Jambura Medical and Health Science Journal, Vol.5 No.2 (August 2026)
p-ISSN 2830-0580 | e-ISSN 2830-4608

ORIGINAL ARTICLE **Open Access**

Analysis of Determinants Related to Stunting in Toddlers in the Working Area of the Buntulia Community Health Center, Pohuwato Regency

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ABSTRACT

Introduction: Stunting is a health problem and associated with the risk of illness and death, suboptimal brain development, resulting in impaired motor and mental growth. Gorontalo Province ranks 12th out of 38 provinces, where Pohuwato District has a stunting prevalence of 18.4% among toddlers. Several variables can influence the incidence of stunting in children, including nutritional intake, infectious diseases, food availability, feeding patterns, and environmental sanitation. This study aims to assess the relationship between nutritional intake, infectious diseases, food availability, feeding patterns, and environmental sanitation with the incidence of stunting in Buntulia Community Health Center working area.
Method: The study was conducted at the Buntulia Community Health Center using quantitative methods with cross sectional approach. A sample of 272 toddlers was obtained using the Slovin formula. The data analysis used logistic regression consisting of univariate, bivariate and multivariate method.
Results: 91.2% of the toddlers did not experience stunting. Regarding individual determinants, 81.1% of the subjects had insufficient nutritional intake, while 89.3% had no history of infectious diseases. Household food security was observed in 57.4% of cases, yet 87.1% of toddlers exhibited inadequate dietary patterns. Additionally, 93.8% of respondents maintained good environmental sanitation. The results of the multivariate model revealed that nutritional intake (95% CI: 0.00) and dietary pattern (95% CI: 0.00) were significant predictors, while food availability (95% CI: 0.15) showed a broader confidence interval in relation to the incidence of stunting.
Conclusion: Only food availability are associated with stunting in the Buntulia Community Health Center working area.

Keywords: Environmental sanitation, feeding patterns, food availability, nutritional intake, stunting

JMHSJ Jambura Medical and Health Science Journal

Published by:
Universitas Negeri Gorontalo

Address:
Jend. Sudirman St. No.6, Gorontalo City, Gorontalo, Indonesia

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+62852 3321 5280

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Article History:
Received 28 September 2025
Accepted 24 March 2026
Published 11 April 2026

DOI:
https://doi.org/10.37905/jmhsj.v5i2.34584

Introduction

The 2023 Indonesian Health Survey (Survey Kesehatan Indonesia, SKI) ranked Gorontalo Province 12th out of 38 provinces in terms of stunting percentage, with a rate of 26.9%, an increase from 23.8% in the previous year. In Pohuwato District, the prevalence of stunting in toddlers also showed a significant increase, from 6.4% in 2022 to 18.4% in 2023. Children who experience stunting are generally caused by malnutrition, especially during the first 1000 days of life.[1] The factors causing stunting include direct and indirect factors, including toddler nutrition intake, infectious diseases, food availability, parenting patterns, feeding, environmental health, as well as socioeconomic factors, maternal education levels, maternal nutrition knowledge, and the environment.[2] In addition, child growth is also influenced by biological factors such as growth hormone or *human growth hormone* (HGH).[3]

Good nutritional intake can reduce the incidence of stunting in toddlers, where a diet high in animal protein is more recommended than plant protein because animal protein has better digestibility and a more complete content of essential amino acids.[4] Therefore, most of the protein consumed by toddlers should come from animal sources to support optimal growth. This is in line with previous research which concluded that energy and protein intake affect the incidence of stunting in children aged 12–36 months at the Tilango Community Health Center, Tilango District, Gorontalo Regency. [5]

Infectious diseases are a direct cause of stunting, thus proper treatment of children suffering from infectious diseases needs to take into account nutritional intake according to their needs in order to help improve their nutrition.[6] Data from the Indonesian Health Survey shows that the national prevalence of Acute Respiratory Tract Infetion (ARI) is 23.5%, with the highest rates in Papua Pegunungan (41.7%), Central Papua (39.4%), and East Nusa Tenggara (36.3%), while in Gorontalo Province the rate is 15.8%. The prevalence of ARI among toddlers has increased nearly threefold compared to the 2018 Riskesdas results, from 12.8% to 34.2%. Meanwhile, the national prevalence of diarrhea was 4.3%, with the highest rates in Central Papua (16.1%) and Papua Pegunungan (14.6%), and the lowest in Riau Islands (2.1%). The prevalence of diarrhea in children under five decreased from 12.3% to 7.4%, with Gorontalo at 9.2%. Infectious diseases are one of the risk factors for stunting (OR 9.375; 95% CI: 1.748–50.286).[1] In addition, the proportion of toddlers with a history of infectious diseases (62.9%) was higher than those without a history of infectious diseases (30.4%), indicating a significant relationship between a history of infectious diseases and stunting.[7]

Based on the previous study on household food security of stunted children aged 6–23 months in Wilangan, Nganjuk Regency, it is known that most non-stunted toddlers are in food-

secure households (75.0%), while stunted toddlers are more likely to be in food-insecure households (41.7%). This shows that food-insecure households have a higher risk of stunting than food-secure households. In addition, feeding practices were also found to have a significant relationship within stunting, where toddlers with inappropriate feeding practices were 4.61 times more likely to experience stunting than toddlers with appropriate feeding practices.[8] The study of Widyaningsih et al. and Rahim et al. also shows that most stunted toddlers (85.4%) have an unbalanced diet, dominated by energy-rich foods such as rice, noodles, and corn, with low consumption of vegetables, fruits, and milk.[7,9]

Environmental factors also contribute to stunting prevalence. Data from The Effect of Water and Sanitation on Child Health International of Epidemiology in 2007 study states that good sanitation access can reduce the prevalence of stunting by 27%.[10,11] For this reason, the government is implementing the Community-Based Total Sanitation (Sanitasi Total Berbasis Masyarakat, STBM) program, starting with the first pillar, which is to stop open defecation. Several researches proves that the implementation of STBM pillar I is associated with a decrease in stunting rates in toddlers, in line with the findings.[12-14]

Based on direct observations of anthropometric measurements of weight and height in November 2024, out of 1,068 toddlers weighed in Buntulia Subdistrict, 28 toddlers were found to be stunted (2.6%). Although the prevalence of stunting in the Buntulia Health Center working area is still below the national target of 14%, the issue of stunting in toddlers remains a focus of the Buntulia District government in Pohuwato Regency. This article aims to analyze the determinants associated with the incidence of stunting among toddlers in the service area of the Buntulia Community Health Center, Pohuwato Regency.

Methods

This study was conducted in the working area of the Buntulia Community Health Center, Buntulia District, Pohuwato Regency. All procedures of this research have been approved by the supervisor and comply with health research ethics which consist of respondent consent, confidentiality, not harming respondents and fairness. To ensure methodological transparency, the metrics and objective criteria used to measure the research variables are summarized in Table 1.

The population in this study were mothers who had children aged 6-59 months. This study used accidental sampling of mothers of toddlers at the Buntulia Community Health Center's health post, with a representative sample size calculated using the Slovin formula.[15] Regarding to the number of total population (N=850) and e value of 5%, the number of samples taken was 272 respondents.

This study employed three data analysis methods: univariate analysis, which described the incident of stunting, nutritional intake, infectious desease, food security, feeding pattern and environmental sanitation. Bivariate analysis employed the chi-square test with a 95% confidence level to ascertain the association between the incidence of stunting nutritional intake, infectious desease, food security, feeding pattern and environmental sanitation. Multivariate analysis was used to determine which factors were most strongly associated with the incidence of stunting.

Result

Table 2 shows the characteristics of respondents in this study, including demographic characteristics, namely gender and age, with 272 respondents. The majority of respondents were female, with 140 respondents (51.5%), and the minority were male, with 132 respondents (48.5%). The age group of 6-11 months had the highest number of respondents at 119 (43.8%), followed by the age group of 24-59 months with 86 respondents (31.63%), and the age group of 12-23 months had the lowest number of respondents at 67 (24.6%). The highest number of respondents who came and were weighed at the health post was in Hulawa village with 50 respondents (18.4%), while the lowest number of respondents who came and were weighed at the health post was in Karya Indah village with 27 respondents (9.9%).

Univariate analysis

Univariate analysis was conducted to determine the distribution and frequency of each variable studied, including stunting, nutritional intake, infectious diseases, food availability, feeding patterns, and sanitation, as presented in the Table 3. There were 248 toddler respondents who did not experience stunting (91.2%) and 24 toddler respondents who experienced stunting (8.8%). Furthermore, in terms of nutritional intake, 218 toddlers or 80.1% had insufficient nutritional intake and only 19.9% or 54 toddlers had adequate nutritional intake. Of the 272 respondents, 243 or 89.3% of toddlers did not have infectious diseases and only 10.7% or 29 toddlers had infectious diseases. A total of 156 toddlers (57.4%) were classified as food secure, while the remaining 116 (42.6%) were classified as food insecure. In the dietary patterns variable, 237 respondents (87.1%) had inadequate dietary patterns, while only 35 respondents (12.9%) had adequate dietary patterns. There were 255 respondents (87.1%) with good environmental sanitation (open defecation behavior), while 17 respondents (63%) had poor environmental sanitation (open defecation behavior).

Table 1. Operational definition and criteria of variables

No	Variable	Definition	Measuring Instrument	Criteria	Scale
1	Stunting	The percentage of children aged 6 to 59 months in Buntulia Subdistrict whose nutritional status, as determined by the length-for-age (LFA) or height-for-age (HFA) index, has a Z-score of less than -2 SD.[16]	a. Microtois weighing (children over 2 years old) Lengthboard (children under 2 years old)[17] b. Nutritional Status in the e-PPGBM (Community-Based Nutrition Recording and Reporting) Application.[18]	a. Stunting (2 SD to -3 sd) b. Normal (2 SD to + 3 SD.[19]	Ordinal
2	Nutrinional Intake	All types of nutrients from the food and beverages consumed daily. The nutrients measured include: energy, carbohydrates, and fat, which are then compared to the recommended dietary allowances.[20]	Interviews using a 24-hour food recall form, which was then analyzed using Nutrisurvey 2007.[21]	a. Inadequate = <80 % of the RDA b. Adequate = 80 % - 110 % of the RDA.[22]	Ordinal
3	Infectious Diseases in Toddlers	Infectious diseases that the toddler has had in	Medical Record	a. Never: if the toddler has never	Nominal

		the past 6 months (respiratory infections and diarrhea).[23]		had an infectious disease in the past 6 months b. History: if the toddler has had an infectious disease within the past 6 months	
4	Food Availability	Food security refers to the condition in which the food needs of every family member have been met over the past 12 months.[24]	US Household Food Security Survey Module (USHFSSM) Questionnaire	a. Food Secure :0-2 b. Food Insecure :3-18.[25]	Ordinal
5	Feeding Pattern	The actions taken by parents to ensure adequate nutrition from the food consumed by their children, appropriate for their age, based on the types of food consumed, the amount of	Child feeding Questionnaire (CFQ)	1= Incorrect category, if the answer score is <55% 2 = Correct category, if the answer score is 55-100%.[27]	Ordinal

		food consumed, and the children's meal schedule.[26]			
6	Environmental sanitation: Open defecation	Living conditions that include The practice of open defecation in open areas due to a lack of a toilet or having a toilet but not using it.[28]	Questionnaire	a. Poor (Open defecation, defecation in public restrooms even though there is a toilet at home) b. Good (Defecating in a toilet equipped with a septic tank and enclosed, using the toilet regularly).[29]	Nominal

RDA: Recommende dietary allowance, SD: Standard deviation

Bivariate analysis

Table 4 indicates the bivariate analysis results. Among the 248 non stunted toddlers, the majority (71.3%; n=194) had poor nutritional intake, while only 19.9% (n=54) maintained good nutrition. Notably, all stunted toddlers (100%; n=24) were characterized by poor nutritional intake. Statistical analysis using the Chi-Square test yielded a p-value of 0.011 ($\alpha < 0.05$), leading to the rejection of the null hypothesis H0. This demonstrates a significant relationship between nutritional intake and the incidence of stunting within the Buntulia

Community Health Center working area.

Table 2. Characteristics of respondents

Variable	Frequency (N=272)	Percentage (%)
Gender		
Male	132	48.5
Female	140	51.5
Age		
6-11 months	119	43.8
12-23 Months	67	24.6
24-59 Months	86	31.6
Village		
Sipatana	33	12.1
Central Buntulia	48	17.6
North Buntulia	36	13.2
Taluduyunu	45	16.5
North Taluduyunu	33	12.1
Karya Indah	27	9.9
Hulawa	50	18.4

Regarding infectious diseases, the majority of non-stunted children (81.6%; n=222) had no history of infection, compared to 9.6% (n=26) who did. Similarly, most stunted infants (7.7%; n=21) had not experienced infectious diseases, while only 1.1% (n=3) had. The Chi-Square test resulted in a p-value of 0.760 ($P > 0.05$), indicating that H0 is accepted. Consequently, there is no significant association between the history of infectious diseases and stunting incidence in this population.

Analysis of food security reveals that most non-stunted toddlers fell into the food-secure category (54.4%; n=148), while 36.8% (n=100) were food-insecure. Conversely, stunted toddlers were more prevalent in the food-insecure group (5.9%; n=16) than the food-secure group (2.9%; n=8). With a p-value of 0.013 ($p < 0.05$), the alternative hypothesis (H0) is accepted, confirming a significant relationship between food security and stunting.

In terms of dietary patterns, the majority of non-stunted toddlers had an inadequate diet (78.3%; n=213), with only 12.9% (n=35) having an adequate diet. All stunted toddlers (8.8%; n=24) were found to have an inadequate dietary pattern. The Chi-Square test produced a p-value of 0.049 ($p < 0.05$), clarifying a significant association between dietary patterns and the

occurrence of stunting in the study area.

Table 3. Univariate analysis results

Variable	Frequency (N=225)	Percentage
Incidence of Stunting		
No Stunting	248	91.2
Stunting	24	8.8
Nutritional Intake		
Good	54	19.9
Poor	218	80.1
Infectious Disease		
Never	243	89.3
Ever	29	10.7
Food Security		
Food Security	156	57.4
Food Vulnerability	116	42.6
Dietary Patterns		
Appropriate	35	12.9
Inadequate	237	87.1
Environmental Sanitation		
Good	255	93.8
Not Good	17	6.3

Finally, the data shows that both non-stunted and stunted toddlers generally had access to good environmental sanitation (85.7% and 8.1%, respectively). Only a small fraction of the total sample exhibited poor sanitation or open defecation behavior. Statistical testing yielded a p-value of 0.659 ($P > 0.05$), suggesting that there is no significant relationship between environmental sanitation (specifically open defecation behavior) and the incidence of stunting in the Buntulia Community Health Center working area.

Multivariate analysis

Multivariate analysis with logistic regression was used to determine the most dominant variable associated with stunting in toddlers in the Buntulia Health Center Working Area, through candidate selection and model creation. Before conducting multivariate analysis, bivariate analysis was first performed on each dependent variable to determine which variables would be used as model candidates to be included in the multivariate analysis (Table 5). If the

bivariate analysis resulted in *a P*-value < 0.5, the variable was included in the multivariate analysis. There were three variables with *P*-values < 0.05, namely nutritional intake (*P*=0.011), food availability (*P*=0.013), and feeding patterns (*P*=0.049). These variables will be included in the multivariate analysis.

Table 4. Determinants associated with the incidence of stunting among toddlers in the service area of the Buntulia Community Health Center, Pohuwato Regency

Variable	Stunting Incident						*P*-value	OR	95% CI	
	Stunting		Not Stunting		Total					
	N	%	N	%	N	%			Lower	Upper
1. Nutritional intake										
Good	0	0.00	54	19.9	54	19.9	0.011*	**1.27**	**1.19**	**1.36**
Insufficient	24	8.8	194	71.3	218	80.1				
2. Infectious diseases										
Ever	3	1.1	26	9.6	29	10.7	0.760	**0.82**	**0.22**	**2.93**
Never	21	7.7	222	81.6	243	89.3				
3. Food availability										
Food security	8	2.9	148	54.4	156	57.4	0.013*	**0.33**	**0.13**	**0.81**
Food insecurity	16	5.9	100	36.8	116	42.6				
4. Dietary patterns										
Appropriate	0	0.0	35	12.9	35	12.9	0.049*	**1.16**	**1.10**	**1.22**
Inappropriate	24	8.8	213	78.3	237	87.1				
5. Environmental sanitation (open defecation behaviour)										
Good	22	8.1	233	85.7	255	93.8	0.659	**1.41**	**0.30**	**6.57**
Not Good	2	0.7	15	5.5	17	6.3				

Chi-square test. CI: Confidence interval, OR: Odds ratio. *significant at *P*<0.05

Table 5. Selection of multivariate candidate variables

Variable	*P*-value	Description
Nutritional intake	0.011	Candidate entry
Food availability	0.013	Candidate entry
Dietary Pattern	0.049	Candidate entry

Simple logistic regression test. *significant at *P*<0.05

Table 6 is the final step of the *logistic regression* analysis and is the final model of the multivariate analysis. The results of the multivariate analysis show that the most closely associated variable to stunting in toddlers is food availability (*P*-value = 0.036).

Table 6. Results of logistic regression test

No	Variable	B	Sig	Exp (B)	95% Cl
1	Nutritional intake	18,756	0.997	139,792,387.808	0.000
2	Food availability	-.964	0.036*	0.381	0.155
3	Dietary Pattern	18,663	0.998	127,437,344.222	0.000

Multiple logistic regression test. B: Regression coefficient, CI: Confidence Internal, Exp(B):Odds ratio (OR) value, Sig.: *P*-value. *significant at *P*<0.05

Discussion

Based on the analysis, stunting in toddlers in the Buntulia Community Health Center working area is influenced by inadequate nutritional intake, improper and unbalanced eating patterns, and low household food availability. This condition is exacerbated by the low economic status of most respondents, who earn below the minimum wage, resulting in limited food availability and infrequent growth and development monitoring at health posts. Long-term energy and protein deficiencies cause the body to experience nutrient depletion and tissue damage, leading to stunting.[30] This study alligns with Sumarti et al.,[31] which revealed a relationship between macronutrient intake and the incidence of stunting in toddlers.

Analysis using the 24-hour food recall method over three days showed that toddlers consumed carbohydrate sources such as instant porridge, rice, noodles, and bread, with rice as the main food (1–2 times/day). The most consumed animal protein source was chicken eggs (1–2 times/day), while plant-based protein sources included tofu and green beans. Fat intake mainly came from formula milk (4 times/day). Toddlers also often consumed snacks such as biscuits, wafers, and chocolate. For fibre, the dominant fruit was bananas (1–2 times/day), while vegetables were mainly carrots (2–3 times/day) and spinach.

Most respondents had nutrient intake (energy, protein, carbohydrates, and fat) in the poor category (<80% of the RDA) in both the stunted and non-stunted groups. Several factors can influence inadequate intake in toddlers. Toddlers with low nutritional intake were 1.28 times more likely to experience stunting than those with adequate nutrition. This aligns with UNICEF's theoretical framework, which states that insufficient food consumption is one of the contributing factors to stunting. The results of this study are consistent with the theory that inadequate energy intake is associated with the risk of stunting in toddlers. Growth hormone

depletion appears in children who are energy deficient. Therefore, protein plays a major role in the growth of toddlers.[32,33]

Based on the recent study, it was found that of the 24 toddlers who were stunted, 3 (1.1%) had experienced infectious diseases, while 26 (9.6%) of those who were not stunted had experienced infectious diseases. Mild infections or those that occur for a short period are not long enough or severe enough to significantly affect a child's nutritional status or growth; thus, they cannot be identified, and there are no repeated infections. According to Presidential Regulation No. 72 of 2021, stunting is closely related to repeated infections. Children who receive complete immunisations may be more immune to infections that can cause stunting. Immunisation is an effort to induce and increase immunity to disease in infants, carried out by injection. Incomplete immunisation causes toddlers' immunity to become weak, making them susceptible to infectious diseases.[34,35]

Regarding household food availability, it was found that families were unable to buy food and eat a balanced diet because they did not have enough money. Mothers of toddlers tended to meet their staple food needs from shops near their homes. A total of 5.9% of mothers in the stunting group reported that they were sometimes only able to buy cheap food for their children because of limited money. The high percentage of food-insecure households in both the stunting and non-stunting groups in this study is related to the low level of family income over the past 12 months, as the majority of people in Buntulia Subdistrict work as miners. The ongoing crackdown and closure of mines in the area has caused some families to lose their jobs, resulting in low household economic access to food and a decrease in household food availability. This is supported by research showing that household food security has a significant impact on the nutritional status of toddlers. If the adequacy and availability of nutritious food is limited or does not meet the needs of toddlers, it will cause food insecurity and disrupt their growth and development.[36]

A high percentage of inappropriate feeding patterns was observed in both stunted and non-stunted toddlers in the present study. Based on direct interviews with parents, inappropriate feeding patterns were caused by various factors, namely low economic status, inability to provide complete nutritious food, giving snacks too close to main mealtimes, and toddlers often being given snacks high in sugar, salt, or unhealthy fats that are low in nutrients. These foods can make children feel full, causing them to refuse more nutritious main meals. Complementary foods that lack variety, are low in energy (calories), and low in protein are often the main problem. Examples include giving only rice porridge without sufficient side dishes, portions not in accordance with needs (side dishes rarely given and only 1–2 pieces),

irregular meal schedules with only two meals a day, rarely giving snacks, eating at irregular times, and no set meal schedule for children.[37]

This study shows that 255 respondents (93.8%) already defecate in toilets and only 17 respondents (6.3%) still practise open defecation. This is influenced by the implementation of healthy life behaviour (perilaku hidup bersih dan sehat, PHBS), local government policies, the STBM programme, toilet construction assistance, and health education, so that the community understands the dangers of open defecation to health and the environment. Therefore, environmental sanitation factors in this area are not the cause of stunting. However, these results differ from a study by Fitirana et al.,[38] which found a significant relationship between environmental sanitation and stunting, where toddlers from households with poor sanitation had a 2.94 times higher risk of stunting compared to those with good sanitation (OR = 2.949; $P = 0.022$).

Regarding household food availability, it was found that families were unable to buy food and eat a balanced diet (staple foods, side dishes, vegetables, and fruit), relying only on a few types of cheap food. Children ate less because parents could not afford to provide enough food, often skipping children's mealtimes and reducing children's meal portions because parents did not have the money to buy and provide more food.

Food availability is a major factor related to stunting because it is the gateway to nutritional fulfilment. If food problems exist from the outset, then children's eating patterns, nutritional intake, and nutritional status will also be affected. Food availability includes the quantity, diversity, and sustainability of food supplies in households. Food shortages or monotonous consumption (e.g., only carbohydrates without protein and micronutrients) can lead to energy and essential nutrient deficits. Food availability affects eating patterns, which in turn determine nutritional intake and ultimately children's growth. Like a warehouse of raw materials, if the warehouse is limited, no matter how good the processing in the kitchen, the results will still be minimal.

This study is in line with the research of Mumtaza,[39] which examined the relationship between food security and food diversity with the incidence of stunting in children aged 24–59 months. Statistical tests showed a significant relationship between household food security and the incidence of stunting ($P = 0.001$). Conversely, families in a food-insecure condition have an increased likelihood of stunting in children. Similar to the study by Sihite & Tanziha conducted at the 11 Ilir Palembang Community Health Centre, statistical tests showed a significance of 0.031 ($P < 0.05$), indicating a relationship between household food security and the incidence of stunting.[36]

The limitations of this study lie in the fact that other variables that may have a significant association with stunting, such as genetic factors, the mother's health history during pregnancy (Chronic Energy Deficiency/CED), and parents' health literacy levels, have not been explored in depth.

Conclusion

The prevalence of stunting among toddlers in the Buntulia Community Health Center working area was recorded at 8.8% (n=24), while the vast majority of the population, comprising 91.2% (n=248) of the sampled toddlers, did not exhibit growth faltering. Although the percentage of stunted children is relatively low compared to some regional averages, the presence of these cases indicates a persistent nutritional challenge within the community that requires targeted intervention. Statistical analysis reveals that the incidence of stunting in this region is significantly influenced by a triad of closely interrelated factors: inadequate nutritional intake, suboptimal feeding patterns, and limited household food security. These variables function as the primary determinants of a child's growth trajectory in Buntulia. The findings suggest that when toddlers are subjected to inconsistent dietary diversity and insufficient caloric or protein intake, the biological risk of stunting increases substantially, regardless of other environmental factors. Of the variables analyzed, household food security emerged as the most critical determinant of stunting in the Buntulia Community Health Center working area. This underscores the fact that economic access to a diverse and stable food supply serves as the foundational gateway for nutritional health. Consequently, addressing stunting in Pohuwato Regency necessitates a multi-sectoral approach that focuses not only on nutritional education but also on strengthening the economic resilience and food availability of local households.

Conflicts of Interest

There is no conflict of interest.

Funding Sources

All funding in this research using authors own money.

Acknowledgments

Nothing to Declare.

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