Jurnal Gizi dan Dietetik Indonesia
(Indonesian Journal of Nutrition and Dietetics)
Vol 13, Issue 3, 2025: 203-212

Available online at: https://ejournal.almaata.ac.id/index.php/IJND
p-ISSN 2303-3045 e-ISSN 2503-183X
DOI: https://dx.doi.org/10.21927/ijnd.2025.13(3).203-212

Complementary feeding practice and geography of residence among stunting children

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ABSTRAK

Latar Belakang: *Stunting merupakan masalah gizi kronik dengan penyebab multifaktoral, mulai dari praktik pemberian pangan hingga lingkungan seperti geografi tempat tinggal. Terdapat beberapa indikator penilaian praktik pemberian makanan pendamping yang optimal pada anak usia 6-23 bulan seperti Animal Source Food (ASF), Zero Vegetable and Fruit (ZVF) dan Unhealthy Food Consumption (UFC).*
Tujuan: *Penelitian ini bertujuan untuk menganalisis hubungan antara konsumsi protein hewani (ASF), makanan tidak sehat (UFC), indikator konsumsi sayur dan buah (ZVF) dan geografi tempat tinggal dengan kejadian stunting pada anak 6-23 bulan di Kabupaten Jember.*
Metode: *Terdapat 88 anak yang berpartisipasi dalam penelitian ini (52 di Kecamatan Puger dan 36 di Kecamatan Jelbuk). Teknik sampling yang digunakan adalah multistage sampling. Data ASF, ZVF dan UFC diambil melalui 24 hours recall questionnaire, geografi tempat tinggal diketahui melalui data BPS sedangkan panjang badan anak diukur menggunakan infantometer sedangkan tinggi badan anak diukur menggunakan stadiometer. Data yang didapat dianalisis menggunakan SPSS 26. Analisis yang dilakukan meliputi univariat untuk menggambarkan distribusi frekuensi, analisis bivariat dengan uji chi-square dan regresi logistik biner untuk analisis multivariat.*
Hasil: *Penelitian ini menunjukkan bahwa terdapat 26.13% anak usia 6-23 bulan yang mengalami stunting, 22,72% anak mengonsumsi protein hewani, 42,02% tidak mengonsumsi sayuran, dan 77,27% mengonsumsi makanan ultra proses. Berdasarkan uji chi-square yang dilakukan, tidak terdapat hubungan ynag signifikan antara konsumsi makanan tidak sehat dan geografi tempat tinggal dengan stunting (p>0.05). Analisis multivariat menunjukkan bahwa konsumsi protein hewani menjadi faktor penyebab stunting yang lebih dominan (p=0.039, OR=9.53,95%CI= 1.12-81.21) dilanjutkan dengan ZVF (p=0.004, OR=5.31, 95%CI= 1.71-16.40).*
Kesimpulan: *Terdapat hubungan signifikan antara konsumsi protein hewani dan indikator konsumsi sayur dan buah dengan stunting pada balita usia 6-23 bulan di Kabupaten Jember.*

KATA KUNCI*: konsumsi protein hewani; indikator konsumsi sayur dan buah; konsumsi makanan tidak sehat; geografi tempat tinggal; stunting*

ABSTRACT

Background: *Stunting is a long-term nutritional issue containing multiple causes, including dietary habits and environmental factors such residential geography. Several metrics were employed to evaluate the ideal methods of introducing complementary food to children between the ages of 6-23 months. These metrics include Animal Source Food (ASF), Zero Vegetable and Fruit (ZVF), and Unhealthy Food Consumption (UFC).*

Objectives: *This study aims to investigate the correlation between ASF, ZVF, UFC and the geographical location of residence with the prevalence of stunting among children aged 6-23 months in the Jember Regency.*

Methods: *The study involved 88 children as the sample approach through multistage sampling. Information on ASF, ZVF, and UFC was obtained by 24-hour recall questionnaire. The BPS data was used to determine the geographical residence, while a stadiometer/infantometer was used to measure height/length. The data were then analyzed using SPSS. Univariate analysis was conducted, followed by bivariate analysis using Chi-square tests. Multivariate analysis was performed using binary logistic regression.*

Results: *The study revealed that 26.13% of children between the ages 6-23 months showed signs of stunting. Among these children, 22.72% consumed diverse ASF, 42.02% did not consume vegetables, and 77.27% consumed ultra-processed foods. The chi-square test revealed a lack of correlation between the consumption of unhealthy food and geographical location of residence with regards to stunting ($p>0.05$). The multivariate analysis revealed that the consumption of animal protein was the primary factor leading to stunting with statistically significant correlation ($p=0.039$, OR=9.53, 95%CI=1.12-81.21). Additionally, ZVF was also discovered as a significant predictor of stunting ($p=0.004$, OR=5.31, 95%CI=1.71-16.40.*

Conclusions: *In conclusion, ASF and ZVF are concurrently associated with the prevalence of stunting among children aged 6-23 months in Jember Regency.*

KEYWORD*: animal source food; zero vegetable and fruit; unhealthy food consumption; geography of residence; stunting*

Article info:
Article submitted on July 19, 2024
Articles revised on October 07, 2024
Articles received on March 17, 2025

INTRODUCTION

Stunting is a form of growth retardation or restriction that can happen during the initial 1000 days of life. Several variables can contribute to stunting, such as nutritional consumption and environmental factors (1). The various factors that contribute to stunting promote this global nutrition issues. Around 22.3 % of children globally are stunted by the year 2022, with half of these instances concentrated in Asia (2). According to data form the Ministry of Health of Indonesia in 2024, Indonesia represents 4.7% of the total global instances of stunting. The 2023 Indonesian Health Survey (SKI) indicates that the prevalence of stunting cases has not met the target set in 2024 National Medium-Term Development Plan (RPJMN), which is 14%. Furthermore, the current prevalence rate of 21.6% is not significantly different from the previous year's rate (3). However, certain provinces have presented the progress in reducing stunting cases. In 2022, East Java accounted for 19.2% of the total cases, but this decreased to 17.7% in 2023. A similar decrease was observed in the Jember Regency. However, the occurrence of stunting in Jember Regency in 2024 continues to be rather significant, with a prevalence rate of 29.7%. A critical consideration is the evaluation of feeding indicators, particularly in children between the ages of 6 to 23 months, a developmental stage where the risk of growth faltering is significantly heightened (4). Diet with a diverse composition can enhance synergies that facilitate absorption of important nutrients, such as consumption of fruit and vegetables and Animal Source Food (ASF) (4). Animal Source Food (ASF) is a substantial part of the calorie intake in complementary foods and has a higher nutrient density compared to grains and cereals (4). The Indonesian Nutrition

Status Survey (SSGI) findings reveal a significant rise in the consumption of animal protein at the national level, increasing from 35.3 in 2021 to 69.9 in 2022 (5). However, children that are stunted likely to have a less varied protein intake (6). This condition can impede growth as a result of diminished synthesis of IGF-1 (7). Moreover, animal-derived foods (ASFs) have a high concentration of micronutrients, which are essential for the growth and development of infants and young children (4).

Fruits and vegetables are a source of micronutrients when consumed. WHO asserts that it is crucial for children to consume vegetable and fruit to meet their nutrient needs during the complementary feeding period (4). Several studies have indicated a correlation between inadequate intake of zinc, iron, potassium, folate, vitamin A, vitamin C, and vitamin K and the occurrence of stunted growth in children (8–10). While the significance of consuming vegetables and fruits for growth is acknowledged, few studies examining the correlation between vegetable and fruit consumption and growth are identified (10). Several low middle-income countries (LMIC) are experiencing a dietary shift characterized by an increase in the intake of foods that are rich in sugar, salt, saturated fats, and simple carbohydrates. This trend is also observed among children (11). A study conducted in Mexico revealed a significant increase in the intake of unhealthy food among children as they progressed in age. This circumstance is closely associated with a reduced intake of foods that have a high biological value of protein, namely red meat (12). A study conducted in Thailand discovered a positive correlation between the intake of unhealthy foods and the occurrence of stunting (13). Furthermore, the diversity of food consumed is influenced by both the changing periods and the availability of food.

The geographical location of one's residence becomes a determining factor that affects the accessibility of food in different regions (14,15). The agricultural productivity in the highland regions of Tanzania adversely affected by the substandard soil quality. This condition has the potential to impact the variety of food provided to children and their nutritional status (16). Jember Regency is characterized by a variety of geological features, including coastal areas, canyons, and mountains (17). Previous studies have examined the significance of foods variety in the context of complementary feeding practices and their correlation with stunting. Additional research is needed to determine the role of various markers of complementary feeding practice in the development of stunting in children between the ages of 6 to 23 months. Research on complementary feeding practices at this age is crucial, as it aligns with the phase of most vulnerability for stunting. Therefore, this study aims to examine the correlation between ASF, ZVF, UFC, and the geographical location of residence with the prevalence of stunting in children aged 6-23 months in the Jember Regency.

MATERIALS AND METHODS

The study adopted a cross-sectional design, with data collection conducted in March 2024. A multistage sampling technique was employed to select participants from both upland and coastal areas. The first stage involved cluster sampling based on topographical regions, divided into upland (16-212 masl) and coastal (1-5 masl), as defined by the Central Bureau of Statistics (BPS) Data (18). The second stage involved proportional random sampling within each cluster to ensure representative sampling. The study was conducted in the working area of Health Center in Puger (coastal) and Jelbuk (uplands). The number of samples participating in this study was determined using proportional random sampling of 15-20 people per independent variable (19,20) . This study used four independent variables, so the number of samples needed was 60-80 people. To anticipate dropout sample, 10% of the total sample was added and used 88 (eighty-eight) samples divided as in the following **Table 1.**

The study requires samples that meet the criteria between the ages of 6-23 months, residing in the research location area, and not already receiving medical care for infectious disease and congenital disease. Additionally, the guardians of the children must provide agreement for their children to participate in the study. The data collected in this study were obtained through a 1×24hour recall questionnaire to gather information on the consumption of ASF,

vegetables, fruits and unhealthy foods (21). A respondent identity questionnaire was used to collect information on the characteristics of the study sample. In addition, BPS data was utilized to determine the geographical conditions of the study area. A diversified consumption of animal protein was defined as the consumption of more than three out of six types of animal protein examined in the study, which comprised breast milk, milk and its derivatives, eggs, meat, organs, fish and shellfish (22). The presence of ZVF was assessed in cases when the kid not consume any vegetables or fruit on the day before to the interview (21). The UFC analyzed if the child consumed food groups containing high in salt, sugar, and/or unhealthy fats on the day before the interview (21).

Table 1. Proportion of samples at each health center working area

Health Center Working Area	Population (N)	Sample (n)
Puger	1018	52
Jelbuk	705	36
Total	1723	88

The respondents' geographical location was categorized into two groups, namely coastal (1-5 masl) and upland (16-212 masl). The height of children who can stand independently was measured using a stadiometer, while the length of children who cannot stand independently was measured using an infantometer, with an accuracy of 0.1 cm. The nutritional status of children under five was classified as either stunting (height-for-age ≤ -2 SD) or normal (>2 SD).

Analysis process used descriptive, bivariate, and multivariate techniques. The chi-square test was then employed to conduct bivariate analysis, with a significance level of 0.05. Variables with a p value <0.25 were included in the logistic regression analysis. This study used a binary logistic regression model to test multiple variables simultaneously. The correlation between the independent and dependent variables can be observed by looking at the p-value associated with each variable. The odds of the relationship between each influential variable can be assessed by analyzing the odds ratio (OR) value, while the prediction value in the form of an interval, can be known through the confidence interval (CI) value. The probability of a child aged 6-24 months to experience stunting can be calculated through the following equation:

$$p = \frac{1}{1+e^{-y}} \quad [1]$$

Where p is the probability of a child aged 6-24 months being stunted, e is a natural number around 2.714, and y is the regression equation used in the model. The Hosmer and Lemeshow test can be used to evaluate model quality, where a p value >0.05 indicates a good model. This study was approved by the Ethics Committee of Dr. Moewardi Hospital (No. 360/II/HREC/2024).

RESULTS AND DISCUSSIONS

Table 2 shows the characteristics of the participants, with the majority falling within the age range of 12-23 months (64.8%). The analysis of the children tested reveal a greater percentage of males (59.1%) in term of gender distribution. Approximately 74% of mothers have attained a secondary school education. During the interview, the vast majority of the interviewees' moms were without employment, accounting for 85.2%. The majority of the sample's fathers possessed a secondary school education, accounting for 56.9% of the group. Additionally, 23.9% of the fathers were working as farm laborers. The sample's ethnic composition indicated that the most of the subjects were Madurese, accounting for 69.3% of the total.

Figure 1 shows that as age increases, children tend to experience an increase in ASF and unhealthy food consumption and a decrease in vegetable and fruit consumption. The largest intake of ASF was observed in children aged 12-23 months, with a prevalence of 33.3% (n=19). Among children aged 12-23 months, a significant proportion (45.6%, n=26) did not consume vegetables and fruits, whereas a majority (78.9%, n=45) has a high intake of unhealthy food. **Table 3** shows a statistically significant correlation

between stunting in children aged 6-23 months in Jember Regency and two variables: ASF (p=0.049) and ZVF (p=0.02). Children with normal nutritional status (53.4%) and stunting (23.8%) had a higher prevalence of consuming ≤3 types ASF. Children with stunted nutritional condition has a higher ZVF prevalence of 18.18%. In contrast, children with a normal nutritional status consumed a higher consumption of fruits and vegetables the day before the interview (50%).

Table 2. Characteristics of respondents

Characteristics	n	%
Age of the children (month)		
6-8	9	10.2
9-11	22	25
12-23	57	64.8
Gender		
Male	52	59.1
Female	36	40.9
Gender		
Madurese	61	69.3
Javanese	27	30.7
Mother's Last Education		
Primary school	28	31.8
Secondary school	57	74.0
College	3	3.4
Mother's Employment Status		
Employed	13	14.8
Unemployed	75	85.2
Father's Last Education		
Elementary school	34	38.6
Secondary school	50	56.9
College	4	4.5
Father's Occupation		
Farm laborer	21	23.9
Self employed	18	20.5
Farmer	17	19.3
Construction worker	6	6.8
Driver	4	4.5
Odd job	4	4.5
Fisherman	4	4.5
Breeder	3	3.4
Overseas	2	2.3
Teacher	1	1.1
Village official	1	1.1
Teacher and village official	1	1.1
Driver	1	1.1
Employee	1	1.1

There was no significant correlation between the geographical location of residence, the level of the UFC and stunting in children between the ages of 6 to 23 months ($p > 0.05$). The study revealed that children with impaired nutritional status were more prevalent in upland areas (15.91%). In contrast, children with a normal nutritional status were found to be more prevalent in coastal areas, accounting for 48.86% of the total. Approximately 23.86% with stunted growth and 53.41% of children with normal nutritional status consume unhealthy diet.

The multivariate analysis indicated a simultaneous correlation between ASF and ZVF and the prevalence of stunting ($p < 0.05$). The

binary logistic regression analysis using the backward LR method resulted in the exclusion of the variables geography of residence and UFC from the final logistic regression model. The variable presented to be the most significant risk factor for stunting in children aged 6-23 months in Jember Regency was ASF (OR=9.53).

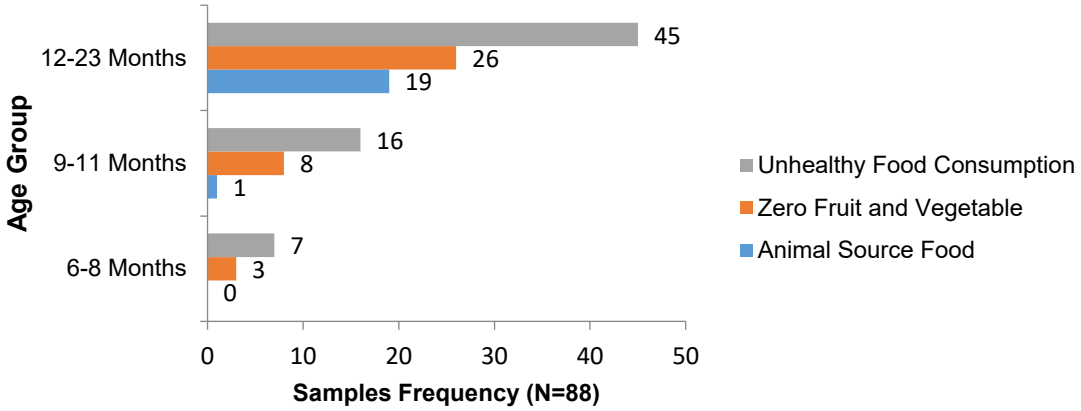

Figure 1. Distribution of complementary food consumption

The model derived from the analysis may be expressed as follows: The probability of specific event can be calculated using the formula:

P = 1/ (1 + 2.7 - (-5.207 + 2.25ASF + 1.67ZVF)) [2]

The resulting model has a fair quality, with a p-value p = 0.701. A strong correlation was found between ASF and the occurrence of stunting in children aged 6-23 months in Jember Regency. The predominant form of ASF ingested was breast milk, with a prevalence of 64.6% in children exhibiting normal growth and 52.4% in children experiencing stunted growth. Among the many types of ASF, organ meat was the least consumed, with a prevalence of 1.5% in children with normal nutritional status and 8.7% in children with stunting. Children aged 12-23 months had higher percentage of consuming more than three categories of ASF compared to children in younger age groups (**Figure 1**). This finding indicates that as children age, their ability to consume ASF increases. A study conducted in Nepal demonstrated a positive correlation between a child's age and a 9% increase in their consumption of ASF (23).

Table 3. Bivariate analysis of factors associated with stunting in children aged 6-24 months

Variable	Nutritional Status				*P* value	OR (95%= CI)
	Stunting		Normal			
	n	%	N	%		
Geography of Residence						
Upland	14	15.91	22	25	0.06	2.82 (1.04-7.62)
Coastal	9	10.23	43	48.86		
Animal Source Food						
>3 type	2	2.27	18	20.45	0.049*	8.04 (1.00-64.27)
≤3 type	21	23.86	47	53.41		
Zero Vegetable and Fruit						
Yes	16	18.18	21	23.86	0.002*	5.59 (1.91-16.33)
No	7	7.95	44	50		
Unhealthy Food Consumption						
Yes	21	23.86	47	53.41	0.134	3.83 (0.811-18.07
No	2	2.27	18	20.45		

**p<0.05 p-values

Additional research has demonstrated a correlation between ASF and stunting. A study conducted in Nepal found that those who consumed low amounts of ASF experienced stunted growth and negative effects on cognitive function (8). This is related to the fact that ASF is a very nutritious type of food that is rarely consumed in LMIC. A study conducted in Tanzania showed that ASF had the ability to decrease the occurrence of stunting in children between the ages 6-23 months (9). However, a study conducted in Bangladesh showed inconsistent results. This can be related to the fact that there were more subjects who consumed ASF compared to those who did not (10).

ASF is a calorie-dense food that is an essential component of complementary foods (24). The ASF has a wide range of micronutrients, such as vitamin A, vitamin B2, vitamin B12, calcium, iron, and zinc. These minerals are difficult to obtain in adequate amounts from plant-based foods (25). Furthermore, ASF contains a comprehensive range of necessary amino acids and is the most suitable source of these nutrients for cellular growth (6,26). Amino acids exert influence on the Mechanistic Target of Rapamycin Complex 1 (MTORC 1), a significant mechanism involved in growth regulation. A deficiency in amino acids has been associated with a heightened likelihood of mortality in children experiencing stunted growth (6). In LMIC, ASF plays a pivotal role in facilitating nutritional enhancement during the early stages of life (27). A study conducted in Nepal has demonstrated that the presence of a small livestock farm at home might augment children's consumption of ASF, which is known to be crucial for child growth and development (23).

This study demonstrates a direct correlation between the consumption of fruits and vegetables and the occurrence of stunting in children residing in Jember Regency. There was a total of 51 children, observed to have eaten fruits and vegetables on the day before the interview. Out of the 65 children had normal growth and development, 46.2% consumed fruits and vegetables that are rich in vitamin A, while 38.5% consumed other types of fruits and vegetables. Meanwhile, among the group of 23 stunted children, 30.4% consumed fruits and vegetables rich in vitamin A, while 4.3% consumed other types of fruits and vegetables.

Multiple studies conducted in LMIC yielded comparable findings to the present study. A global study conducted in 49 countries revealed a significant correlation between fruit consumption and a decrease in stunting among children aged 6-23 months (26). A study conducted in India revealed that children aged 6-23 months who consumed fruits and vegetables infrequently and in little amounts also experienced stunted growth (28).

Table 4. Multivariate logistic regression analysis of factors associated with stunting in children aged 6-24 months

Variable	B	p-value	OR	95% CI		P	Negelkerke R Square
				Lower	Upper		
Animal Source Food	2.25	0.0398	9.53	1.12	81.21		
Zero Vegetable and Fruit	1.67	0.004*	5.31	1.71	16.40	0.000	0.309

*p<0.05 p-values

Children aged 6-23 months in urban areas of Bangladesh who consume inadequate amounts of fruits and vegetables are considerably more likely to experience growth faltering (p = 0.04). This result may be attributed to the role of macro- and micronutrients present in fruits and vegetables, which play a crucial role in maintaining body functions and promoting growth (10). In addition, several studies have indicated the significant influence of macro and micronutrients obtained from fruits and vegetables on growth and development. There is a correlation between the average consumption between vitamin A and stunted growth. Vitamin A is crucial for optimal child development (8,9). This pertains to the stunted growth caused by decrease in the

production of IGF-1, which is involved in the release of growth hormone throughout the night. Furthermore, insufficiencies in zinc and iron might cause a decrease in food consumption, subsequently resulting in stunted growth. Ascorbic acid, present in fruits and vegetables, improves the absorption of non-heme iron and folate (29).

This study suggests that there is no significant correlation between the consumption of unhealthy foods (high level of sugar and salt) and stunting in children aged 6-23 months in the Jember Regency. There was a prevalence of 77.8% of children aged 6-8 months who consumed unhealthy foods, 72.7% of children aged 9-11 months, and 78.9% of children aged 12-23 months. A study conducted in Thailand showed that the consumption of sweets and other unhealthy foods increased with age among children. Nevertheless, the study indicated a direct correlation between the intake of unhealthy foods and the frequency of stunting (13). Unhealthy food consumption significantly contributes to children's decreased preference to consume complementary foods at home (30). The study found a direct correlation between the high UFC as well as the number of children who did not consume ASF (77.27%). The high prevalence of UFC (77.2%) was identified as the primary reason for the insignificant correlation between the incidence of stunting in children aged 6-23 months.

There is no significant correlation between the geography residence and the occurrence of stunting in Jember Regency. The findings of this study differ with the conclusions of other studies carried out in India. The findings suggest that children residing in rural highland locations at an altitude of above 2000 masl have a higher likelihood of experiencing stunting. According to the study, the highest occurrence of stunting was observed in children between the ages of 18 to 59 months. The challenging climate and topography pose a substantial barrier to the execution of government nutrition programs (31). In contrast, the presence of dependable transportation infrastructure in Jember Regency enables the smooth execution of government nutrition initiatives (32). Areas in Argentina with an altitude exceeding 2000 masl exhibit a high prevalence of stunting, wasting, and underweight (33).

This study was limited to groups living in areas with highland and coastal topographical characteristics, but did not consider the typical parental occupation of the region and income as differentiators. In some studies, it is mentioned that the parents' occupations that are in accordance with the topographic conditions of the region of residence also influence the incidence of stunting and children's food choices.

CONCLUSIONS AND RECOMMENDATIONS

A significant correlation was found between ASF and ZVF and stunting in children between the ages of 6-23 months in the Jember Regency. This study indicates the necessity for programs aimed at increasing knowledge regarding the significance of include animal protein, vegetables, and fruits into children's supplementary diets. However, the geographical location of the residence do not show a significant correlation with the prevalence of stunting in children aged 6-23 months in Jember Regency (p=0.06). The lack of a substantial association between these two variables can be attributed to the presence of well-developed road infrastructure. In addition, there was no significant correlation of unhealthy foods and stunting in children aged 6-23 months in Jember Regency (p=0.134). Nevertheless, there was a positive correlation between age and the consumption of unhealthy foods, whereas there was a negative correlation between the consumption of animal protein, vegetables, and fruits. Further research is required to evaluate the dietary patterns of children and families, as well as to identify the factors influencing the choice of ingredients in complementary foods in children aged 6-23 months.

ACKNOWLEDGEMENT

This work was supported by Directorate General of Higher Education, Research and Technology of the Ministry of Education, Culture, Research and Technology (Grant number 086/E5/PG.02.00.PL/2024).

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