintain optimal immune and metabolic systems, thus protecting children from recurrent infectious diseases that worsen nutritional status.

Dominant Factors Associated with Stunting

The results of the final multivariate modeling showed a relationship between meat and fish consumption (P 0.020) and eggs (P 0.037) and the incidence of stunting in children under five. Meanwhile, starchy staple foods, vitamin A-rich fruits and vegetables, other fruits and vegetables, organ meats, legumes/nuts/seeds, and milk were confounding variables. Meat and fish consumption is a dominant variable associated with stunting (P = 0.020).Stunted children under five with low meat and fish intake were four times more likely (AOR 4.205) to experience stunting, compared to children under five with adequate meat and fish intake, after controlling for egg intake. This finding aligns with previous research, which found that low protein consumption is associated with high stunting rates (p 0.000 < 0.05) (37). Animal-based protein is not merely a supplement but a crucial component. The essential amino acids it contains are necessary for optimizing children's linear growth and brain development (38). Policies and interventions to reduce stunting must shift from simply providing calories (carbohydrates) to providing a quality diet (balanced nutrition), specifically by increasing public access to nutrient-dense foods from animal sources and their derivatives.

This study has several limitations. The cross-sectional study design is limited by the inability to establish causal relationships and the inability to monitor the development of a phenomenon or behavior over the long term. This study utilized a questionnaire to measure dietary diversity. The questionnaire instrument has limitations, such as the subjectivity of respondents' answers, the potential for misinterpreting questions, and reliance on respondents' memory or honesty. Informed consent procedures were explained to respondents to address these limitations.

CONCLUSION

There was a relationship between dietary diversity and stunting (P 0.001, OR 6.532, CI 3.158-13.510). There was a relationship between consumption of vitamin A-rich fruits and vegetables (P 0.037, OR 4.221), meat and fish consumption (P 0.002, OR 5.101), egg consumption (P 0.039, OR 4.145), and milk consumption (P 0.048, OR 1.938) and stunting in children under five. Starchy staple foods, vitamin A-rich fruits and vegetables, other fruits and vegetables, offal, legumes/nuts/seeds, and milk were confounding variables. Meat and fish consumption were the dominant variables influencing stunting (P 0.020), followed by egg consumption (P 0.037). Stunted children under five with insufficient meat and fish intake were four times more likely (AOR 4.205) to experience stunting, compared to children under five with good fish and meat intake, after controlling for egg intake. Dietary diversity, especially consumption of animal protein such as meat, fish, and eggs, has the potential to reduce child stunting. This study recommends that policymakers specifically the Ministry of Health prioritize dietary diversity in efforts to reduce stunting, with a primary focus on the intake of animal-based protein.

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