PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
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OPEN ACCESS Pakistan Journal of Nutrition

ISSN 1680-5194
DOI: 10.3923/pjn.2019.969.976

Research Article
Age of Milk Introduction is a Dominant Factor of Stunting Among Toddlers Aged 24 Months in Bogor District: A Cross-Sectional Study

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Abstract

Background: Prohibition of milk promotion for children less than 3 years of age raises concerns about the possible increase of stunting among children under-five. Milk is an animal protein-rich beverage that can stimulate growth and development. This study aimed to determine the relationship between toddler's milk intake and stunting. **Materials and Methods:** This cross-sectional study was conducted between January and June 2018 in Bojong Gede, Bogor District. A total of 113 mothers with toddler aged 24 months participated in this study. Five villages were selected based on the highest number of stunting among children under-five. Mothers and toddlers who came to Posyandu were taken as subjects until the required number of samples were met. **Results:** More than one-quarter(26.5%) of the samples were associated with stunting. There were significant differences in nutrient intake between stunted and the normal toddler and among toddlers who do not consume and consume milk. Stunted toddlers experienced a later age of milk introduction, less frequent milk consumption and a lower amount of daily milk consumption compared to the normal toddler. After controlled by type of milk consumption, the frequency of drinking milk, the protein consumption, the mother's working status and the father's education, the age of milk introduction was the dominant factor (OR = 4.1, $p<0.05$) associated with stunting. **Conclusion:** This study showed that children's milk intake plays a significant role in preventing stunting. The age of milk introduction, as well as the frequency of daily milk consumption and the amount of daily milk consumption, are important factors to support the normal growth of children. Daily milk consumption must be considered as an important strategy in reducing the prevalence of stunting in Indonesia.

Key words: Age of milk introduction, complementary food, milk consumption, stunting children, under two children

Received: June 18, 2019 Accepted: July 18, 2019 Published: September 15, 2019

Citation: S. Fikawati, E.K. Adhi, A. Syafiq and S.M. Bakara, 2019. Age of milk introduction is a dominant factor of stunting among toddlers aged 24 months in bogor district: a cross-sectional study. Pak. J. Nutr., 18: 969-976.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Stunting has both short-term and long-term consequences. In the short-term, stunting increases the risk of illness and death, whereas long-term stunting affects productivity and increases the risk of chronic diseases associated with nutritional intake such as diabetes, coronary heart disease and stroke[1-5]. Globally, 26% of children under five years of age experience stunting with the highest number in sub-Saharan Africa with 40%[6]. In Indonesia, the prevalence of stunting among children under-five is quite high (37.2% in 2013 and 30.8% in 2018[7]).

The age of 6-24 months is the most critical period in childhood growth. The highest stunting occurred during this period. During this period, children need a high intake of nutrients but some evidence shows a limited quality and quantity of food consumed by children, especially after exclusive breastfeeding[1,2,8]. After the baby is 12 months old, breastmilk could only suffice for about 1/3 of the baby's energy needs[9]. Animal proteins, such as meat, poultry, fish and eggs, must be eaten as often as possible, regardless of the breastfeeding status of children[10].

Animal-based foods contain proteins and amino acids that are not found in plant-based foods. The composition and quality of amino acids in animal-based protein are better than those found in plant-based protein. To achieve adequate growth and development, it is necessary to have foods that have suitable protein and complete amino acids[11]. Protein deficiency causes wasting, stunting, weight loss and decrease in the level of growth hormone[12]. Children who are stunted have low serum concentrations of nine essential amino acids compared to children who do not have stunting[13].

Milk is an animal source that contains energy, proteins, amino acids and micronutrients found only in animal food sources that can stimulate growth[14]. Experts stated the importance of milk for the nutritional status of children. Adequate milk consumption can add substantial nutrients to the achievement of a Recommended Dietary Allowance (RDA) for Indonesian children. The achievement of RDA for all nutrients is higher in users of dairy products than in non-dairy users[15,16]. Studies have also shown that milk is the most common source of animal protein consumed by children, once daily compared to other animal protein sources[17].

Several studies in children aged 2-5 years in South Africa have shown that height-for-age z-scores (HAZ) are higher among children who drink milk than those who do not. It is estimated that the inadequate intake of calcium and vitamin D, due to the low intake of milk after weaning, contributes to stunting in this population[18]. Similarly, studies on children aged 12-60 months in East Java, Indonesia indicate that there is a significant association between toddler consumption type and stunting. In the stunting group, the menu consists of staple foods, side dishes and vegetables, whereas in the normal group, there are additional fruits and milk in the menu[19].

As one of the most densely populated countries in the world, Indonesia has a very low milk intake, with only around 11.8 L per capita per year, very low compared to the neighboring countries of Southeast Asia, such as Thailand, Malaysia and Singapore, where milk intake reaches 33.7, 36.2 and 48.3 L capita^{-1} year^{-1} [20]. This low milk intake is inversely proportional to the human development index (HDI). The HDI for these countries are 83, 57 and 9 respectively, while Indonesia is 116[21].

Recently, milk is not an important part of the diet of infants and children in Indonesia. Starting with the changing of the previous and popular nutrition slogan *Empat Sehat Lima Sempurna* (Healthy Four Perfect Five) to General Guidelines for Balanced Nutrition (2012) and later on adopting the WHO Guidance on Ending the Inappropriate Promotion of Foods for Infants and Young Children (2016), the role of milk in the diet is underestimated[22]. The recommendation states that products intended for use as breast-milk substitutes should not be promoted, including any milks or products that could be used to replace milk in either liquid or powdered form, which are marketed specifically to feed infants and young children up to the age of 3 years (such as follow-up formula and growing-up milks)[22]. Governments, NGOs and health workers are reluctant to give milk to children under 3 years of age.

Considering the assumption that milk plays an important role in the prevention of stunting, this study aimed to determine the relationship between toddler's milk intake and stunting among toddlers aged 24 months in Bojong Gede, Bogor District. A study on the Nutrition Status Monitoring (2016) showed that the prevalence of stunting in under-five children in Bogor District is 28.8% and the district is included in 100 priority districts/cities for stunting intervention[23]. The null hypothesis of this study is that there is no difference in milk intake and the age of milk introduction between stunted and the normal toddler.

MATERIALS AND METHODS

This cross-sectional study was conducted between January and June 2018 in Bojong Gede, Bogor District. The subject was the mother-toddler pair who met the following inclusion criteria: (1) 24-month old toddler (one month before

or within a month), (2) physical health and (3) mother's willing to participate in the research and interview, while the toddler with congenital defects, down syndrome or other genetic disorders were excluded from the study.

Bojong Gede, Raw Panjang, Bojong Baru, Ragajaya and Kedung Waringin Villages were purposively selected based on the number of 24-month old toddler and the highest number of stunting. Accidental sampling was used in selecting the subjects and the toddlers who came to Posyandu in the selected villages were taken as subjects until the required number of samples was met.

The dependent variable in this research was stunting, with milk intake as the main independent variable. The confounding variable includes parent's education, parent's job, family size, history of breastfeeding, history of infectious diseases and child nutrition. The height measurements were made using microtoise. Calculation of height-for-age was done using the WHO 2005 software. Children were categorized as stunted if the standard deviation was <-2 SD.

The measured milk intake includes variables of milk type, age to get used to drinking milk (age of milk introduction) and milking frequency. The variables of milk intake and confounding variables, such as parental education, occupation of parents, family size, breastfeeding history and history of infectious diseases, were collected using questionnaires through interviews. Nutritional intake was measured using the 1×24 h food recall method. The child in this study was 24 months old and had been eating family food and/or complementary foods.

This study was approved by the Ethics Team of the Faculty of Public Health, University of Indonesia, number 65/UN2.F10/PPM.00.02/2018, dated February 26, 2018. Before the measurement and the interview, the respondents would sign the informed consent. In the bivariate analyses, the numerical data were tested using an independent t-test or Mann Whitney, depending on the normality of the data, whereas the categorical data was tested using Chi-Square. Multivariate analysis of multiple logistic regression was used to examine the relationship between milk intake and stunting after being controlled by confounding variables.

RESULTS

The total number of samples was 113 mother-toddler pairs. The results showed that 26.5% out of the 113 toddlers in Bojong Gede sub-district, Bogor District were stunted. Table 1 shows the characteristics of toddlers and respondents, as well as their relationship to stunting events. Among these variables, father's education ($p = 0.02$), infectious disease frequency ($p = 0.018$) and protein intake ($p = 0.018$) were significantly associated with stunted toddlers aged 24 months.

Table 2 shows the differences between the average nutrient intake between the stunted and the normal toddler. The average of all nutrient intakes (both macro and micronutrients) of stunted toddlers was significantly less than those of the normal toddler.

Table 3 illustrates that 15.9% of the children had not yet received any other milk except breastmilk and nearly half (44.4%) of these children were stunted. At the age of 24 months, toddlers who were still breastfed without obtaining any other milk were 4.3 times more likely to be stunted compared to toddlers who drank solely other milk. Other than that, there was one-third (33.6%) of the children who were still breastfeeding but had already received other milk and about 34.2% of these children were stunted and had 2.8 times greater chance of being stunted compared to toddlers who consume solely other milk.

In this study, the average age of milk introduction in24-month old toddlers with stunting was older than the normal toddlers (15.4 months and 11.9 months). There was a relationship between the age of milk introduction and the incidence of stunting at the age of 24 months. Toddlers who start drinking milk at the age of ≥12 months are 4.1 times more likely to suffer from stunting compared to toddlers who started drinking milk before the age of 12 months.

Table 3 also finds a significant relationship between milk drinking frequency, amount of drinking-milk consumption and stunting events. The average frequency of drinking milk of toddlers with stunting was lower than that of the normal toddlers (17 times $week^{-1}$ and 24 times $week^{-1}$), as well as the amount of drinking-milk consumption (337.63 mL day^{-1} and 468.13 mL day^{-1}).

Table 4 illustrates the average nutrient intake between two groups (those who consumed milk and those who did not). All the nutrient intake of a toddler who consumed milk was significantly higher than those who do not consume it, especially calcium. However, the average nutrient intake in both groups was still below the recommended value, with the exception of proteins, iron and zinc, of those who consumed milk.

The variables included in the multivariate modeling were milk type, age of milk introduction, milk drinking frequency, father's education, mother's job, history of exclusive breastfeeding, period of infection history, energy intake and protein intake. The result of the multivariate analysis shows that the age of milk introduction at the age of 12 months is the dominant factor of the stunting event

Table 1: Relationship between confounding variables and stunting in toddlers aged 24 months in Bojong Gede sub-district, Bogor District 2018

Variables	All respondents (n = 113)	Nutritional status (H/A)		p-value (1-sided)	OR (95% CI)
		Stunting (n = 30)	Normal (n =83)		
Father's education					
<High school	34 (30.08%)	14 (41.2%)	20 (58.8%)	0.020*	2.8 (1.2-6.6)
≥High School	79 (69.91%)	16 (20.3%)	63 (79.7%)		1.0
Mother's working status					
Working	26 (23.01%)	7 (26.9%)	19 (73.1%)	0.572	1.0 (0.4-2.8)
Not working	87 (76.99%)	23 (26.4%)	64 (73.6%)		1.0
Early initiation of breastfeeding					
No	108 (95.57%)	29 (26.9%)	79 (73.1%)	0.600	1.5 (0.2-13.7)
Yes	5 (4.42%)	1 (20.0%)	4 (80.0%)		1.0
Exclusive breastfeeding					
No	59 (52.21%)	16 (27.1%)	43 (72.9%)	0.528	1.1 (0.5-2.5)
Yes	54 (47.79%)	14 (25.9%)	40 (74.1%)		1.0
Infectious disease history (ARI and/or Diarrhea) within 6 months					
Yes	88 (77.87%)	26 (29.5%)	62 (70.5%)	0.135	2.2 (0.7-7.1)
No	25 (22.12%)	4 (16.0%)	21 (84.0%)		1.0
Infectious disease frequency (ARI and/or Diarrhea)					
>median (>2 times within 6 months)	37 (32.7%)	15 (40.5%)	22 (59.5%)	0.018*	2.8 (1.2-6.6)
≤median (≤2 times within 6 months)	76 (67.3%)	15 (19.7%)	61 (80.3%)		1.0
Nutrient intakes					
Energy intake					
Less (<100% IRDA)	90 (79.6%)	26 (28,9%)	64 (71,1%)	0.200	1.9 (0.6-6.2)
Adequate (≥100% IRDA)	23 (20.4%)	4 (17.4%)	19 (82.6%)		1.0
Protein intake					
Less (<100% IRDA)	37 (32.7%)	15 (40.5%)	22 (59.5%)	0.018*	2.8 (1.2-6.6)
Adequate (≥100% IRDA)	76 (67.3%)	15 (19.7%)	61 (80.3%)		1.0
Carbohydrate intake					
Less (<100% IRDA)	102 (90.3%)	29 (28.4%)	73 (71.6%)	0.153	3.9 (0.5-32.5)
Adequate (≥100% IRDA)	11 (9.7%)	1 (9.1%)	10 (90.9%)		1.0
Fat intake					
Less (<100% IRDA)	86 (76.1%)	26 (30.2%)	60 (69.8%)	0.088	2,5 (0.8-7.9)
Adequate (≥100% IRDA)	27 (23.9%)	4 (14.8%)	23 (85.2%)		1.0

IRDA: Indonesian recommended dietary allowances* p<0.05

Table 2: Average distribution of nutrient intake by nutrition status (H/A) in toddlers aged 24 months in Bojong Gede sub-district, Bogor District 2018

Nutrient	All respondents (n = 113)	Nutritional status (H/A)		p-value
		Stunting (n = 30)	Normal (n = 83)	
Energy (kkal)	838.7	715.4	883.2	0.011*
Protein (g)	32.3	27.3	34.1	0.025*
Carbohydrate (g)	101.1	89.3	105.3	0.051**
Fat (gram)	34.7	28.2	37.0	0.005*
Vitamin D (mcg)	5.5	3.7	6.1	0.001*
Calcium (mg)	566.7	310.2	571.9	0.003*
Fe (mg)	7.0	4.8	7.8	0.004*
Zn (mg)	4.0	3.2	4.3	0.027*

*p<0.05, **p<0.1

(p = 0.021), as shown in Table 5. This explains that toddlers who have just started drinking milk after 12 months of age or more will have a 4.1 times greater chance of suffering from stunting compared to toddlers who started drinking milk before the age of 12 months after being controlled by protein intake, maternal working status and father's education.

DISCUSSION

The results show that 26.5% of the toddlers aged 24 months in Bojong Gede sub-district, Bogor District experienced stunting. This is not much different from the 2016 Nutritional Status Monitoring (PSG) study in Bogor District,

Table 3: Average distribution and relationship of milk intake with stunting in toddlers aged 24 months in Bojong Gede sub-district, Bogor District 2018

		Nutritional status (H/A)			
Milk consumption	No.	Stunting (n = 30)	Normal (n = 83)	p-value	OR (95% CI)
Type of milk consumption					
Only breastmilk (without other milk)	18 (15.9%)	8 (44.4%)	10 (55.6%)	0.016*	4.3 (1.3-13.8)
Mix (breastmilk and other milk)	38 (33.6%)	13 (34.2%)	25 (65.8%)	0.034*	2.8 (1.0-7.4)
Only milk	57 (50.4%)	9 (15.8%)	48 (84.2%)		1.0
Age of milk introduction					
Age ≥12 months	60 (53.1%)	23 (38.3%)	37 (61.7%)		4.1 (1.6-10.6)
Age <12 months	53 (46.9%)	7 (13.2%)	46 (86.8%)	0.002*	1.0
Average					
Age of milk introduction (months)	11.9	15.4	10.6	0.007*	-
Milk frequency (times week^{-1})	22	17	24	0.034*	-
Total milk consumption (mL day^{-1})	433.49	337.63	468.13	0.020*	-

Table 4: Differences in nutritional intake between toddlers aged 24 months consuming milk and not consuming milk in Bojong Gede sub-district, Bogor District 2018

Nutrient	Not consuming milk (n=18)	Consuming milk (n=95)	p-value	Recommendation IRDA 2013
Energy (kal)	504.3	902.1	0.000*	1125
Protein (g)	20.3	34.6**	0.000*	26
Carbohydrate (g)	62.8	108.3	0.000*	155
Fat (g)	21.3	37.3	0.000*	44
Vitamin D (mcg)	2.2	6.1	0.000*	15
Calcium (mg)	69.9	584.4	0.000*	650
Fe (mg)	2.1	8.0**	0.000*	8
Zn (mg)	2.1	4.4**	0.000*	4

IRDA: Indonesian recommended dietary allowances *p<0.05, **Intake above recommendation

Table 5: Final model of milk intake with stunting in toddlers aged 24 months in Bojong Gede sub-district, Bogor District 2018

						95% CI	
Variables	B	SE	Z	p-value	OR	Lower	Upper
Type of milk consumption	0.232	0.684	0.115	0.734	1.3	0.3	4.8
Age of milk introduction	1.398	0.608	5.293	0.021*	4.1	1.2	13.3
Frequency of drinking milk	-0.010	0.019	0.294	0.588	0.9	0.9	1.0
Protein consumption	0.030	0.022	1.832	0.176	1.0	0.9	1.1
Mother's working status	0.752	0.601	1.569	0.210	2.1	0.7	6.9
Father's education	0.750	0.492	2.325	0.127	2.1	0.8	5.6

*p<0.05

which shows that the prevalence of stunting in toddlers under five years of age is 28.8%[24]. The results also illustrate that stunting in the area continues to be a public health problem (prevalence> 20%). Observations in 5 regions of the world, especially in AFRO and SEARO, show the same pattern as stunting starts within 3-24 months (the decrease value per month is -0.10 z score in AFRO and -0.08 in SEARO)[25]. Other studies also suggest that toddlers aged 13-23 months have a greater risk of stunting than toddlers from 0-12 months of age[26]. These are possibly due to inadequate supplementary feeding and the history of frequent infections with age[25].

Table 1 shows that father's education, infectious disease frequency and protein intake are associated with stunting. Low father's education is more likely to have stunting toddlers. This could be caused by the direct relationship between father's education and the socio-economic level of the family. Father's education will influence working choices and income. A low economy is associated with a reduced ability to achieve family nutrition, which increases the risk of malnutrition.

Infants with a history of acute respiratory infection (ARI) and diarrhea more than twice in the last 6 months had a greater chance of being stunted compared to toddlers aged 24 months who had a history of infection less or twice in the last 6 months. Most of the infants in the stunting group had ARI. Toddlers who suffer from diseases will experience a decrease in appetite, which ultimately affects food consumption and weight. If this condition occurs for a prolonged time and is not well addressed, it will deteriorate the nutritional status[22].

There is a relationship between the adequacy of macronutrient intake and stunting, especially protein intake. Toddlers with inadequate protein intake were almost 3 times more likely to suffer from stunting compared to children with adequate protein intake (Table 1). Table 2 confirms the result

that there is a significant difference in nutrient intake between the stunting and the normal toddler. In all the nutrients, stunting toddler had a significantly lower intake than the normal toddler. This is in accordance with one of the basic principles of nutrition that nutritional status of toddler is determined directly by food intake[1].

UNICEF (2016) and MOH-RI (2016) mentioned that breastfeeding up to two years provides better nutrition because breastmilk has a relatively high fat content compared to complementary foods[27,28]. Based on IDHS data, breastfeeding until the age of two years in Indonesia reached 55.3%[29]. The result of this study showed that 15.9% of the children were still breastfeeding and had never received other milk and almost half (44%) of these children experienced stunting. Therefore, breastfeeding up to 2 years, as promoted by the government, international organizations and NGOs, should be managed by appropriate strategies. Mothers intended to breastfeed up to 2 years should receive assistance to monitor their child growth curve. Negative growth requires an additional intake of milk other than breastmilk. This study reports that additional milk is to be started earlier (before 1-year-old) rather than later.

Toddlers who did not consume milk other than breastmilk have the highest probability (4.3 times) of stunting compared to toddlers who consume a combination of breastmilk and other milk (2.8 times) and toddlers who consume only other milk (no breastfeeding). This might be due to an inadequate intake of breastmilk and an inadequate nutritional intake simultaneously. It is known that after 12 months of age, breastmilk only provides one-third of the baby's energy needs. For this reason, the role of complementary foods is indispensable, especially when the mother wants to optimize breastfeeding until the infant is 2 years of age[11,22].

Table 3 shows that the average age of milk introduction in toddlers with stunting was older than the normal toddler (15.4 vs 10.6 months). Toddlers with an age of milk introduction ≥12 months have a 4.1 times greater chance of stunting than toddlers with an age of milk introduction <12 months. Toddlers over 1-year-old who are breastfed may be reluctant to consume complementary foods in the same amount as a non-breastfed child. Biondi[30] stated that breastfeeding over 1 year became a risk factor for stunting. On the other hand, caregivers may think that breastfed toddlers do not need similar amount of complementary feeding as non-breastfed toddlers. This may trigger inadequate nutrients intake of the toddler[30].

Stunted toddler had less frequency of drinking milk compared to the normal toddler (17 vs 24 times per week). Counted daily, the stunted toddler consumed milk 2 times per day, whereas the normal toddler consumed milk 3 times per day. This could be interpreted that to have a normal HAZ, the toddler should consume milk at least 3 times per day. In terms of volume, the stunted toddler consumed less milk than the normal toddler (337.6 mL day^{-1} vs 468.1 mL day^{-1}). This result supports Wiley *et al.*[31] who reported that IGF-I concentrations were higher in toddlers who drank the most milk (>500 vs. <250 mL day^{-1}). IGF-I is a compound that regulates growth and development.

Table 4 shows that the achievement of IRDA for all nutrients is higher in the users of dairy products than in non-dairy users. Widodo *et al.*[16] stated that adequate milk consumption in Indonesian toddlers can contribute substantially to the achievement of IRDA. These results confirm the importance of supplementary milk for children aged 24 months with the aim of increasing their nutritional intake. In this study, among children who consumed milk, the intake of nutrients almost reaches the recommendation. Protein, iron and zinc, intakes are in line with recommendations. If we focus on calcium (due to its importance for height and bone density), toddlers who did not consume milk had a much lower calcium intake than toddlers who consumed milk.

The multivariate analysis in Table 5 shows that there is a relationship between age of milk introduction and stunting after being controlled by confounding variables. Toddlers aged 24 months who started drinking milk at ≥12 months would have a 4.1 times greater risk of suffering from stunting compared to toddlers<12 months after having been controlled by the mother's working status, protein intake, type of milk consumption and father's education. This is consistent with a study conducted by Wiley *et al.* (2018), stating that children who breastfed for more than 18 months or who received other milk after 6 months were shorter than those who were breastfed for less than 18 months or received other milk within the first 6 months. They found that children who received other milk at the age of <6 months had a higher concentration of IGF-I compared with children who received other milk at the age of ≥6 months[31]. Other studies have shown that infants who receive breastmilk up to 3 months of age have lower IGF-I levels than infants who receive formula milk or both[32].

This study implies the importance of milk consumption and the age of milk introduction in preventing the occurrence of stunting. The introduction of milk after 6 months of age but before 12 months of age, is recommended as an application of the results of the study. Growth below the standard growth curve necessitates an additional intake of milk other than breastmilk. It should be noted, however, that this study is

limited to its scope in the specific context related to the study area. Thus, the application in form of the program should always consider situational analysis in a specific location.

CONCLUSION

Several conclusions can be drawn from this study. First, the average nutrient intake was significantly different between the stunting and the normal toddler, where the stunting toddler had a significantly lesser nutrient intake (both macro and micronutrients) than those of the normal toddler. Second, the nutrient intake of toddlers who consumed milk other than breastmilk was significantly higher than those who did not consume other milk. Toddlers with inadequate protein intake were almost 3 times more likely to become stunted compared to children with adequate protein intake. Third, there was a significant difference between the different ages of milk introduction and stunting. Toddlers who started drinking milk at the age of ≥12 months were 4 times more likely to become stunted compared to those who started drinking milk at the age of <12 months.

SIGNIFICANCE STATEMENT

The study discovered the role of milk consumption to prevent stunting in toddlers aged 24 months. This study demonstrated the importance of the age of milk introduction, milk consumption frequency, as well as the amount of milk consumption for children to have normal HAZ. Therefore, milk consumption must be considered as an important strategy to reduce the prevalence of stunting in Indonesia and other countries with similar environments.

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