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# Nutrition Intake as a Risk Factor of Stunting in Children Aged 25–30 Months in Central Jakarta, Indonesia

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## ABSTRACT

This study aims to determine the relationship between nutrient intake and the incidence of stunting and to determine the dominant factors associated with stunting in children aged 25–30 months in Gambir and Sawah Besar Districts, Central Jakarta, Indonesia. This research was a quantitative study with a cross-sectional study design. The type of data collected was secondary data from a case control study entitled Differences in Milk Intake and Stunting Incidence in Children Aged 25–30 Months in Central Jakarta in 2019. Data collected included height measurement, questionnaire-based interview, and 24-hour food recall. The percentage of stunting in children aged 25 to 30 months was 29.8%. The factor associated with stunting was iron intake (OR=5.0; 95% CI:1.02–25.25; p<0.05). Stunting was more likely to occur in children with inadequate iron intake than in those with adequate intake. To prevent stunting, iron-rich foods are essential and should be taken in sufficient amounts daily.

**Keywords**: children, iron intakes, nutrient, stunting

## INTRODUCTION

Stunting is one of the indicators that determine child mortality and morbidity, including in developing countries. Globally, the prevalence of stunting in children under 5 years is 26%. WHO reports that 150–200 million children under the age of 5 are underweight and stunted (Verma & Prasad 2021). Stunting will reduce productivity as adults and cause a decrease in human resources always in the future (Sjarif *et al.* 2019). Childhood stunting has significant and long-term consequences for individuals, families, and countries (Muleta *et al.* 2021).

Indonesia is one of the five countries with the highest stunting rates in the world (Sjarif *et al.* 2019). Based on the 2021 Indonesian Nutritional Status Survey (SSGI), the prevalence of stunting in Indonesia is 24.4%. Central Jakarta is one of the areas with the highest prevalence of stunting in Jakarta, reaching 19.7% (MoH RI 2021). Gambir and Sawah Besar sub-districts are two sub-districts in Central Jakarta with a high frequency of stunting compared to other sub-districts (BPS 2019).

Stunting in children is mostly caused by poor nutrition, a high disease burden, inadequate child feeding, poor sanitation, and a lack of access to high-quality health and nutrition services (Muleta *et al.* 2021). For children's growth and development, an adequate intake of macro- and micronutrients (such as energy, protein, and vitamins A, C, and calcium) is important. As compared to those with sufficient intake (>90% RDA), children with energy and protein intake below 70% RDA have 1.3 times higher risk of stunting (Bening 2016).

Studies from Bogor demonstrate a strong correlation between children's insufficient carbohydrate consumption and the prevalence of stunting. Other research shows that fat intake is also a risk factor for stunting. Less of fat intake will have an effect on fat synthesis leading to an impact on children's growth (Basri *et al.* 2021; Wulandary & Sudiarti 2021).

Micronutrient consumption must also be factored in for children's growth. Stunting is a condition where a lack of vitamin C is thought to be a contributing factor. Vitamin C is essential for the production of collagen, a fiber and protein structure necessary for bone growth (Bening *et al.* 2016). Calcium intake is essential for the formation of bones. Calcium plays a role in the process of forming substrates and will

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accumulate during the formation of bone tissue. The mechanisms of cell division, growth, and tissue healing will be inhibited by the lack of calcium, which will have an impact on the weight and height of children (Srg *et al.* 2021).

Low iron intake can interfere with cognitive function and child growth because iron helps the immune system, making children less susceptible to disease. Inadequate zinc intake will also reduce the production and secretion of IGF-1 (growth factor), which might result in developmental delays in children (Losong & Adriani 2017). Children who are lack of zinc as well as vitamin A intakes are susceptible to stunting because vitamin A regulates protein synthesis.

A few years ago, the Indonesian government concentrated on sensitive nutritional interventions, which involved efforts aimed at reducing stunting rates through indirect causes of stunting. Ninety two percent of the total funds allocated for accelerating stunting reduction from 2019 to 2021 are utilized for sensitive nutritional interventions, such as providing access to drinking water, sanitation, nutrition, and parenting counseling (BAPPENAS 2021). Starting in 2022, the government is requesting cross-sectoral collaboration to enhance public education for eating goods derived from animals as strategy to improve nutrition and health. All of the necessary amino acids for growth are present in animal-derived protein. Having protein in a form that is easily absorbed by the body to support toddler growth, animal meals also include a variety of micronutrients, such as iron (Ernawati *et al.* 2016).

The objective of this research is to determine the association between micronutrient intake and the prevalance of stunting and to determine the most significant nutrients related with stunting in children aged 25–30 months in Gambir and Sawah Besar Districts of Central Jakarta.

## METHODS

### Design, location, and time

The method of cross-sectional research was selected in this study and secondary data were collected from a case-control study entitled "Differences in Milk Intake and Stunting Incidence in Children Aged 25–30 Months in Central Jakarta in 2019". The research was done in Central Jakarta from October 2018 to December 2019. Respondents in this research lived in the Gambir subdistrict (townships of Duri Pulo, Petojo Utara, Petojo Selatan, and Cideng) and in the Sawah Besar subdistrict (townships of Karang Anyar, Kartini, Mangga Dua Selatan, and Pasar Baru). This research obtained ethical clearance from the Ethics Commission of the Research and Community Service Institute at Atma Jaya University (Reference number: 1154/III/LPPMPM. 10.05/09/2019).

### Sampling

The population in this study was 121 children aged 25–30 months. The age range was chosen because the age of 25–30 months old has the same food group, level of adequacy of energy and nutrients, and physical activity. The inclusion criteria in this research were mothers or caregivers who live in the Gambir and Sawah Besar Districts of Central Jakarta and had children aged 25 – 30 months, and mothers who were willing to be interviewed as research respondents.

The exclusion criteria were children aged 25–30 months with physical conditions that could affect the results of anthropometric measurements (limb and spinal disorders). All sampling units (121 children) were involved in the analysis of the relation between nutrition intake and nutritional status.

### Data collection

Six enumerators from public health nutrition, Faculty of Public Health, University of Indonesia, were entrusted to collect the data. Anthropometric measurements were used to collect nutritional status data based on height for age and weight for age. Height measurements were taken in two trials to ensure the accuracy of the data. The instrument used was a calibrated microtoise from SECA 206 model.

Data on daily consumption intake and nutritional intake were obtained using the 24-hour food recall method, which was conducted over 2 days at the beginning of the study, and data on food consumption were converted to nutrient intake using the Nutrisurvey (Indonesian database). In this study the category of nutritional intake was less and good with a cut off point of 80% of the Indonesia's RDA table (2013).

### Data analysis

All statistical analysis were done with SPSS version 17. The dependent variable in this study was stunting and the independent variables were macronutrient (energy, carbohydrate, protein, and fat) and micronutrient (calcium, iron, zinc, vitamin A, and vitamin C) intakes. Confounding variables in this study were the number of family members, family income, father's occupation, mother's occupation, father's education, mother's education, breast milk history, birth weight, RTIs history, diarrhea history, mother's nutrition literacy, and mother's knowledge level.The frequency distribution was tested in univariate analysis. A chi-square test with a level of significance of $p<0.05$ and a 95% CI was employed with bivariate analysis to examine the extent of the link between factors assumed to be connected to stunting.

Multiple logistic regression analysis was performed on variables arising from bivariate selection that had a $p<0.25$ or were regarded as significantly related to stunting, the variable were family income, mother's education, birth weight, energy intake, carbohydrate intake, protein intake, fat intake, calcium intake, iron intake, vitamin C intake, vitamin A intake, and zinc intake.

## RESULTS AND DISCUSSION

Data from a total 121 respondents aged 25–30 months in Central Jakarta were successfully collected. The percentage of stunting in a study at selected locations in Central Jakarta in children aged 25 to 30 months was 29.8%. The percentage of stunted children in this research was higher than the prevalence of stunting in Indonesia, where the percentage according to SSGI (MoH RI 2021) was 24.4%. By 2025, the WHO aims to have lowered the prevalence of stunting among children by 40% (Verma & Prasad 2021).

According to bivariate analysis, stunting in children aged 25–30 months in Central Jakarta in 2019 was connected to birth weight and mother's education ($p<0.05$) (Table 1). In line with the findings of this study, Utami *et al.* (2018) reported that birth weight and birth length were risk factors for stunting in various Asian nations. Additional research indicated that Low Birth Weight (LBW) is the most frequent cause of stunting in children aged 12–23 months (Utami *et al.* 2018). According to the research findings, children with low birth weight are 3.8 times more probable to have stunting than children with normal birth weight. A child's low birth weight might be caused by a deficiency of nutritional fulfillment throughout pregnancy as well as the mother's bad health (Abbas *et al.* 2021).

According to prior research in Vietnam, a history of LBW was a potential factor for the occurrence of stunting in children under the age of three. It is claimed that babies born with LBW problems have an underdeveloped digestive tract, which reduces the digestive tract's ability to absorb fat and digest protein and as the result the body's nutrient reserves are insufficient. Infants born with low body weight often experience development stalling, which is compounded by inadequate or insufficient catch-up growth. Insufficient growth, faltering, and bad catch-up growth situations will result in stunting or conditions indicating an inability to achieve optimal growth in children (Kamilia 2019).

Table 1 shows that mothers with high degree of education are strongly associated with the occurrence of stunting ($p<0.05$). According to the study's findings, mothers with poor education had a 2.8 greater risk of having stunted children than mothers with higher levels of education. Parenting and feeding patterns in the first year of life play a significant role in child development, all of this is influenced by the educational background of the mother and has a significant impact on the quality of her upbringing (Apriluana & Fikawati 2018). In general, mothers with higher education will have a better understanding on health. More educated mothers are more aware of the importance of nutrition and serving their children appropriate meals for their growth and development (Chowdhury *et al.* 2020). Children of mothers with highest level of education below secondary school have a 2.4 times higher risk of stunting than children of mothers with highest level of education level above secondary school (Piniliw *et al.* 2021).

The following bivariate analysis will find out the link between nutritional intake and the prevalence of stunting (Table 2). Eight nutrients, including energy, carbohydrate, protein, fat, calcium, iron, vitamin A and vitamin C intakes appear to be significantly associated to the occurrence of stunting ($p<0.05$). The high ORs for macronutrient intake include energy, carbohydrate, protein, and fat intakes. Table 2 also shows micronutrient intakes with the highest OR being iron, vitamin C, calcium, vitamin A, and zinc intakes.

Table 1. Characteristics of children aged 25–30 months

| Variables | Stunting n=36 | Normal n=85 | Total respondents n=121 | OR | *p* |
|---|---|---|---|---|---|
| | n (%) | | | | |
| Numbers of family members | | | | | |
| Large (>4 people) | 10 (27.8) | 26 (72.2) | 36 (29.8) | Ref | 0.927 |
| Small (<4 people) | 26 (30.6) | 59 (69.4) | 85 (70.2) | 0.8 (0.3–2.0) | |
| Family income | | | | | |
| <Minimum salary level | 26 (35.6) | 47 (64.4) | 73 (60.3) | Ref | 0.124 |
| >Minimum salary level | 10 (20.8) | 38 (79.2) | 48 (39.7) | 2.1 (0.9–4.8) | |
| Father's occupation | | | | | |
| Does not work | 2 (40) | 3 (60) | 5 (4.1) | Ref | 0.990 |
| Working | 34 (29.3) | 85 (70.2) | 116 (95.9) | 1.0 (0.4–2.4) | |
| Mother's occupation | | | | | |
| Does not work | 30 (31.3) | 66 (68.8) | 96 (79.3) | Ref | 0.645 |
| Working | 6 (24) | 19 (76) | 25 (20.7) | 1.4 (0.5–3.9) | |
| Father's education | | | | | |
| Low (<Junior high school) | 12 (30.8) | 27 (69.2) | 39 (32.2) | Ref | 1.000 |
| High (> Senior high school) | 24 (29.3) | 58 (70.7) | 82 (67.8) | 1.1 (0.4–2.4) | |
| Mother's education | | | | | |
| Low (<Junior high school) | 19 (44.2) | 24 (55.8) | 43 (35.5) | Ref | 0.018* |
| High (>Senior high school) | 17 (21.8) | 61 (78.2) | 78 (64.5) | 2.8 (1.2–6.3) | |
| Breast milk history | | | | | |
| <6 Months | 6 (31.6) | 13 (68.4) | 19 (15.7) | Ref | 1.000 |
| >6 Months | 30 (29.4) | 72 (70.6) | 102 (84.3) | 1.1 (0.3–3.1) | |
| Birth weight | | | | | |
| <3,000 g | 21 (47.7) | 23 (52.3) | 44 (36.4) | Ref | 0.002* |
| >3,000 g | 15 (19.5) | 62 (80.5) | 77 (63.6) | 3.8 (1.6–8.5) | |
| RTIs history | | | | | |
| Yes | 9 (33.3) | 18 (66.7) | 27 (22.3) | Ref | 0.824 |
| No | 27 (28.7) | 67 (71.3) | 94 (77.7) | 1.2 (0.4–3.1) | |
| Diarrhea history | | | | | |
| Yes | 6 (42.9) | 8 (57.1) | 14 (11.6) | Ref | 0.350 |
| No | 30 (28) | 77 (72) | 107 (88.4) | 1.9 (0.6–6.0) | |
| Mother's nutrition literacy | | | | | |
| Low (<51) | 17 (34) | 33 (66) | 50 (41.3) | Ref | 0.512 |
| High (>51) | 19 (26.8) | 52 (73.2) | 71 (58.7) | 1.4 (0.6–3.0) | |
| Mother's knowledge level | | | | | |
| Low | 14 (34.1) | 27 (65.9) | 41 (33.9) | Ref | 0.584 |
| High | 22 (27.5) | 58 (72.5) | 80 (66.1) | 1.4 (0.6–3.0) | |

*Significantly related $p<0.05$ as analyzed with bivariate analysis
RTIs: Respiratory Tract Infections; OR: Odds Ratio

The children who are stunted consume a low quantity of nutrients, this is consistent with earlier research that showed macronutrient and micronutrient deficiencies were the most important factors influencing children's nutritional status in various nations (Verma & Prasad 2021). According to other studies, one of the main causes of stunting is a shortage of nutrients such as

Table 2. Characteristics of nutritional intake in children aged 25–30 months

| Variables | Stunting n=36 | Normal n=85 | Total respondents n=121 | OR | *p* |
|---|---|---|---|---|---|
| | n (%) | | | | |
| **Macronutrient** | | | | | |
| Energy intake | | | | | |
| Less (<80% RDA) | 34 (38.6) | 54 (61.4) | 88 (72.7) | Ref | 0.001* |
| Good (>80% RDA) | 2 (6.1) | 31 (93.9) | 33 (27.3) | 9.8 (2.1–43.4) | |
| Carbohydrate intake | | | | | |
| Less (<80% RDA) | 33 (37.5) | 55 (62.5) | 88 (72.7) | Ref | 0.005* |
| Good (>80% RDA) | 3 (9.1) | 30 (90.0) | 33 (27.3) | 6.0 (1.6-21.2) | |
| Protein intake | | | | | |
| Less (<80% RDA) | 11 (61.1) | 7 (38.9) | 18 (14.9) | Ref | 0.004* |
| Good (>80% RDA) | 25 (24.3) | 78 (75.7) | 103 (85.1) | 4.9 (1.7–14) | |
| Fat intake | | | | | |
| Less (< 80% RDA) | 28 (38.9) | 44 (61.1) | 72 (59.5) | Ref | 0.014* |
| Good (> 80% RDA) | 8 (16.3) | 41 (83.7) | 49 (40.5) | 3.3 (1.3–7.9) | |
| **Micronutrient** | | | | | |
| Calcium intake | | | | | |
| Less (<80% RDA) | 31 (36.9) | 53 (63.1) | 84 (69.4) | Ref | 0.017* |
| Good (>80% RDA) | 5 (13.5) | 32 (86.5) | 37 (30.6) | 3.7 (1.3–10.6) | |
| Iron intake | | | | | |
| Less (<80% RDA) | 34 (41.5) | 48 (58.5) | 82 (67.8) | Ref | 0.0001* |
| Good (>80% RDA) | 2 (5.1) | 37 (94.9) | 39 (32.2) | 13.1 (2.9–58.0) | |
| Zinc intake | | | | | |
| Less (<80% RDA) | 18 (40) | 27 (60) | 45 (37.2) | Ref | 0.91 |
| Good (>80% RDA) | 18 (23.7) | 58 (76.3) | 76 (62.8) | 2.1 (0.9–4.7) | |
| Vitamin A intake | | | | | |
| Less (<80% RDA) | 22 (41.5) | 31 (58.5) | 53 (43.8) | Ref | 0.022* |
| Good (>80% RDA) | 14 (20.6) | 54 (79.4) | 68 (56.2) | 2.7 (1.2–6.1) | |
| Vitamin C intake | | | | | |
| Less (<80% RDA) | 31 (41.9) | 43 (58.1) | 74 (61.2) | Ref | 0.001* |
| Good (>80% RDA) | 5 (10.6) | 42 (89.4) | 47 (38.8) | 6.0 (2.1–17.0) | |

*Significantly related $p<0.05$ as analyzed with bivariate analysis

RDA: Recommended Dietary Allowances; OR: Odds Ratio protein, energy, and iron, which are essential for growth and development of toddlers (Sholikhah & Dewi 2022). Children's food intake throughout the first thousand days of life, is strongly associated with brain development. Insufficient nutrition intake in children can contribute to poor motor development, low level of activity, and a lack of interest in the environment (Martiani *et al.* 2021).

The factors included in the multivariate analysis were family income, mother's education, birth weight, energy intake, carbohydrate intake, protein intake, fat intake, calcium intake, iron intake, vitamin C intake, vitamin A intake, and zinc intake ($p<0.25$). By performing the multiple logistic regression tests in the multivariate analysis, it was concluded that iron intake (OR=5.0; 95% CI:1.02–25.24) was the dominant factor in stunting. (Table 3). According to the study's findings, children with low iron consumption are at a higher possibility of stunting than children with good levels of iron. In this population, it was also discovered that 67.8% of children had less iron intake.

Previous research found that children who did not get enough iron had a 2.9 times higher risk of stunting than those who did. Another study in Surakarta revealed that children aged 1–3 years with iron deficiency were 3.2 times more probable to be stunted than children with adequate quantities of iron (Cahyati & Yuniastuti 2019). Iron is necessary for the development of bones, teeth, joints, muscles, and skin. Iron is involved in energy metabolism as well as the process of linear development and proliferation of body tissues (Cahyati & Yuniastuti 2019).

Iron deficiency can cause a child's growth to be stunted. Iron also plays a part in transporting oxygen to all tissues. If oxygenation of the tissues is interrupted, the bones will not grow adequately and the process of bone formation will be slowed down (Cahyati & Yuniastuti 2019; Nugraheni *et*

Table 3. Factors associated with stunting analysed with multiple logistic regression

| Variables | OR (95% CI) | *p* |
|---|---|---|
| First model | | |
| Family income | 2.4 (0.89–6.70) | 0.090 |
| Mother's education | 2.2 (0.63–7.64) | 0.211 |
| Birth weight | 2.6 (0.86–7.89) | 0.081 |
| Energy intake | 9.0 (0.65–124.76) | 0.100 |
| Carbohydrate intake | 0.8 (0.77–9.04) | 0.880 |
| Protein intake | 4.2 (1.07–16.46) | 0.039 |
| Fat intake | 0.6 (0.17–2.46) | 0.533 |
| Calcium intake | 4.0 (1.02–16.08) | 0.046 |
| Iron intake | 11.24 (1.16–108.22) | 0.036 |
| Vitamin C intake | 4.0 (1.02–16.08) | 0.046 |
| Vitamin A intake | 0.7 (0.26–2.28) | 0.647 |
| Zinc intake | 0.6 (0.18–1.96) | 0.400 |
| Final result | | |
| Iron intake | 5.0 (1.02–25.24) | 0.047 |
| Energy intake | 4.6 (0.86–25.24) | 0.074 |
| Vitamin C intake | 2.7 (0.82–9.13) | 0.099 |

OR: Odds Ratio; CI: Confidence Interval

*al.* 2020a). According to Cahyati and Yuniastuti (2019), many stunting cases occur in children with a history of delayed bone growth.

In previous studies, low iron intake was caused by a lack of iron-containing foods. Red meat, chicken liver and cow liver are the finest sources of iron. Iron deficiency is more common in children who eat less iron-rich foods. The incorrect timing of weaning meals according to the child's age might also lead to the inadequate intake of iron (Nugraheni *et al.* 2020a). The findings of this study support the government's goal of promoting animal-based foods for toddlers to reduce stunting. Based on protein consumption per capita, Indonesia has met the national protein consumption adequacy guidelines; however, consumption of animal protein remains rather low. The consumption of eggs in Indonesia is between 4–5 kg/year, that of meat less than 40 g/person, and that of milk and its derivatives is 0–50 kg/person/year (Ministry of Health Republic of Indonesia (MoH RI 2023)). According to other studies, children who are malnourished consume a lot of protein from vegetables but less from animal proteins like fish and milk (Ernawati *et al.* 2016).

Normal children's protein intake was mostly from animal-source foods such as eggs, but the protein intake of stunted children was primarily sourced from legumes (Figure 1). Stunted children, in this population, consumed fewer iron-rich foods derived from animal protein, thus contributing to low iron intake. Animal proteins foods such as meat, fish, chicken, eggs and milk contain a relatively high level of protein (40% higher) compared to protein from vegetable sources (Ernawati *et al.* 2016). Animal proteins provide high levels of amino acids and can increase zinc and iron absorption, which can affect children's growth (Sholikhah & Dewi 2022).

Animal proteins provides amino acids that are necessary for the production of several hormones like thyroid hormone and Human Growth Hormone (HGH), which significantly improves the body's metabolic rate and promotes rapid growth and development (Sholikhah & Dewi 2022). Consuming foods containing animal protein is essential to get the required amounts of iron, which encourages faster growth and lowers stunting's prevalance in children.

Children with low energy intake are 4.6 times greater likely to be stunted than children with a high energy intake (Table 3). According to earlier studies on children aged 25–60 months in Lombok, children with less energy intake had 9.9 times greater risk of stunting than those with good energy intake (Anshori *et al.* 2020). Lack of energy intake will lead to stunted grow in children as a result of lack of nutrients in food. A lack of energy intake can be caused by an irregular eating pattern and a lack of food diversity. One of the factors affecting a child's growth is energy intake. A child's linear growth can be disrupted if the child experiences chronic energy deficiency (Nugraheni *et al.* 2020b).

This study also found that children with less vitamin C intake tend to have higher risk of stunting than children with sufficient vitamin C intake (Table 3). Vitamin C aids in the production of collagen, fiber, and protein structure, as well as

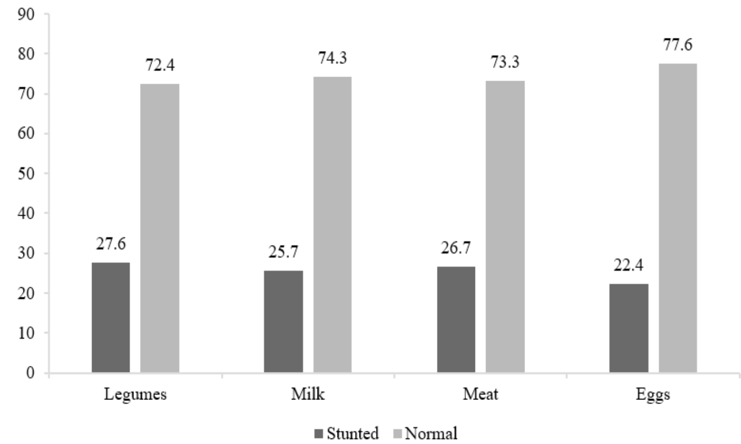


Figure 1. Percentage of children who consume iron-rich foods (n=121)

increasing the body's resistance against infections. Collagen is involved in the development of bones, teeth, and scar tissue and normal collagen cannot be generated in the absence of adequate quantities of vitamin C (Bening *et al.* 2016).

Children who are lacking in vitamin C will have difficulty in forming protein and collagen, which will inhibit their growth and development. A study on pregnant women in Egypt found that blood levels of vitamin C in pregnant women had a significant positive impact on neonatal anthropometry and placental weight. According to this study, other studies also showed that vitamin C had a significant correlation with an increased risk of stunting. Bening *et al.* (2016) discovered that children with insufficient vitamin C intake had a 2.9-fold higher risk of stunting than children with adequate vitamin C intake.

This study has several limitations, including a small sample size and an absence of an accurate description of the incident development process because it is a cross-sectional study. It is suggested that future studies should focus on large samples. According to the results presented in this study, attempts to improve iron consumption through food should be taken into consideration. Good iron consumption will influence behaviour and cognitive functions. Furthermore, iron helps produce hemoglobin, which promotes brain development. Several longitudinal studies have shown that nutrients, including macro- and micronutrients, promote an increase in children's linear growth.

## CONCLUSION

The findings reveal that iron intake is the dominant factor associated with stunting (OR=5.0), after controlling for energy and vitamin C intakes. The study found that 67.8% of children had low intake of iron. The children in the stunting group ate more plant-based proteins than animal protein. Children who do not consume enough iron are more likely to be stunted than those who do. Iron consumption is crucial for preventing stunting and it needs to be met daily in sufficient amount.

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## DECLARATION OF INTERESTS

The authors have no conflict of interest in in the conduct of this study from beginning to end

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