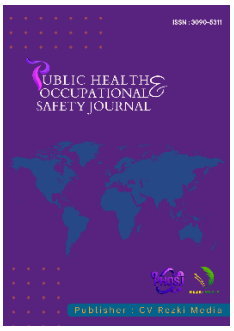

Exploring the interplay of gender, breastfeeding practices, and minimum dietary diversity on stunting among Indonesian children aged 6–23 months

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ABSTRACT

Background: Stunting has the highest prevalence compared to other major malnutrition problems. Risk factors for stunting include gender, breastfeeding, and complementary feeding practices. Stunting requires a faster reduction in prevalence to avoid functional losses in children.

Objectives: This study aimed to determine the association between gender, early breastfeeding initiation, exclusive breastfeeding, breastfeeding status, and Minimum Dietary Diversity with the incidence of stunting.

Methods: This study was an observational analytic study with a cross-sectional approach. The population of the study was children aged 6-23 months in West Java who were sampled by the Indonesian Nutrition Status Study (SSGI) 2021, and the study sample was all members of the population who met the inclusion criteria. Data in this study were obtained through SSGI 2021 documentation and analyzed using the Chi-Square and logistic regression tests.

Results: The results of the bivariate analysis showed a significant association between gender (OR=1.249; 95%CI 1.013-1.540; p=0.042) and breastfeeding status (OR=0.693; 95%CI 0.533-0.901; p=0.007) with the incidence of stunting. Early breastfeeding initiation (p=0.792), exclusive breastfeeding (p=0.059), and MDD (p=0.882) had no significant association with the incidence of stunting in children aged 6-23 months in West Java. Multivariate analysis showed that the most influential factor in the incidence of stunting was gender (OR=1.260; 95%CI 1.022-1.555; p=0.031).

Conclusions: This study shows the association between gender and breastfeeding status on the incidence of stunting. Further research is recommended to explore the role of complementary feeding practices and maternal nutrition in stunting prevention.

Keywords: early breastfeeding initiation, exclusive breastfeeding, minimum dietary diversity, stunting.

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INTRODUCTION

West Java Province has the most significant number of children under the age of 0-4 months in Indonesia, more than 3 million (BPS, 2020a, 2020b), with a stunting prevalence of 24.5% in 2021, which is close to the national rate and shows no significant decrease from 2019 at 26.2% (Kementerian Kesehatan Republik Indonesia, 2021). Stunting has severe impacts, such as increased morbidity, risk of non-communicable diseases, and reduced learning capacity and productivity (Soliman et al., 2021; Umeokonkwo et al., 2020). According to the UNICEF framework, the leading causes of stunting are dietary intake and infectious diseases, with indicators such as breastfeeding (IMD, exclusive and continuous breastfeeding) and complementary feeding (food frequency and diversity), and also influenced by gender (UNICEF, 2020b; Schoenbuchner et al., 2019). This study focuses on the relationship between breastfeeding, complementary feeding, and gender in the incidence of stunting. In 2018, only 42% of children under five were exclusively breastfed (UNICEF, 2020b). In West Java, IMD was 43%, and exclusive breastfeeding for infants 6-23 months was 51.8% in 2021 (Kementerian Kesehatan Republik Indonesia, 2021). Exclusive breastfeeding is associated with stunting (Mutakifah et al., 2022). Exclusive breastfeeding and lack of diversity in complementary foods can lead to stunting and nutrition-related diseases (Black et al., 2013). WHO recommends that infants 6-23 months consume a minimum of five of the eight MDD groups (WHO, 2017), as dietary diversity is closely linked to the incidence of stunting (Paramashanti et al., 2017). However, in 2021, 48% of children under two in West Java and 47.5% in Indonesia did not consume a diverse diet (Kementerian Kesehatan Republik Indonesia, 2021).

In addition to breastfeeding and complementary feeding, gender is also known to be a factor that can contribute to stunting. Children of the male gender have a higher level of vulnerability than females (Schoenbuchner et al., 2019). This is thought to be due to differences in sexual hormones between men and women, especially testosterone, progesterone, and estradiol, which can affect the immune response (Muenchhoff & Goulder, 2014). The results of the 2018 Basic Health Research (Riskesdas) show that the prevalence of stunting in children under two years of age in males is 32.1% in Indonesia and 36.5% in West Java. The prevalence of stunting in female children under two years of age was 27.7% in Indonesia and 25.9% in West Java (Badan Penelitian dan Pengembangan Kesehatan, 2019).

Previous research has shown that the first two years of life are crucial determinants of stunting, obesity, and non-communicable diseases in adulthood. It is also known that stunting before 2 years of age can be an indicator to predict poorer cognitive and educational outcomes in childhood and adolescence. Low height at 2 years is associated with reduced human capital, shorter adult height, and lower education and productivity (Black et al., 2013). The age range of 6-23 months is the period of breastfeeding and complementary feeding and is an important stage of child development. Nutrition interventions during this period also have great potential to prevent and address child nutrition and growth problems (UNICEF, 2020b).

Some previous studies in Indonesia reported different results regarding stunting factors. For example, Sari et al. (2021), in their study published in Kesmas, found that exclusive breastfeeding history was a significant risk factor for stunting in children aged 12-23 months. Meanwhile, Keban et al. (2023) in Fatukbot, East Nusa Tenggara, reported that feeding patterns and exclusive breastfeeding were locally

associated with stunting in children under five. However, most of these studies were limited to analyzing only one of the factors - exclusive breastfeeding or diet - and were only conducted in specific regions such as NTT. There is no comprehensive study that simultaneously investigates the association between gender, early breastfeeding initiation (IMD), exclusive breastfeeding, continuous breastfeeding status, and Minimum Dietary Diversity (MP-ASI) compliance with the incidence of stunting in children under two years of age 6-23 months specifically in West Java Province.

This study is novel because it applies a multi-dimensional approach by examining the interaction of various breastfeeding indicators (IMD, exclusive breastfeeding, continuous breastfeeding), aspects of complementary feeding (minimum food diversity), and child gender as moderator variables. This analytical model has never been applied in West Java, providing a new perspective on how the interaction of these factors affects the risk of stunting in children under two years of age in a local and sex-specific context.

The contribution of this study is crucial in providing a stronger scientific basis for nutrition policy-making. The findings will help provide recommendations oriented towards gender-sensitive interventions, with different strategies for boys and girls, and an emphasis on the importance of a combination of IMD, exclusive breastfeeding, continued breastfeeding, and adequate complementary feeding. This will strengthen public health programs in West Java and provide a more measurable evaluation tool for stunting reduction.

Thus, this study aims to identify the association between gender, early breastfeeding initiation (IMD), exclusive breastfeeding, continuous breastfeeding status, and Minimum Dietary Diversity (MP-ASI) compliance with the incidence of stunting in children aged 6-23 months in West Java Province.

METHODS

Study Design and Participants

This quantitative study uses an observational analytic design using the cross-sectional method. This study looks for the relationship between the independent variables, namely gender, Early Breastfeeding Initiation (IMD), exclusive breastfeeding, breastfeeding status, and Minimum Dietary Diversity (MDD), with the dependent variable, namely the incidence of stunting in children aged 6-23 months. The population of this study were children aged 6-23 months in West Java Province who were sampled in the 2021 SSGI study. The sample determination was carried out using a purposive sampling technique with the criteria that children aged 6-23 months in West Java Province had complete data related to age, gender, body length measurements, and breastfeeding and complementary feeding. The sampling technique resulted in 2,670 samples of children aged 6-23 months in West Java Province. The data used in this study were obtained through the 2021 Indonesian Nutrition Status Study (SSGI) documentation, including age, sex, length/height, length/height measurement method, early breastfeeding initiation, exclusive breastfeeding, breastfeeding status, and MDD.

Ethical approval statement

The Indonesian Nutrition Status Study 2021 as the main data source in this study has been granted ethical approval by the Health Research Ethics Commission, Badan

Penelitian dan Pengembangan Kesehatan (KEPK-BPPK) with letter number LB.02.01/2/KE.248/2021.

Research Instruments

In this study, information on MDD was assessed based on SSGI data, a recall of foods consumed by children under two years of age in the last 24 hours. MDD was measured using eight food groups: breast milk, rice, roots, and tubers; nuts and seeds; dairy products; meat; eggs; vitamin-A-rich fruits and vegetables; and other fruits and vegetables. Children under two years of age are considered to meet the MDD if they consume at least 5 of the eight food groups on the last day. Each child under two years of age will get 1 point for each food group consumed so that the MDD score will range from 0 to 8. The results are then categorized into two categories, namely "Met" if consuming ≥ 5 food groups (total score ≥ 5) and "Not met" < 5 food groups (total score < 5).

Data Analysis

The research data were analyzed through univariate analysis by presenting the frequency distribution of the respondents' characteristics, bivariate analysis using a chi-square test using 5% alpha and 95% Confidence Interval, and multivariate analysis using a logistic regression test.

RESULTS

This study involved 2,670 children aged 6-23 months in West Java Province who were sampled by SSGI 2021 and met the inclusion and exclusion criteria. Table 1 shows that the majority of children under two years of age who were the study subjects were aged 13-23 months (63.4%) and had male gender (50.6%). The study subjects were also dominated by children who did not receive early initiation (51.9%), and most children were exclusively breastfed (51.6%). The most common breastfeeding status in the study subjects was still breastfed (75.9%). In addition, most children under two years of age (53.8%) met the minimum dietary diversity (MDD). As for the classification of stunting in children, it is known that there are 2250 children with normal status (84.3%) and 420 children under the age of two years stunted (15.7%).

The results in Table 2 show that 17.2% of male children and 14.2% of female children had stunting status. The gender variable was found to have a significant association with the incidence of stunting, where male children had a 1.25 times higher risk of being stunted than female children (ORc=1.249; 95%CI 1.013-1.540; p=0.042). There were 15.9% of children who did not receive IMD and 15.5% of children who received IMD who were stunted. However, there was no significant association between early breastfeeding initiation and the incidence of stunting (p-value=0.792). It was also statistically significant that exclusive breastfeeding was not associated with stunting, as the p-value was 0.059 > 0.05. Another variable that did not have a statistically significant relationship with the incidence of stunting was Minimum Dietary Diversity (MDD), with a p-value of 0.882. The breastfeeding status variable was found to have a statistically significant association with the incidence of stunting. Children under two years of age who were no longer breastfed were found to be more protective against stunting than children who were still breastfed (ORc=0.693; 95%CI 0.533-0.901; p=0.007).

Table 1. Sample Characteristics

Characteristic	Frequency (n=2670)	Percentage (%)
Age		
6-12 months	977	36,6
13-23 months	1693	63,4
Gender		
Male	1350	50,6
Female	1320	49,4
Early Breastfeeding Initiation		
No	1386	51,9
Yes	1284	48,1
Exclusive Breastfeeding		
No	1292	48,4
Yes	1378	51,6
Breastfeeding Status		
No	643	24,1
Yes	2027	75,9
Minimum Dietary Diversity (MDD)		
Not Met	1234	46,2
Met	1436	53,8
Incidence of Stunting		
Stunting	420	15,7
Normal	2250	84,3

Table 2. Data Analysis Results

Variable	Incidence of Stunting		OR_c (95% CI)	p	OR_a (95% CI)	p
	Stunting n (%)	Normal n (%)				
Gender						
Male	232 (17,2)	1118 (82,8)	1,249 (1,013 – 1,540)	0,042*	1,260 (1,022 - 1,555)	0,031*
Female	188 (14,2)	1132 (85,8)				
Early Breastfeeding Initiation						
No	221 (15,9)	1165 (84,1)	1,034 (0,840 – 1,274)	0,792	–	–
Yes	199 (15,5)	1085 (84,5)				
Exclusive Breastfeeding						
No	185 (14,3)	1107 (85,7)	0,813 (0,659 – 1,002)	0,059	0,878 (0,705 – 1,092)	0,242
Yes	235 (17,1)	1143 (82,9)				
Breastfeeding Status						
No	79 (12,3)	564 (87,7)	0,693 (0,533 – 0,901)	0,007*	0,719 (0,547 – 0,945)	0,018*
Yes	341 (16,8)	1686 (63,2)				
Minimum Dietary Diversity (MDD)						
Unmet	196 (15,9)	1038 (84,1)	1,022 (0,829 – 1,259)	0,882	–	–
Met	224 (15,6)	1212 (84,4)				

* = *p-value* <0,05

The variables included in the criteria for logistic regression analysis ($p<0.25$) were gender, exclusive breastfeeding, and breastfeeding status. The other variables were not included in the logistic regression model. Logistic regression analysis showed that gender and breastfeeding status had a significant association with the incidence of stunting ($p<0.05$), with an OR of gender of 1.260 and an OR of breastfeeding status of 0.719. Based on these results, it was found that the most influential factor in stunting was the variable with the largest OR value, namely gender (Table 2).

DISCUSSION

Relationship between Gender and Stunting

The findings in this study are that there is an association between gender and the incidence of stunting in children under two years of age. This study shows that boys under the age of two have a 1.25 times higher risk of stunting than girls. This result is in line with the findings of Yuningsih and Perbawati (2022), who found a significant association between sex and stunting ($p=0.04$) and supports the view that sex is a biological risk factor for stunting (Thompson, 2021). A meta-analysis by Thurstans et al. (2020) also showed that malnutrition, such as stunting, wasting, and being underweight, is more common among boys.

Biologically, males have only one X chromosome, which carries immune-critical microRNAs, making them more susceptible to adverse mutations and primary immune deficiencies (Libert et al., 2010; Schurz et al., 2019). Sexual hormone differences also affect the immune system, where testosterone produced due to the SRY gene on the Y chromosome can inhibit the immune system and increase lean body mass and basal metabolism (Fischer et al., 2015; Thompson & Michelle, 2013).

Systemic inflammation due to infections that males are more susceptible to can decrease the production of IGF-1 and IGFBP, which play a role in bone growth, thereby increasing resistance to growth factors (DeBoer et al., 2017; Wu et al., 2015). In addition, higher energy requirements lead to earlier weaning and earlier introduction of complementary foods for male infants, which also increases the risk of stunting (Bork & Diallo, 2017).

Relationship between Early Breastfeeding Initiation and Stunting

Early Breastfeeding Initiation (IMD) is important because it involves skin-to-skin contact and colostrum ingestion. Skin-to-skin contact can prolong the duration of breastfeeding, increase the likelihood of exclusive breastfeeding, and help with body temperature regulation and the transfer of good bacteria from mother to baby (Moore et al., 2016; Pannaraj et al., 2017). Colostrum, rich in growth factors and immune components such as IgA and lactoferrin, is essential for developing the infant's immune system (Ballard & Morrow, 2013; Munblit et al., 2016). Since infants cannot produce their own IgA, a lack of IgA from breast milk can lead to disturbances in the gut microbiota and inflammatory diseases (Guo et al., 2021). High systemic inflammation can also decrease IGF-1 and IGFBP production, triggering resistance to growth factors (DeBoer et al., 2017).

This study found no significant association between IMD and stunting, which aligns with the findings of Nsereko et al. (2018). This discrepancy may be due to the IMD indicator, which only detects skin-to-skin contact, not colostrum or breastfeeding (WHO & UNICEF, 2021). Not all infants can breastfeed within the first hour, and maternal recall may be biased due to labor complications (Carter et

al., 2021). Nonetheless, the risk of stunting in infants without IMD was recorded to be 1.034 times higher. Infants without IMD are more susceptible to hypoglycemia, hypothermia, and metabolic acidosis, which can lead to IGF-1 resistance and impaired bone growth (Bulbul & Uslu, 2016; Zaki & Shanbag, 2023).

The Relationship between Exclusive Breastfeeding and the Incidence of Stunting

Exclusive breastfeeding provides essential nutrients for infant growth and immunity during the first 6 months, but this study found no significant association between exclusive breastfeeding and the incidence of stunting. Similar results were found by Tello et al. (2022), who stated that there was no significant association between exclusive breastfeeding and stunting in children under 2 years of age. Interestingly, this study showed that children not exclusively breastfed appeared to be more protective against stunting (ORc=0.813, 95% CI 0.659-1.002).

This may be due to the different indicators used. The WHO defines the exclusive breastfeeding indicator as children aged 0-5 months who were only breastfed in the last 24 hours (WHO & UNICEF, 2021), but this study's indicator was children who were introduced to liquids/foods other than breast milk at ≥ 6 months of age. While this indicator may avoid bias from pre-lacteal feeding, it has the disadvantage of a long recall period and the risk of inaccurate data (Alayón et al., 2022). Previous studies have shown that recall of exclusive breastfeeding after 6 months has low sensitivity and specificity due to maternal overestimation (Bland et al., 2003). It is also possible that although infants were not introduced to foods other than breast milk until ≥ 6 months of age, they did not receive adequate breast milk before that.

Zong et al. (2020) also found that there was no significant difference in the body length of infants aged 1-6 months who were or were not exclusively breastfed, and children aged 6-12 months who remained breastfed had a lower mean body length than those fed formula. This may be influenced by the post-birth decline of natural growth hormones and the role of genetic factors and complementary feeding practices in the second half of life.

Relationship between Breastfeeding Status and Incidence of Stunting

This study found a significant association between breastfeeding status and incidence of stunting, where children under two years old who were no longer breastfed were more protective against stunting than those still breastfed (ORc=0.693; 95% CI 0.533-0.901). This finding aligns with Jones et al. (2014), who reported a negative association between continuous breastfeeding and stunting, and Nsereko et al. (2018), who showed breastfeeding for more than 1 year as a predictor of stunting because it delays complementary feeding. However, these results do not necessarily mean that better breastfeeding practices increase the risk of stunting, as mothers with malnourished children or living in highly malnourished communities may breastfeed more intensely (Tello et al., 2022). In food insecurity, high breastfeeding may help maintain a child's weight and height through body fat accumulation (Skau et al., 2019). The breastfeeding indicator in this study is not sensitive as children may be breastfed irregularly, as supported by the last 24 hours recall data (Sankar et al., 2015). WHO and UNICEF recommend continued breastfeeding until 2 years or older (WHO & UNICEF, 2021), while the AAP states that breastfeeding can be continued as long as both mother and baby are comfortable (American Academy of Pediatrics, 2012). In Islam, breastfeeding until the child is 2 years old is recommended as long as it does not harm the mother or child (Ismail, 2018).

Relationship between Minimum Dietary Diversity and Incidence of Stunting

Children aged 6-23 months should be given varied complementary foods to meet nutritional needs because breast milk alone is insufficient (UNICEF, 2016). Limited stomach capacity leads to small but rich portions of essential nutrients, and dietary diversity is associated with linear growth (Onyango et al., 2014). WHO recommends Minimum Dietary Diversity (MDD) as measured by eight food groups; children are considered to meet MDD if they consume at least five groups daily (WHO & UNICEF, 2021). Appropriate feeding practices, including the type, timing, amount, and consistency of food, are important to reduce the risk of malnutrition and stunting (UNICEF, 2020a). Food consistency should be gradual from soft to solid, as inappropriate texture or dilution of complementary foods can reduce energy intake (Koletzko et al., 2019). The frequency and amount of food are adjusted according to the child's age and breastfeeding status (UNICEF, 2020a).

This study found no significant association between MDD and stunting, in line with Gassara et al. (2023). Dietary quality is also assessed through Minimum Acceptable Diet (MAD) and Minimum Meal Frequency (MMF), which were not analyzed in this study due to data limitations, possibly leading to bias (Mya et al., 2019; Sankar et al., 2015). However, the risk of stunting was 1.022 times higher in children who did not meet the MDD. Dietary diversity predicts diet quality and micronutrient density (Bandoh & Kenu, 2017; Prado & Dewey, 2014).

Animal foods such as meat, milk, eggs, and poultry are rich in essential micronutrients such as vitamins A, B-12, iron, and zinc, which are difficult to obtain from plants alone (Dror & Allen, 2011). Dairy products support growth through their complete nutritional content (Judit, 2020). Vitamin A is important for growth and immunity but is associated with malnutrition (Abedi et al., 2015). Grains and cereals are also sources of energy and nutrients that help reduce undernutrition (Khamis et al., 2019). Lack of consumption of nutrient-dense foods such as eggs, milk, fruits, and vegetables at 6-23 months of age increases the risk of stunting (Aguayo & Menon, 2016).

Limitations of the study

This study has limitations due to the weakness of the breastfeeding indicators and does not consider the frequency or quantity of breast milk and complementary foods. The recall period for IMD and exclusive breastfeeding variables tends to be long, which may lead to inaccurate data. In addition, the 24-hour recall in the MDD variable cannot eliminate the possibility of inconsistent food diversity.

CONCLUSIONS

This study shows the relationship between gender and breastfeeding status on the incidence of stunting. Other factors, such as IMD, exclusive breastfeeding, and Minimum Dietary Diversity (MDD), were not significantly associated with stunting. Further studies are needed to identify factors contributing to stunting using indicators of frequency, duration, and quantity of breastfeeding, as well as Minimum Acceptable Diet to identify complementary feeding. Based on the results of this study, it is recommended that regular communication and monitoring be carried out to mothers regarding breastfeeding and complementary feeding practices comprehensively by paying attention to aspects of type, frequency, quantity, and method of administration. In addition, it is also recommended that healthcare

facilities ensure the availability of services that allow mothers to deliver through non-vaginal methods so that they can still provide early breastfeeding initiation within one hour after birth.

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DATA AVAILABILITY

The data used and/or analyzed in this study are available from the correspondence author upon reasonable request. Data are not publicly available due to privacy and participant data protection reasons.

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This research received no external funding.

CONFLICT OF INTEREST

The authors declare that there is no potential conflict of interest related to the implementation, analysis, and publication of the results of this study. The entire research process and article writing were carried out independently without any pressure or influence from any party.

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