

# The Impact of Iron Supplementation During Pregnancy and Change of Consumption among Stunting Children Aged 6-24 Months During the COVID-19 Pandemic in Indonesia

## Abstract

**Background:** During the COVID-19 pandemic, stunting is estimated to increase 2.4 times higher (It seems that some information is missing here because the usage of the word 'higher' hints at a comparison with some other statistic. Or please consider making the following changes in the statement: "...stunting is estimated to be 2.4 times higher than the normal trend." which can increase mortality, morbidity, and cause economic losses in the future. This study aims to identify the risk factors for stunting during the COVID-19 pandemic. **Methods:** An unmatched case-control study was conducted to compare the exposure of stunted (cases) and non-stunted (controls) children. There were 127 children aged 6-24 months, 43 cases, and 84 controls. **Results:** The probability of stunting was two times greater in children who experienced good changes in the consumption of tofu/tempeh (p: 0.047; AdjustedOR (aOR): 2.296; 95% CI 1.013-5.205) and fourtimes greater in children who have a mother that did not receive iron supplementation during pregnancy (p: 0.030; aOR: 4.344; 95% CI: 1.154-16.355). **Conclusions:** Based on the above results, increasing access to nutritious food, and the delivery of services and information related to maternal and child health services during the pandemic needs to be intensified by using innovative low-risk platforms.

**Keywords:** Consumption, COVID-19, iron supplementation, stunting

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## Introduction

The incidence of stunting is estimated to increase 2.4 times during the pandemic, especially in children from poor families.<sup>[1]</sup> The target for reducing stunting, to be achieved under the 2030 Sustainable Development Goals, is predicted to be increasingly difficult.<sup>[2]</sup> Stunting can cause various diseases, economic losses, and can even endanger future generations.<sup>[3]</sup> In many developing countries, including Indonesia, stunting peaks at the age of 6-24 months.<sup>[4,5]</sup>

In various parts of the world, COVID-19 causes an increase in food insecurity and malnutrition.<sup>[6]</sup> During the pandemic, changes in food consumption also occurred.<sup>[7]</sup> The pandemic is believed to increase the risks of malnutrition in children, one of which causes a decrease in the quality and quantity of food consumption as well as limited access to health services for children.<sup>[1]</sup>

The lack of quality food consumption by children from poor families is almost

double than that of children from well-off families.<sup>[1]</sup> Before the outbreak of COVID-19, the quality and quantity of food being consumed by children aged 6-23 months is quite apprehensive—only 29% of children aged 6-23 months achieve adequate dietary diversity, and only 53% meet the minimum eating frequency.<sup>[8]</sup> Meanwhile, the age of 6-24 months is a period that is quite vulnerable to malnutrition because children are introduced to complementary foods other than breastmilk.<sup>[9]</sup>

Children need to obtain good health services and a supportive environment (availability of clean water, hygiene, sanitation) else they become vulnerable to infection because of the stage of immunity development in their bodies.<sup>[10]</sup> During the pandemic, the quality of maternal and child health services has decreased due to the fact that many health workers who initially handled the health of pregnant women were diverted to take care of COVID-19 patients.<sup>[2]</sup> A study stated that during the first 3 months of COVID-19, the coverage of essential nutrition services

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decreased by 30% in low and middle-income countries and further decreased to 75-100% during the lockdown.<sup>[11]</sup>

This study aims to determine the risk factors for stunting in children aged 6-24 months during the COVID-19 pandemic.

## Methods

### Design

This study was conducted in January - March 2021, after one year of the COVID-19 pandemic, using an unmatched case-control study design to compare exposure to stunted (cases) and non-stunted (controls) children. The case group is children aged 6-24 months who suffer from stunting (z-score index height for age z-score (HAZ) <-2 SD) and the control group is children who do not suffer from stunted (normal) with a HAZ  $\geq$ -2 SD based on WHO Anthro 2006.<sup>[12]</sup> HAZ calculation was carried out using software of WHO Anthro.<sup>[13]</sup>

### Sample and data collection

The sample was children aged 6-24 months who were born and lived in Pasir Putih Village, Sawangan District, Depok City, West Java. This location is one of the stunting loci (out of the 10 loci) with a high stunting rate in Depok City. In 2018, compared to the national figure, West Java Province had a stunting prevalence that was higher than the national figure of 32%.<sup>[5]</sup>

Interviews with mothers from the selected sample using a structured questionnaire were conducted by five trained enumerators and the data collection process follows the health protocol. The data collected includes children's characteristics, health status, parent/family characteristics, socio-demography, environmental factors, children's eating frequency, and hemoglobin levels. Interviews were conducted with mothers from the selected sample using a structured questionnaire. The length of the children was measured using a baby length board with an accuracy of 0.1 cm. Hemoglobin (Hb) level was checked using the Hemocue device with the help of two health workers from the Pasir Putih Village Public Health Centre, Sawangan District, Depok City.

### Variables

The variables analyzed were sociodemographic (gender of the child, mother's age, mother's education, household head occupation, income, number of under-five children, drinking water difficulty), children's health status (birth weight, birth length, exclusive breastfeeding, reported illness, anemia, iron), access to health interventions (iron supplementation during pregnancy, vitamin A supplementation, deworming), and changes in food consumption (red meat, white meat, eggs, tofu/tempeh, fruits, vegetables, processed foods, and dairy products).

Changes in food consumption were defined as 'good' and 'poor'. Changes in consumption were assessed by comparing the frequency before and after the pandemic [Table 1].

### Data analysis

The data analysis was carried out using SPSS version 24.0. Bivariate analysis was carried out using Chi-square statistics to assess potential predictors of stunted, using a significance limit of  $P < 0.25$ .<sup>[14]</sup> Multiple logistic regression analysis was then performed to assess the correlation between risk factors and stunting with a significance limit of  $P \leq 0.05$ .

### Ethical approval

Ethical approval was obtained from the Research Ethics Committee and Community Service, Faculty of Public Health, University of Indonesia. Ethical approval no. 613/UN 2. F10.D11/PPM.00.02/2020. Written informed consent was obtained before data collection.

## Results

### Sociodemographic characteristics

This study consists of 43 cases and 84 controls, a total of 127 children aged 6-24 months. The number of samples of boys and girls is almost the same as shown in Table 2. Most of the children have mothers aged 25 years and over (85%). The number of children is almost the same across categories in maternal education. Among the surveyed, most of the heads of households have an informal job (62.1%), earn less than 3 million per month (73.2%), have 1 under-five child (78.7%), and have never experienced difficulty accessing water (71.7%).

Children with mothers aged 25 years and over tended to have a significantly lower rate of stunting ( $p: 0.107$ ; OR: 0.369 (0.147-1.065)). In addition, children in households who sometimes had difficulty accessing water had significantly higher rates of stunting ( $p: 0.246$ ; OR: 1.607 (0.723-3,570)). There was no significant association between socio-demographic variables and stunting in the multivariate analysis.

### Children's health status and access to health interventions

Table 3 describes the risk factors for stunting related to the children's health status and access to health interventions. The

**Table 1: The Food Consumption Category based on The Change of Consumption Frequency Before and After Pandemic**

Category	Before pandemic	During pandemic
Good	sometimes, rarely, never	often or every day
	often	every day
	often	Often
	every day	every day
Poor	every day	sometimes/rarely/never
	often	sometimes/rarely/never
	sometimes/rarely/never	sometimes/rarely/never

**Table 2: Sociodemographic Characteristics**

Variables	Not stunted		Stunted		Total		Crude odds ratio (95%CI)	P
	n=84	%	n=43	%	n=127	%		
Sex								
Boys	42	50	19	44.2	61	48.0		0.535
Girls	42	50	24	55.8	66	52.0	1.263 (0.604-2.643)	
Mother's age (years)								
<25	9	10.7	10	23.3	19	15		0.107
≥25	75	89.3	33	76.7	108	85	0.369 (0.147-1.065)	
Mother's education								
≥ Senior high	45	53.6	22	51.2	67	52.8		0.797
≤ Junior high	39	46.4	21	48.8	60	47.2	1.101 (0.528-2.299)	
Household Head Occupation								
Formal	26	33.8	18	46.2	44	37.9		0.196
Informal	51	66.2	21	53.8	72	62.1	0.595 (0.271-1.307)	
Monthly income								
<3 million Rp	60	71.4	33	76.7	93	73.2		0.519
>3 million Rp	24	28.6	10	23.3	34	26.8	0.758 (0.323-1.775)	
Number of under-five children <sup>[15]</sup>								
1	68	81.0	32	74.4	100	78.7		0.399
≥2	16	19.0	11	25.6	27	23.3	1.461 (0.609-3.505)	
Drinking water difficulty								
Never	63	75.0	28	65.1	91	71.7		0.246
Yes, sometimes	21	25.0	15	34.9	36	28.3	1.607 (0.723-3.570)	

**Table 3: Health status of child and access to health intervention**

Variables	Not stunted		Stunted		Total		Crude odds ratio (95%CI)	P
	n=84	%	n=43	%	n=127	%		
Birth weight (gram)								
≥2500	78	92.9	37	86.0	115	90.6		0.220
<2500	6	7.1	6	14.0	12	9.4	2.108 (0.637-6.980)	
Birth length (cm)								
≥50	27	32.1	8	15.6	35	27.6		0.099
<50	57	67.9	35	81.4	92	72.4	2.072 (0.847-5.068)	
Exclusive breastfeeding								
No	30	35.7	19	44.2	49	38.6		0.355
Yes	54	64.3	24	55.8	78	61.4	0.702 (0.332-1.485)	
Reported illness proceeding 2 weeks								
No	29	34.5	16	32.7	45	35.4		0.918
Yes	55	65.5	27	68.2	82	64.6	0.890 (0.414-1911)	
Anemia								
No	40	47.6	18	41.9	58	45.7		0.576
Yes	44	52.4	25	58.1	69	54.3	1.263 (0.631-2.651)	
Iron supplementation during pregnancy								
Yes	80	95.2	36	83.7	116	91.3		0.043
No	4	4.8	7	16.3	11	8.7	3.889 (1.071-14.126)	
Vitamin A supplementation								
Yes	83	98.8	43	100	126	99.2		1.000
No	1	1.2	0	0	1	0.8	0.659 (0.581-0.747)	
Deworming								
Yes	78	92.9	38	88.4	116	91.3		0.506
No	6	7.1	5	11.6	11	8.7	1.711 (0.491-5.962)	

results also showed that stunted children tend to have low birth weight, and low birth length, and are not exclusively

breastfed. In addition, stunted children tend to be anemic, have mothers who do not receive iron supplementation during

pregnancy, who do not receive vitamin A supplementation, and who do not receive deworming treatment. The multivariate analysis showed that stunting children were significantly more likely to have mothers who did not receive iron supplementation during pregnancy (p: 0.030; aOR: 4.344; 95% CI: 1.154-16,355) [Table 5].

### Changes in food consumption

During COVID-19, the majority of children surveyed had adverse changes in consumption of red meat and dairy products; while, the consumption of white meat, eggs, tofu/tempeh, and vegetables is mostly good. The number of children who experienced changes in consumption of good or poor quality of fruit was not much different.

Table 4 shows the probability of stunting in children is 1.8 times greater in children who experience good changes in red meat consumption compared to children with poor red meat consumption, although the level of significance is close to significant (p: 0.256; OR: 1.877; 95% CI: 0.760-4.640). In multivariate analysis, the chance of stunting was 2 times greater in children who experienced good changes in tofu/tempeh consumption compared to children with poor consumption (p: 0.047; Adjusted OR (aOR): 2.296; 95% CI 1.013-5.205) [Table 5].

The summary statistical model presented that the Nagelkerke R-squared was 0.091 which implies that 9.1%

of the variability in stunting at birth could be explained by iron supplementation during pregnancy and change in consumption of tofu/tempeh.

Graph 1 shows the difference in frequency between stunted and non-stunted children. In stunted children, the frequency of consumption of dairy products remains good and increases but not in children who are not stunted. However, the frequency of consumption of tofu/tempeh, processed food, and red meat remained good and increased in children who are not stunted. The frequency of other types of food tends not to be too different between stunted and non-stunted children.

### Discussion

During COVID-19 in Indonesia, the government imposed Large-Scale Social Restriction (*Pembatasan Sosial Berskala Besar/PSBB*) which limited peoples' activities from and at home.<sup>[16]</sup> This had an impact on several sectors which resulted in a reduction in staff and a decrease in household income.<sup>[17]</sup> The pandemic disrupts health services, nutrition, and socioeconomic disorders that can lead to an increase in malnutrition in children.<sup>[11]</sup> The longer families suffer from limited access to basic health services and food insecurity due to COVID-19, the worse the impact will be on stunting.<sup>[2]</sup>

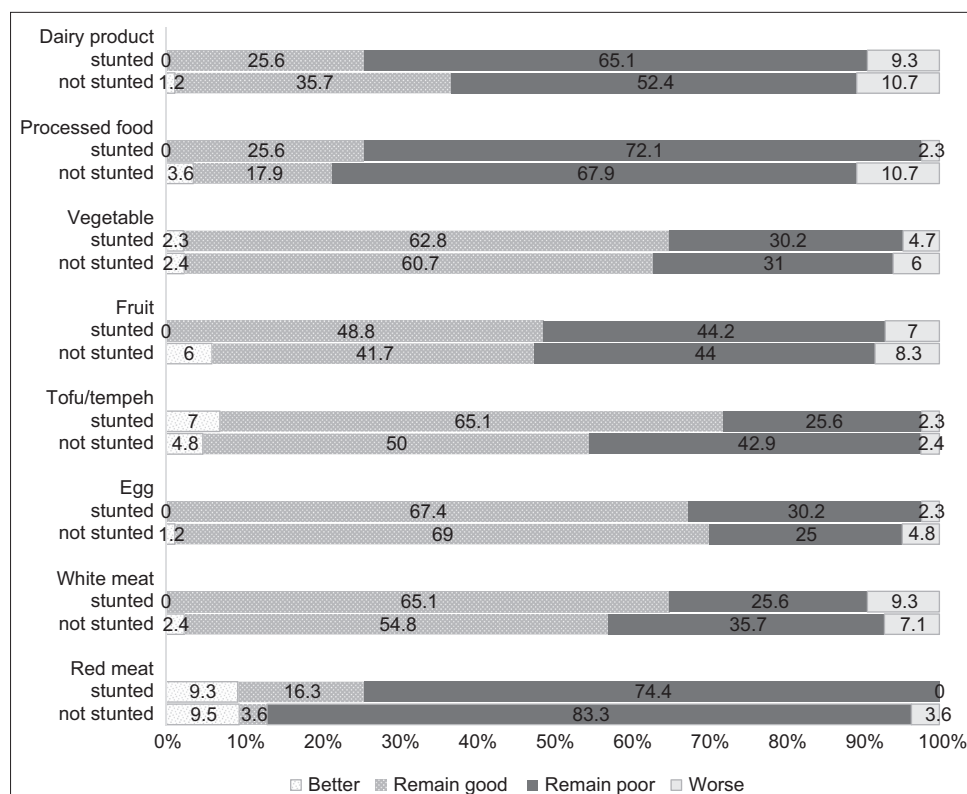
This study showed that the risk of stunting increased more than 3 times in children of mothers who did not receive iron

**Table 4: Food Consumption Status**

Food consumption	Not Stunted		Stunted		Total		Crude OR (95%CI)	P
	n=84	%	n=43	%	n=127	%		
Red meat								
Poor	71	84.5	32	74.4	103	81.1	1.877 (0.760-4.640)	0.256
Good	13	15.5	11	25.6	24	18.9		
White meat								
Poor	36	42.9	15	34.9	51	40.2	1.400 (0.654-2.998)	0.499
Good	48	57.1	28	65.1	76	59.8		
Egg								
Poor	22	26.2	11	25.6	33	26.0	1.032 (0.446-2.391)	1.000
Good	62	73.8	32	74.4	94	74.0		
Tofu/tempeh								
Poor	38	45.2	12	27.9	50	39.4	2.134 (0.966-4.716)	0.089
Good	46	54.8	31	72.1	77	60.0		
Fruit								
Poor	44	52.4	21	48.8	65	51.2	1.152 (0.552-2.404)	0.849
Good	40	47.6	22	51.2	62	48.8		
Vegetable								
Poor	31	36.9	15	34.9	46	36.2	1.092 (0.507-2.353)	0.977
Good	53	63.1	28	65.1	81	63.8		
Processed food								
Poor	17	20.2	11	25.6	28	22	0.738 (0.310-1.757)	0.645
Good	67	70.8	32	74.4	99	78		
Dairy products								
Poor	54	64.3	32	74.4	86	67.7	0.619 (0.273-1.401)	0.339
Good	30	35.7	11	25.6	41	32.3		

**Table 5: Risk factors for stunting among children aged 6-24 months in multivariable analysis**

Variables	Crude		Adjusted	
	odds ratio (95%CI)	P	odds ratio (95%CI)	P
Maternal age (years)				
<25		0.107		
≥25	0.369 (0.147-1.065)			
Household Head Occupation				
Formal		0.196		
Informal	0.595 (0.271-1.307)			
Drinking water difficulty				
Never		0.246		
Yes, sometimes	1.607 (0.723-3.570)			
Birth weight (gram)				
≥ 2500		0.220		
<2500	2.108 (0.637-6.980)			
Birth length (cm)				
≥ 50		0.099		
<50	2.072 (0.847-5.068)			
Iron supplementation during pregnancy				
Yes		0.043		0.030
No	3.889 (1.071-14.126)		4.344 (1.154-16.355)	
Red meat consumption				
Poor		0.256		
Good	1.877 (0.760-4.640)			
Tofu/tempeh consumption				
Not good		0.089		0.047
Good	2.134 (0.966-4.716)		2.296 (1.013-5.205)	
Constanta	0.262			
Nagelkerke R2	0.091			



**Graph 1: Changes in food consumption frequency among stunted and non-stunted children aged 6-24 months, 2020**

supplementation during pregnancy compared to children of mothers who received iron supplementation. This is in line with the findings of previous studies.<sup>[18,19]</sup> A retrospective cohort study showed that iron supplementation reduced the risk of stunting by 14% in children <2 years of age.<sup>[19]</sup> Children of mothers who consumed 120 iron supplements during pregnancy had a higher mean length for age (LAZ) than children of mothers who consumed <120 iron supplements.<sup>[18]</sup>

Giving iron supplementation to pregnant women is very necessary to prevent anemia, puerperal sepsis, low birth weight, and premature birth.<sup>[20]</sup> The results of this study confirm the results of previous studies<sup>[18,19]</sup> which was that the provision of iron supplementation for pregnant women is necessary to prevent stunting children. Although the results of this study indicated that there was no significant relationship between anemia and stunting, the cross-tabulation results showed that the probability of anemia in children whose mothers did not consume iron during pregnancy was 2 times higher than in children whose mothers did not consume iron during pregnancy. Therefore, preventive services must be maintained and expanded by using innovative ways while minimizing risks.

During a pandemic, the quantity and quality of child and maternal nutrition can be affected. There was a 30% reduction in coverage of essential nutrition services in low and middle-income countries and a decline to 75-100% in the event of a lockdown.<sup>[11]</sup> There was also task shifting from maternity services to COVID-19 treatment.<sup>[2]</sup> A similar situation exists in Indonesia where the number of districts/cities that provide maternal and newborn health services reached 23.3%; only 11.7% of Integrated Health Posts (*Posyandu*) are actively providing services (health facilities for monitoring growth and development, immunization, supplementation, and counseling for children and pregnant women)<sup>[21]</sup> and this is very worrying, if this continues.

The results of the multivariable analysis also showed that tofu/tempeh consumption had a significant relationship in the stunting group. The consumption increase of tofu/tempeh may be due to the relatively cheap price of tofu/tempeh, making it more affordable to buy. The price of 500 gr tofu/tempeh is Rp. 7,500 (\$0.5), while red meat is IDR 60,000 (\$4-5). This shift to cheaper food sources is an adaptation to the declining purchasing power of the people.

Tofu/Tempeh is a food source of vegetable protein derived from fermented soybeans. Protein is found in animal and vegetable protein but is much lower in vegetable protein.<sup>[10]</sup> Consumption of animal protein can reduce stunting prevalence by 4.3 percentage points, the more combinations of animal protein consumed the higher the percentage point of stunting that can be reduced.<sup>[10]</sup>

Therefore, although the frequency of consumption of tofu/tempeh as a source of vegetable protein is high, it is not sufficient enough to fulfill the protein needs of children for their growth and development, especially if tofu/tempeh is consumed as a substitute for animal protein sources.

To meet food security, the government prepares social safety net programs for basic needs, especially for low socio-economic families, ranging from cash (unconditional cash transfers) and food aid. One of the social safety net programs provides an unconditional cash transfer of 150 thousand rupiahs (\$10) per month for children under 6 years old.<sup>[22]</sup> This is quite beneficial because a study found that one of the beneficiaries stated that “I never thought I could buy food regularly for my children such as eggs, fish, and vegetables because I did not have enough money”.

COVID-19 has changed patterns of maternal and child health service delivery and child consumption, and perhaps other practices. We suggest future studies on innovation and its impact on delivering maternal and child health services during the pandemic. In addition, we also suggest future studies on consumption impacts on children’s nutritional status and development. Qualitative studies related to the experiences of mothers and children in maintaining health during a pandemic may also be of interest to support our findings.

There are several weaknesses of this study, such as children’s consumption patterns were based on the memories and perceptions of parents, hence, bias might appear. In addition, data on food consumption before the pandemic was reported retrospectively which could lead to recall bias. However, we hope that respondents can distinguish between the time before and after the pandemic because of the contrasting conditions between normal life and a life spent staying just at home (during the pandemic).

Meanwhile, this study has the following strength— to our knowledge, this is the first study conducted to collect various risk factors for stunting including children’s health status of maternal and child health services as well as changes in the frequency of children’s consumption based on recall 24 hours the pandemic. (Phrase unclear/incomplete. Please consider revising.)

## Conclusions

The change of stunting is two times greater in children who experience good changes in tofu/tempeh consumption, and fourtimes greater in children who have mothers that did not receive iron supplementation during pregnancy. Increasing access to nutritious food as well as the delivery of services and information related to maternal and child health services during the pandemic needs to be intensified by using innovative low-risk platforms.

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## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

## Key messages

Health systems that support maternal and child health services must be more innovative and advanced so that they can cover the shortages that occurred during the pandemic. Social support systems should be maintained to help household food security.

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## Conflicts of interest

There are no conflicts of interest.

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