SOCIAL AND ENVIRONMENTAL FACTORS ASSOCIATED WITH STUNTING IN BATU CITY, EAST JAVA, INDONESIA

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Abstract. Stunting is a health problem with long-term effects on the lives of children. Stunting is still a major issue in Indonesia. To catch up with the next stage of child development, stunted newborns up to 2 years old must be intervened. It is critical to understand what variables contribute to stunting so that appropriate interventions can be implemented to reduce the prevalence of stunting. This study aimed to identify factors that may affect stunted toddlers in Batu City, East Java, Indonesia. The study used a stunting report covering the period from January to June 2023 from the Batu City Public Health Office and the review was performed to analyze the relevant determinants of stunted children under five years in Batu City. The most dominant factor that caused stunting in this research was the level of maternal education. Confounding factors included breastfeeding practices and unhealthy environments. Community participation in initiatives to promote wellness and other health-related efforts to improve the quality of life is suggested.

Keywords: stunting, undernutrition, wasting, risk factors, toddlers, Indonesia

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INTRODUCTION

Stunting is a health problem with long-term consequences for children's lives. Height-for-age less than two standard deviations (SD) below the median of the World Health Organization's Child Growth Standards is considered stunting (WHO, 2014). Stunting is a devastating side effect of poor nutrition throughout pregnancy and the first years of children. Children who are stunted are unlikely to achieve their full height potential or their full cognitive potential in terms of the development of the brain. These children have significant disadvantages from the start of their lives, which affect their ability to learn in school, earn as adults, and participate in their communities. Although stunting has been progressively dropping over the past ten years, it will still impact 148.1 million, or 22.3% of children under the age of five worldwide in 2022 with the vast majority of the affected children in Asia (52% of the world's total population) and Africa (43% of the worldwide population) (UNICEF-WHO-WB, 2023).

Stunting is still a major issue in Indonesia. Based on the data for 2022, Indonesia is included in the category of high prevalence of stunting (31%) (UNICEF-WHO-WB, 2023). Meanwhile, according to the results of the Indonesian Nutrition Status Survey by the Republic of Indonesia's Ministry of Health in 2022, stunting toddlers in East Java are still at 23.5% (Health Development Policy Agency, 2023). This means that stunting must be addressed as an urgent public health problem and requires full attention from the government (Laksono *et al*, 2022b).

Stunting will have a negative impact on the child's growth and development both in the short and long term, which are irreversible. Children who suffer from stunted growth are unable to reach the optimal height for their age. Another disadvatage is its effect on the brain, thus a child's cognitive potential may not be achieved (Putri and Rong, 2021).

In the long term, stunting can have an impact on poor cognition and educational performance, resulting in decreased productivity. Stunting in childhood will also increase the likelihood of giving birth to a smaller child, which in turn can cause its own set of problems for the child (Das *et al*, 2020; Laksono *et al*, 2022a; Sawadogo-Lewis *et al*, 2021; Laksono *et al*, 2022b).

The causes of stunting factors in children are quite sophisticated and complex since they consist of multiple aspects. The interrelationship of household, social, economic, environmental, and cultural factors might have an impact on stunting (Laksono *et al*, 2022b). However, it is widely accepted that mothers perform the most significant role in the care of their children during the most critical growth phase (feeding, care, hygiene, and treatment-seeking) (Sirajuddin *et al*, 2021).

An elevated level of smoking, on the other hand, may be linked to an increase in the prevalence of stunting. According to the National Socio-Economic Survey (SUSENAS), smoking reduces household protein and calorie intake (Djutaharta *et al*, 2022). Additionally, early exposure to smoke can result in respiratory infections like pneumonia and other respiratory disorders that harm a child's growth and development (Muchlis *et al*, 2023). Furthermore, Laksono *et al* (2022b) reported that maternal level of education was causally associated with stunting children under the age of two in Indonesia. Mothers with primary school or lower education are 1.587 times more prone than mothers with college-level education to have children with stunted development under the age of two.

Despite the complexity of the variables causing childhood stunting, there are possibilities for social factors, including family economic level, dietary patterns, history of breastfeeding/exclusive breastfeeding, and maternal education level, and environmental factors such as residential environment throughout the first 1000 days of a child's life to affect the child' s growth. Stunting neonates and children up to the age of two must

be treated to move on to the next stage of development. Understanding the factors that lead to stunting is crucial so that the right treatments may be put in place to lower the stunting prevalence. Therefore, researchers were interested in understanding the factors that contribute to stunting in children under the age of five in Batu City, East Java.

MATERIALS AND METHODS

Study design and setting

The study analyzed the current significant factors in the development of stunted children under the age of five in Batu City using an unpublished stunting report covering the period from January to June 2023 from the Batu City Public Health Office.

Data collection, management and analysis

This study utilized the secondary data which were the results of nutritional status monitoring activities conducted by community health centers in the working area of the Batu City Health Service in January-June 2023. The data selected for analysis came from 16 villages Batu City, including 1,046 stunted toddlers aged under 5 years.

Data retrieved by researchers from these stunted toddlers were family economic level, dietary patterns, residential environment, maternal education, and history of breastfeeding/exclusive breastfeeding.

Descriptions of each variable were as follow:

Stunting was defined based on length/height for age, which is less than -2 standard deviation (SD) on the WHO growth curve (WHO, 2020).

Family economic level was divided into two categories, namely low economic level, and high economic level. The economic level is assessed from the poverty line. If the average monthly per capita expenditure of a family is below or equal to the poverty line, it is categorized as poor/low economic level. We used the most recent poverty line of Batu City available (IDR 522,819) (Central Bureau of Statistics of Batu City, n.d.).

Dietary patterns were divided into two categories, namely four-star diets and less than four-star diets. A four-star diet has been proposed for infants and young children fed in four food groups, each represented by a star. The four stars consist of beans, fruits and vegetables, basic energy (white rice, brown rice, bread, potato, corn, taro, noodles), and animal products (chicken, fish, fish, beef, shrimp, egg, quail egg, milk). If a toddler's diet does not meet these four groups, it is said to be a diet of fewer than four stars (UNICEF, 2022).

Residential environments consisted of two categories, namely clean environments and less clean environments. In accordance with the Ministry of Health's program, namely the Healthy Indonesia Program with a Family Approach, and indicators of clean and healthy living behavior, a clean residential environment is reflected in several things including no family members smoking, having access to clean water facilities, and having access or use healthy latrines (Republic of Indonesia's Ministry of Health, 2021). The environment is considered clean if all three indicators are met. If even one of these is not met, it falls into the less clean environment category.

History of breastfeeding/exclusive breastfeeding was classified into two types: not being given breast milk/exclusive breastfeeding and being given breast milk/exclusive breastfeeding. The not being given breast milk/exclusive breastfeeding group is children who are not breastfed, while the other group is children who are breastfed, either exclusively or not.

Maternal education level referred to in the research was the mother's last formal education, as well as having a diploma. Education level is categorized into low (≤9 years of education) and high (>9 years of education).

In term of data analysis, univariate analysis was performed on all the variables using a table of frequency distributions that shows the distribution and proportions of each parameter. The relationship between the independent variables together with the dependent variable was determined through a regression test using Statistical Package for Social Sciences (SPSS) version 20 (IBM, Chicago, IL). The aim of this modeling is to validate the relationship between the independent variable and the dependent variable. In the regression analysis, we first assessed the bivariate relationships between the independent variables (family economic level, dietary patterns, residential environment, maternal education, and history of breastfeeding/exclusive breastfeeding) and stunting, then multivariable models with all variables included, followed by identification of the most statistically significant models. Regression analysis produces a log coefficient symbolized by β.

The initial analysis step carried out was bivariate selection. In this stage, independent variables were selected to be included in the model, where variables with a *p*-value >0.25 were not included in the model. After that, an interaction test was carried out. At this stage, an assessment was carried out whether there was an interaction between the independent and dependent variables after being included in the multivariate model. The selection of interaction tests was carried out by gradually removing interaction variables that were not significant (*p*-value >0.05).

The next step was to simplify the model by eliminating confounders with minimal influence on the β coefficient. The confounding test is performed by deleting variables with a *p*-value >0.05 one by one,

beginning with the variable with the highest *p*-value and progressing to the variable with the lowest *p*-value, until the final linear regression model was determined.

Ethical statement

This study has received ethical approval by the Research Ethics Committee of Universitas Negeri Malang (Approval Letter No. 19.01.2/UN32.20.2.9/LT/2024).

RESULTS

Batu City is a city in East Java Province which is a separate part of Malang Regency as explained in Law Number 11 of 2001 concerning the Establishment of Batu City. Previously, the Batu City area was part of North Malang Development Area Subunit 1 (SSWP 1). Together with Malang Regency and Malang City, Batu City is part of the regional unity known as Greater Malang. Batu City is known for its excellence in the tourism and agricultural sectors, which later became the main economic sources (BPK Representative of East Java Province, n.d.).

Table 1 displays the frequency distribution of stunting risk factors included in this study and the bivariable relationships between these factors and stunting. Based on Table 1, it is known that more than half of stunted toddlers (57.9%) have families with a high economic level and the majority of stunted toddlers (79.4%) have a less than four-star diet. The majority of stunted toddlers are also known to live in a clean environment (83.5%) and have mothers with a high level of education (76.8). Apart from that, almost 78% of stunted toddlers received breast milk/exclusive breastfeeding.

Table 1

The frequency distribution of stunting risk factors and the bivariable relationships between these factors and stunting (N = 1,046)

Variable	Frequency *n* (%)	*p*-value	β	95% CI
Family economic level[a]		0.028	-0.07	-0.132, -0.009
High	606 (57.9)			
Low	440 (42.1)			
Dietary pattern[b]		0.765	-0.011	-0.085, 0.064
Four-star diets	215 (20.6)			
Less than four-star diets	831 (79.4)			
Residential environment[c]		0.136	0.136	-0.013, 0.285
Clean	873 (83.5)			
Less clean	173 (16.5)			

Table 1 (cont)

Variable	Frequency *n* (%)	*p*-value	β	95% CI
Maternal education[d]		0.006	0.173	0.059, 0.287
High	803 (76.8)			
Low	243 (23.2)			
History of breastfeeding/exclusive breastfeeding		0.076	0.076	-0.041, 0.194
Given breastmilk/exclusive breastfeeding	813 (77.7)			
Not given breastmilk/exclusive breastfeeding	233 (22.3)			

[a]Family economic level is classified as follow. High: a family's average per capita expenditure per month is >IDR 522,819; Low: a family's average per capita expenditure per month is ≤IDR 522,819
[b]Dietary pattern is classified as follow. Four-star diets: a child's diet consists of beans, fruits and vegetables, basic energy, and animal products; Less than four-star diets: a child's diet that does not include all four types of food)
[c]Residential environment is classified as follow. Clean: no family members smoking, having access to clean water facilities, and having access or use healthy latrines; Less clean: a family does not meet one or more of those three indicators)
[d]Maternal education is classified as follow. High: >9 years of education; Low: ≤9 years of education)
β: the log coefficient from the results of the regression analysis; CI: confidence interval; IDR: Indonesian Rupiah

Of the five variables, only two variables were associated with stunting at the $p \leq 0.05$, although the nature of the associations was not necessarily as anticipated. Mothers with higher education, as anticipated, are protective factors against stunting (p=0.006). Meanwhile, families with a high economic level are associated with a greater incidence of stunting compared to those with lower economic status (p=0.028). There was no significant relationship between the incidence of stunting and dietary pattern (p=0.765), residential environment (p=0.070), and history of breastfeeding/exclusive breastfeeding (p=0.183).

Two sets of multivariable log-linear regression results are displayed in Table 2. In accordance with the requirements of multivariate modeling, dieteary pattern with a p-value of >0.25 as shown in Table 1, are not included in the regression model. Therefore, in the first model, four variables, namely family economic level; residential environment; maternal education; and history of breastfeeding/exclusive breastfeeding, were included in the regression. There were no p-values less than 0.05 in the interaction test, hence no interaction variables were identified. In the second model, we parsed variables from the first model using a backward elimination process.

According to this study, the mother's educational level is one of the primary reasons for stunting in children in Batu City. Our research results, as can be seen in Table 2, show that mothers with higher education are associated with a reduction in the ratio of stunting toddlers by 14.3% (β=0.143). The residential environment and breastfeeding/exclusive breastfeeding variables were found to be confounding variables. Families who live in less clean environments have a risk of stunting toddlers around 6.3% higher (β=0.063) than families who live in clean environments (p=0.341), while toddlers who are not given breast milk/exclusive breast milk have a 5% (β=0.050) higher risk of stunting toddlers than toddlers who are given breast milk/exclusive breast milk (p=0.272).

Table 2

Linear regression results for stunting incidents and associated factors (full and reduced models)

Factor	Full model		Reduced model	
	β	95% CI	β	95% CI
Family economic level	-0.012	-0.091, 0.067	N/A	N/A
Residential environment	0.057	-0.092, 0.206	0.063	-0.075, 0.200
Maternal education	0.132	-0.017, 0.281	0.143	-0.075, 0.200
History of breastfeeding/exclusive breastfeeding	0.044	-0.064, 0.152	0.050	-0.045, -0.146

β: the log coefficient from the results of the regression analysis; CI: confidence interval; N/A: The variable is not a confounder, hence it is not included in the reduced model

DISCUSSION

The most dominant factor which caused stunting in this research was the level of maternal education. Children of low-education mothers were more likely to be stunted than children of higher-education mothers. These findings were consistent with the results of other research study that found a link between maternal education level and the prevalence of stunting (Laksono *et al*, 2022a). The higher the mother's educational level, the greater the potential for the child's development. Working mothers with a higher level of education have better knowledge of meeting their children's needs; this condition applies physically, psychologically, and socially because the caregivers' mental health and parents' parenting techniques are influential (Laksono *et al*, 2021; Laksono *et al*, 2022a).

Our finding revealed that exclusive breastfeeding practice is a confounding factor in stunting. WHO and UNICEF encourage commencing nursing within one hour of delivery, exclusive breastfeeding until the age of six months, and initiating complementary feeding with breastfeeding at six months of age as well as continuing breastfeeding for up to two years (WHO, 2023; UNICEF, 2018). Early breastfeeding initiation becomes critical for future breastfeeding success and ensures that children receive appropriate nutrients, lowering the risk of stunting (Muldiasman *et al*, 2018; Susianto *et al*, 2022).

The benefits of starting breastfeeding early may minimize the risk of neonatal morbidity and mortality (Simanjuntak *et al*, 2018). Pre-lacteal non-human milk antigen feeding may disrupt normal physiological gastrointestinal priming and increase the risk of partial breastfeeding within a child's first 6 months, which is thought to be associated with stunting (Kismul *et al*, 2017; Simanjuntak *et al*, 2018). From birth to 6 months of age, breast milk is the finest supply of nutrients for infants.

The milk produced by mothers provides the essential vitamins, minerals, and substance that newborns need (Yuliastini *et al*, 2020). The crucial node that indicated stunting was exclusively breastfeeding (Satapathy *et al*, 2021). Early breastfeeding increases the likelihood of exclusive breastfeeding, resulting in stunting prevention (Susianto *et al*, 2022). According to a recent study, the mother's education degree has had a positive effect on exclusive breastfeeding practice in Indonesia. Higher education levels were associated with higher levels of self-efficacy. The mother's education level was related to the practice of exclusive breastfeeding (Laksono *et al*, 2021). Malnutrition has been associated to a reduced immune system, and children have been shown to be chronically malnourished due to low food intake and frequent intestinal diseases (Kragel *et al*, 2020; Yuliastini *et al*, 2020). To enhance child feeding habits and reduce childhood malnutrition, optimal methods for breastfeeding should be emphasized (Aakre *et al*, 2017).

Our finding revealed that an unhealthy environment is a confounding factor in stunting. Stunting has been linked to unsanitary situations via a variety of processes and routes, including recurrent diarrhea, infection pathways, and environmental enteric dysfunction (EED) (Kwami *et al*, 2019). The household environment showed a strong association between Water, Sanitation, and Hygiene (WASH) and children with stunted growth (Lee *et al*, 2021). Even though the unhealthy environment is a confounding factor in this study, managing structural variables (such as the supply of water and behaviors) integrated with other nutritional determinants (such as food quality and quantity) may offer the chances for a more powerful, more focused and comprehensive strategy for stunting management (Kwami *et al*, 2019).

Interestingly, the findings revealed a positive association between high economic status and increased rates of stunting in families.

A study shows that low-income families and high incomes have almost the same number of stunted toddlers (Rahayuwati *et al*, 2023). Stunting is generally associated with low overall socio-economic conditions and/or repeated exposure to diseases or events that can harm health. Thus, family income is not the only factor that can cause stunting in toddlers. The different lifestyle patterns of each family also contribute to the risk of stunting, such as the ability to provide sufficient food, the ability to utilize local food ingredients, as well as the ability to prevent and control infectious diseases (Fikrina, 2017). Research shows that as many as 30% of wealthy families experience stunting due to insufficient awareness and incorrect parenting patterns in providing adequate nutrition (Aida, 2019). This indicates that the underlying cause of these nutritional problems is poverty and a lack of public knowledge about healthy lifestyles and optimal nutrition. The family's low economic status will reduce the opportunity to buy food of better quality and quantity. However, even so, these factors still depend on how a person uses their income and education to meet children's nutritional needs, and other factors can increase the risk of stunting (Yunita *et al*, 2022).

Stunting can be affected by a multitude of aspects, such as household, nutritional, and healthcare elements, at both the personal and social levels. Enhancing family income, empowering women, improving dietary variability among mothers and their children, as well as strengthening maternal healthcare systems will be important steps in reducing under-five stunting as early as possible (Ayelign and Zerfu, 2017).

This study's shortcoming is that it applied a cross-sectional retrospective descriptive study which made it unable to explain the underlying cause of the stunting factors. Furthermore, researchers lack control over variables in secondary data, influencing the reliability and validity of conclusions. To address the limitations of this study,

alternative methodologies such as longitudinal studies, mixed-methods approaches, and community-based participatory research may be useful for future research, allowing for a more in-depth exploration of causal relationships, contextual understanding, and community engagement.

In conclusion, the most dominant factor which caused stunting in this research was the level of maternal education. Confounding factors include breastfeeding practices and unhealthy environments. It is suggested that members of the public be involved in community outreach and other forms of health-related initiatives to improve the overall well-being. Parents also need to regularly participate in the community-based *posyandu* to ensure that their children's growth and development can be continuously observed. Therefore, any issues related to the growth and development of the child can be treated quickly.

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CONFLICT OF INTEREST DISCLOSURE

The authors declare no conflict of interest.

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