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Original Article

Hygiene and Sanitation Towards the Incidence of Stunting in Children Under Five Years Old in Bidara Cina Villege, East Jakarta in 2024

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Abstract

Stunting remains a critical public health issue in East Jakarta, with Bidara Cina Village identified as one of the areas facing significant challenges related to hygiene, sanitation, and nutrition among toddlers. This study aimed to analyze the relationship between hygiene and sanitation practices and stunting, while also considering individual and family factors among children under five years old (0–60 months) in Bidara Cina Village, East Jakarta, in 2024. A cross-sectional study design was employed, involving 126 respondents, with data collected through observations and interviews. Data analysis included bivariate analysis (Chi-square test) and multivariate analysis (Multiple Logistic Regression). The bivariate analysis revealed significant associations between stunting and hygiene and sanitation practices, including handwashing with soap ($p = 0.01$; OR = 9.828), ownership of personal toilet facilities ($p < 0.001$; OR = 9.750), and the physical quality of water ($p < 0.001$; OR = 4.713). Individual factors such as age (49–60 months; $p < 0.001$; OR = 0.350) and history of illness or infection ($p < 0.001$; OR = 4.631), as well as family factors such as socioeconomic status ($p = 0.003$; OR = 6.00) and smoking behavior ($p = 0.004$; OR = 4.245), also showed significant associations. The conclusion of this study is based on the multivariate analysis identified ownership of toilet facilities ($p = 0.004$; OR = 5.068) and the age range of 49–60 months ($p = 0.011$; OR = 1.528) as the most influential factors, contributing to 33.2% of stunting cases among toddlers in Bidara Cina Village. Efforts to address stunting in this area should prioritize improving access to sanitation facilities and targeting interventions for older toddlers.

Keywords: *Children Under Five Years Old; Hygiene; Sanitation; Stunting*

Introduction

The issue of stunting among toddlers in Indonesia remains a major concern due to its high prevalence, despite a slight decrease. Recent data indicate that the prevalence of stunting in Indonesia decreased from 24,4% in 2021 to 21,6% in 2022 (Kementerian Kesehatan Republik Indonesia, 2023). Although Jakarta has the second-lowest stunting prevalence in Indonesia at 14,8% (Badan Kebijakan Pembangunan Kesehatan, 2022), the province of DKI Jakarta, still the nation's capital, has yet to achieve its target prevalence of 13,2% (Kementerian Kesehatan Republik Indonesia, 2023). Notably, East Jakarta is the region within DKI Jakarta with the highest number of stunting cases, reaching up to 11.147 cases (Badan Pusat Statistik Kota Jakarta Timur, 2023).

Modern, Sauli and Mpolya (2020) elucidate that stunting is caused by chronic diarrhea, repeated exposure, and reinfection, as well as untreated diarrhea in children under 24 months. This aligns with findings by Ghosh *et al*. (2021), which indicate that diarrhea triggered by water contamination and inadequate sanitation can affect nutrient absorption due to reduced food spending in the stomach,

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potentially leading to malnutrition and worsening children's overall health. Anato (2022) also found that poor sanitation and hygiene practices contribute to diarrhea, which causes malnutrition in children under five globally, with the proportion of cases reaching 50%.

It is crucial to further investigate the issue of stunting due to sanitation and hygiene in children under five, as the short-term consequences of stunting include decreased psychomotor and mental development, increased healthcare costs, and the costs of caring for sick children. Children who experience stunting early in life are at risk of experiencing stunting in adulthood and are more likely to suffer from chronic diseases such as obesity, hypertension, kidney disorders, and diabetes mellitus. Stunting in toddlers also has implications for their adult lives, correlating with lower levels of education and economic productivity (Fooken & Vo, 2021). The World Bank estimates that each 1% decrease in adult height due to stunting results in a 1,4% loss in economic productivity. Women who experience stunting are also at increased risk of perinatal and neonatal mortality (Stewart *et al*., 2013).

According to the December 2023 report of the Integrated Service Post (Posyandu) in Bidara Cina Village, 27.2% of toddlers are classified as below the red line (BGM) on the Child Growth Chart (KMS), verified and validated with the nutritional status of TB/U, indicating a prevalence of stunting. The researcher selected Bidara Cina Village for this study due to its high stunting rate (27.2%) compared to the rates in DKI Jakarta (14.8%) and nationally (21.6%). Additionally, Bidara Cina Village has only 71.28% adequate sanitation, below the national average of 80,92% (Badan Pusat Statistik, 2022). Bidara Cina Village has a population of 1406 toddlers, sufficient to meet the minimum sample population required by the researcher (116). This urgency drives the researcher to further explore the relationship between sanitation and hygiene and the incidence of stunting in toddlers in Bidara Cina Village, East Jakarta, in 2024.

A. *Stunting*

Stunting is literally defined as a condition where a child's height, in standard deviation units against the median of the WHO Child Growth Standards, falls below -2 SD and -3 SD (UNICEF, 2013). This indicates a failure to achieve growth in accordance with age standards, which can have long-term impacts. The causes of stunting include inadequate nutritional intake, low food quality, and an increase in infectious diseases, or a combination of these factors.

Table 1: Classification of Nutritional Status Assessment for Children Under 5 Years Based on Height-for-Age (HFA) and Length-for-Age (LFA) According to the Regulation of the Ministry of Health of the Republic of Indonesia Number 2 of 2020 on Child Anthropometric Standards

Nutritional Status Category	***Z-score***
Severely Stunted	< -3 SD
Stunted	-3 SD until < -2 SD
Normal	-2 SD until +3 SD
Tall	> +3 SD

Source: Ministry of Health of the Republic of Indonesia (2020).

Note:

- *Z-score*: A standard measure from the World Health Organization (WHO) and the Multicentre Growth Reference Study (MGRS) used to assess the antropometric status of children
- SD: Standard deviation

B. *Hygiene and Sanitation*

Hygiene and sanitation are crucial determinants of public health, particularly in preventing stunting among children (Anggraeni *et al*., 2023). Hygiene, including practices like handwashing with soap, reduces the risk of infectious diseases such as diarrhea, which can impair nutrient absorption and hinder growth (Sahiledengle *et al*., 2022; Voth-Gaeddert *et al*., 2018). Sanitation focuses on creating a hygienic environment, such as providing access to safe water and proper waste disposal, both of which directly

impact health outcomes (Ademas *et al*., 2021; Gaffan *et al*., 2023). For example, open defecation not only increases the risk of fecal contamination but also contributes to environmental enteropathy (EE), a condition that disrupts nutrient absorption and exacerbates stunting (Mumin *et al*., 2023; Soboksa *et al*., 2021). Studies have shown that households relying on unimproved drinking water sources have lower height-for-age Z-scores, highlighting the link between water quality and stunting (Oginawati *et al*., 2023; Sangalang *et al*., 2022). These findings underscore the importance of addressing hygiene and sanitation as foundational interventions for reducing stunting.

C. *Toddlers Individual's Factors*

The early years of life, particularly the first 1,000 days, are a critical window for growth and development. Nutritional deficits during this period can lead to irreversible stunting, with boys reportedly more vulnerable than girls (Chirande *et al*., 2015; Tamir *et al*., 2022). Exclusive breastfeeding plays a protective role by providing essential nutrients, while immunization safeguards against infectious diseases that could further compromise growth (Logarajan *et al*., 2023; Brahima, Noor & Jafar, 2020). Moreover, infectious diseases such as diarrhea disrupt nutrient absorption and increase the metabolic demands on the body, creating a vicious cycle between malnutrition and illness that heightens the risk of stunting (Khalil *et al*., 2018; Modern, Sauli & Mpolya 2020). These individual factors emphasize the interplay between nutrition, disease prevention, and caregiving in shaping a child's growth trajectory.

D. *Family's Factors*

Family characteristics, including maternal education, occupation, and socioeconomic status, significantly influence a child's nutritional status. Educated mothers are more likely to adopt effective childcare practices, such as balanced nutrition and hygiene, reducing the risk of stunting (Hurley *et al*., 2021; Chirande *et al*., 2015; Fitriani & Herliana, 2024). Additionally, maternal occupation and household income impact the availability of resources needed for adequate child care (Ndagijimana *et al*., 2024). Socioeconomic challenges, including food insecurity and household smoking habits, exacerbate the risks of malnutrition and poor health outcomes (Danso & Appiah, 2023; Gaffan *et al*., 2023; Pangaribuan *et al*., 2023). These findings highlight the multifaceted role of family factors in addressing stunting and the need for targeted interventions that consider the broader social determinants of health.

Material and Methods

This study employs a cross-sectional design to examine the relationship between variables among mothers with toddlers aged 0–59 months in the Bidara Cina sub-district, East Jakarta. Data will be collected from April to May 2024 using primary methods such as structured observations and interviews. The target population consists of mothers caring for toddlers in the area, with inclusion and exclusion criteria ensuring a focused and relevant sample. A consecutive sampling method will be used to recruit 126 participants, with the sample size calculated using the hypothesis test formula for two proportions (Lemeshow et al, 1990). Ethical approval will be obtained, and all participants will provide informed consent to ensure ethical standards are upheld.

Data analysis will begin with univariate methods to summarize variables using descriptive statistics such as means, medians, and ranges. A normality test will determine the appropriate bivariate analysis method: Pearson's correlation for normally distributed data or Spearman's correlation for non-normally distributed data. These tests will evaluate the strength and significance of relationships between variables, with multivariate analysis using linear regression applied to variables with a *P*-value < 0.25. The regression model will produce predictive equations, identifying key factors influencing the outcomes. Statistical significance will be determined at a *P*-value ≤ 0.05, and the correlation coefficient will provide insight into the strength of relationships.

Discussion and Results

Table 2: Distribution of Stunting in Toddlers (0-59 months) in Bidara Cina Sub-district, East Jakarta, 2024.

Nutritional Status	Number	Percentage (%)
Normal	58	46
Stunting	68	54
Total	126	100

Table 3: Distribution of Hygiene and Sanitation Variables in Toddlers (0-59 months) in Bidara Cina Sub-district, East Jakarta, 2024

Variable	Number	Percentage (%)
Handwashing with Soap		
Yes	115	91.3
No	11	8.7
Private Latrine Ownership		
Yes	84	66.7
No	42	33.3
Physical Quality of Water		
Good	36	28.6
Poor	90	71.4
Drinking Water Source		
Improved	40	31.7
Unimproved	86	68.3
Total	126	100

Table 4: Distribution of Individual Factors in Toddlers (0-59 months) in Bidara Cina Sub-district, East Jakarta, 2024

Variable	Number	Percentage (%)
Age		
0-12 months	18	14.3
13-24 months	19	15.1
25-36 months	30	23.8
37-48 months	27	21.4
49-60 months	32	25.4

Gender		
Female	64	50.8
Male	62	49.2
Exclusive Breastfeeding		
Yes	82	65.1
No	44	34.9
Immunization Completeness		
Complete	111	88.1
Incomplete	15	11.9
Nutritional Status and Consumption		
Good	114	90.5
Poor	12	9.5
History of Disease or Infection		
Good	69	54.8
Poor	57	45.2
Total	126	100

Table 5: Distribution of Family Factors in Toddlers (0-59 months) in Bidara Cina Sub-district, East Jakarta, 2024

Variable	Number	Percentage (%)
Mother's Age		
<20 years	2	1.6%
20-35 years	93	73.8%
>35 years	31	24.6%
Mother's Education		
College graduate	19	15.1%
High school graduate	64	50.8%
Junior high school graduate	35	27.8%
Elementary school graduate	7	5.6%
No formal education	1	0.8%
Mother's Employment		
Not employed	107	84.9%
Employed	19	15.1%

Family Socioeconomic Status		
Low (<1 million IDR/month)	16	12.7%
Medium (1-5 million IDR/month)	91	72.2%
High (>5 million IDR/month)	19	15.1%
Smoking Behavior from Family Members		
No	26	20.6%
Yes	100	79.4%
Total	126	100%

Table 6: Relationship Between Hygiene and Sanitation Variables with Stunting in Toddlers (0-59 months) in Bidara Cina Sub-district, East Jakarta, 2024

Variable	Stunting N (%)	Normal N (%)	OR	CI 95%	*P-Value*
Handwashing with Soap					
Yes	58 (50.4%)	57 (49.6%)	9.828	1.218 – 79.287	0.01*
No	10 (90.9%)	1 (9.1%)			
Private Latrine Ownership					
Yes	32 (38.1%)	52 (61.9%)	9.750	3.696 – 25.720	<0.001*
No	36 (85.7%)	6 (14.3%)			
Physical Quality of Water					<0.001*
Good	10 (27.8%)	26 (72.2%)	4.713	2.019 – 10.998	
Poor	58 (64.4%)	32 (35.6%)			
Drinking Water Source					
Improved	18 (45%)	22 (55%)	1.698	0.797 – 3.615	0.184
Unimproved	50 (58.1%)	36 (41.9%)			

**P-value<0.05*

Based on Table 6, the Chi-Square test analysis reveals a significant association between handwashing with soap, personal latrine ownership, and the physical quality of water with stunting. The proportion of stunted toddlers is higher in households without a personal latrine and in households with poor physical quality of water. Toddlers whose mothers do not practice handwashing with soap are 9.828 times (1.218 – 79.287) more likely to experience stunting compared to those whose mothers do practice handwashing with soap. Additionally, toddlers living in households without a personal latrine are 9.750 times (3.696 – 25.720) more likely to be stunted compared to those in households with a personal latrine. Furthermore, toddlers residing in households with poor physical water quality are 4.713 times (2.019 – 10.998) more likely to experience stunting compared to those in households with good physical water quality.

Tabel 7: Relationship between Individual Factor Variables of Toddlers and Stunting in Toddlers (0-59 months) in Bidara Cina Village, East Jakarta in 2024

Variable	Stunting N (%)	Normal N (%)	OR	CI 95%	*P-Value*
Age					
0-12 months	5 (27.8%)	13 (72.2%)	-	-	0.016
13-24 months	9 (47.4%)	10 (52.6%)	0.108	0.029 – 0.407	0.001*
25-36 months	14 (46.7%)	16 (53.3%)	0.252	0.074 – 0.862	0.028*
37-48 months	15 (55.6%)	12 (44.4%)	0.245	0.081 – 0.738	0.012*
49-60 months	25 (78.1%)	7 (21.9%)	0.350	0.113 – 1.084	<0.001*
Gender					
Female	30 (46.9%)	34 (53.1%)			
Male	38 (61.3%)	24 (38.7%)	1.794	0.883 – 3.645	0.112
Exclusive Breastfeeding					
Yes	41 (50%)	41 (50%)	1.588	0.754 – 3.347	0.263
No	27 (61.4%)	17 (38.6%)			
Immunization Completeness					
Complete	62 (55.9%)	49 (44.1%)			0.280
Incomplete	6 (40%)	9 (60%)	0.527	0.176 – 1.581	
Nutritional Status and Consumption					
Good	61 (53.5%)	53 (46.5%)	1.216	0.364 – 4.060	1.00
Poor	7 (58.3%)	5 (41.7%)			
History of Disease or Infection					<0.001*
Good	26 (37.7%)	43 (62.3%)	4.631	2.156 – 9.948	
Poor	42 (73.7%)	15 (26.3%)			

**P-value<0.05*

Based on Table 7, the proportion of stunting is as follows: 27,8% for children aged 0-12 months; 47.4% for children aged 13-24 months; 46.7% for children aged 25-36 months; 55,6% for children aged 37-48 months; and 78.1% for children aged 49-60 months. According to SPSS analysis, the 0-12 months age group serves as the reference group. The analysis indicates a significant relationship between stunting and the 13-24 months age group with an odds ratio (OR) of 0.108 (0.029 – 0.407). This means that children aged 13-24 months are 0.108 times less likely to experience stunting compared to the 0-12 months age group. Similarly, there is a significant relationship between stunting and the 25-36 months age group with an OR of 0.252 (0.074 – 0.862), indicating that children aged 25-36 months are 0.252 times less likely to be stunted compared to the 0-12 months age group. Furthermore, there is a significant relationship between stunting and the 37-48 months age group with an OR of 0.245 (0.081 – 0.738), suggesting that children aged 37-48 months are 0.245 times less likely to be stunted compared to the 0-12 months age group. Lastly, a significant relationship is observed between stunting and the

49-60 months age group with an OR of 0.350 (0.113 – 1.084), indicating that children aged 49-60 months are 0.350 times less likely to be stunted compared to the 0-12 months age group.

Additionally, Table 7 shows a significant relationship between a history of disease or infection and stunting. This is demonstrated by the higher proportion of stunting among children with a poor history of disease or infection, with an OR of 4.631 (2.156 – 9.948). This implies that children with a poor history of disease or infection are 4.631 times more likely to experience stunting compared to those with a good history of disease or infection.

Table 8: Relationship Between Family Factors and Stunting in Children Aged 0-59 Months in Bidara Cina, East Jakarta, 2024

Variable	Stunting N (%)	Normal N (%)	OR	CI 95%	*P-Value*
Mother's Age					
<20 years	2 (100%)	0 (0%)	-	-	0.352
20-35 years	46 (49.5%)	47 (50.5%)	3.6	0.00	0.999
>35 years	20 (64.5%)	11 (35.5%)	0.538	0.232 – 1.248	0.149
Mother's Education					
College graduate	4 (21.1%)	15 (78.9%)	-	-	0.067
High school graduate	33 (51.6%)	31 (48.4%)	0.00	0.00	1.00
Junior high school graduate	23 (65.7%)	12 (34.3%)	0.00	0.00	1.00
Elementary school graduate	7 (100%)	0 (0%)	0.00	0.00	1.00
No formal education	1 (100%)	0 (0%)	1.00	0.00	1.00
Mother's Employment					
Not employed	59 (55.1%)	48 (44.9%)	0.732	0.275 – 1.947	0.620
Employed	9 (47.4%)	10 (52.6%)			
Family Socioeconomic Status					
Low (<1 million	15 (78.9%)	4 (21.1%)	6.00	1.842 – 19.546	0.003*
IDR/month)					
Medium (1-5 million IDR/month)	35 (38.5%)	56 (61.5%)	3.75	-	0.079
High (>5 million IDR/month)	8 (50%)	8 (50%)	-	0.858 – 16.398	0.11
Smoking Behavior from Family Members					
No	7 (26.9%)	19 (73.1%)	4.245	1.633 – 11.035	0.004*
Yes	61 (61%)	39 (39%)			

**P-value<0,05*

Based on Table 8, the proportion of stunting among children from households with low socioeconomic status is 78.9%, 38.5% for households with medium socioeconomic status, and 50% for households with high socioeconomic status. According to SPSS analysis, households with high socioeconomic

status serve as the reference group. The analysis reveals a significant relationship between stunting and households with low socioeconomic status, with an odds ratio (OR) of 6.00 (1.842 – 19.546). This indicates that children from households with low socioeconomic status are 6 times more likely to experience stunting compared to children from households with high socioeconomic status.

Additionally, Table 8 shows that the proportion of stunting among children from households with a family member who smokes is 61%, while it is 26.7% among those from households without a smoking family member. SPSS analysis shows a significant relationship between stunting and households with a smoking family member, with an odds ratio (OR) of 4.245 (1.633 – 11.035). This means that children from households with a smoking family member are 4.245 times more likely to be stunted compared to children from households without a smoking family member.

This table presents the multivariate analysis results from the Multiple Logistic Regression test conducted in this thesis research. The odds ratios (OR) and corresponding 95% confidence intervals (CI) indicate the strength and significance of the associations between various factors and stunting. Variables with a *p*-value less than 0.05 are considered statistically significant, highlighting their impact on the likelihood of stunting among children.

Table 9: Results of Multivariate Analysis Using Multiple Logistic Regression

Variable	Coefficient B Value	Beta Value	*P-Value*	*Odd Ratio* (OR)	*R Square*
Constant Value	-2.778	-	0.013*	-	0.332
Latrine Ownership					
No	1.623	0.266	0.004*	5.068 (1.667 – 15.407)	
Toddler's Age					
49–60 months	0.424	0.203	0.011*	1.528 (1.102 – 2.120)	

**P-value < 0.05*

Based on Table 9, the linear regression test results indicate that the variables of latrine ownership and child's age are significantly associated with stunting status and contribute 33.2% to the occurrence of stunting in children. The final multivariate linear regression model is represented by the following equation:

Stunting Status of Children = -2.778 +1.623 (No Latrine Ownership) + 0.424 (Toddler's Age: 49–60 months) + X

Based on the regression equation, it can be concluded that each unit increase in latrine ownership (for example, from not having a latrine to having one) is associated with a 1.623 times increase in the likelihood of stunting in children, after controlling for other variables. Additionally, each year increase in the child's age is associated with a 0.424 increase in the likelihood of stunting, after controlling for other factors

This study identifies several limitations that should be considered when interpreting its results. The research method employing a cross-sectional approach allows for the observation of relationships between variables at a single point in time but does not definitively establish causation. The dependent variable of the study, namely stunting, also has measurement limitations that may affect the validity of the results. The use of consecutive sampling in data collection presents limitations, as the sampled population may not fully represent the population of toddlers in Kelurahan Bidara Cina, East Jakarta.

The findings reveal several significant observations regarding factors influencing stunting, with a notable relationship between toilet use and the incidence of stunting among toddlers in Kelurahan Bidara Cina, East Jakarta in 2024 (P = 0.004). Toddlers residing in households without private toilets are 0.192 times (0.063 – 0.584) more likely to experience stunting compared to those living in households with private toilets. Soboksa *et al*. (2021) found that using unimproved toilets resulted in

toddlers being 3.7 cm shorter compared to those living in households with improved toilets. Toddlers are at risk of stunting if they live in environments with unimproved toilets, even if their families use improved toilets (World Bank, 2014). The government needs to launch public sanitation infrastructure programs in densely populated areas and develop effective waste management systems to help prevent contamination that can lead to health issues (Humphrey et al., 2019).

Furthermore, there is a significant relationship between toddler age and the incidence of stunting among toddlers aged 49–60 months in Kelurahan Bidara Cina, East Jakarta in 2024 *(P* = 0.011 and OR = 1.508). This means that toddlers aged 49–60 months are 1.508 times more likely to experience stunting compared to other age groups. Similar research by Torlesse *et al*. (2016) also indicated that toddlers aged 12-23 months have a 4.4 times higher risk of stunting compared to younger toddlers. To address this, specific strategies are required, including the implementation of periodic nutrition education programs for parents and health campaigns emphasizing the importance of nutrition during the toddler period (Danso & Appiah, 2023; Tamir *et al*., 2022; Logarajan *et al*., 2023). Additionally, educational programs in schools such as playgroups or kindergartens should be strengthened with materials on balanced nutrition and healthy eating habits (Hurley *et al*., 2021; Nkurunziza *et al*., 2017; Torlesse *et al*., 2016; World Bank, 2014; Soboksa *et al*., 2021).

Although the results indicate that the history of illness or infection may not have a direct or significant impact on stunting when other factors are considered simultaneously, it is crucial to examine other variables that might have a more substantial effect and conduct further analysis to understand the complex relationships between various factors and stunting. This is consistent with Sarfraz *et al*. (2023) who found that the history of illness or infection did not have a significant direct impact on stunting when other factors were considered. This study suggests that factors such as nutritional status, sanitation, access to healthcare, and socio-economic conditions may have a more dominant influence on stunting compared to the history of illness or infection. Education on healthy living environments and hygiene is essential for reducing stunting incidence. Toma *et al*. (2023) found that healthy living environments have a higher probability of reducing stunting. Therefore, programs to improve environmental hygiene, such as waste management and hygiene campaigns, should be enhanced to effectively address stunting (Hurley *et al*., 2021; Sarfraz *et al*., 2023; Tamir *et al*., 2022; Toma *et al*., 2023).

Furthermore, while the results suggest that family smoking behavior may not have a direct or significant impact on stunting when other factors are considered simultaneously, it is essential to examine other variables that might have a greater effect and conduct further analysis to understand the complex relationships between various factors and stunting. Ntozini & Davis (2023) in Zimbabwe also reported that poor sanitation and limited access to clean water are primary determinants of stunting, surpassing the impact of family smoking. To improve public health and reduce stunting incidence, anti-smoking education and campaigns should be intensified to decrease family smoking prevalence. Education on the negative impact of smoking on children's health should be regularly delivered at posyandu and community health centers (Ntozini & Davis, 2023).

The results also indicate that family socio-economic conditions may not have a direct or significant impact on stunting when other factors are considered simultaneously. Therefore, it is important to examine other variables that may have a greater effect and conduct further analysis to understand the complex relationships between various factors and stunting. This aligns with research by Kelly *et al*. (2021) which suggests that factors such as nutritional status, sanitation, access to healthcare, and caregiving may have a more dominant influence on stunting compared to family socio-economic conditions. Currently, low-income families receive various forms of social assistance such as food aid from the government or other private stakeholders as part of CSR programs. These programs have helped improve access to basic needs and mitigate the direct impact of low economic conditions on children's health. Therefore, increasing access to affordable and quality healthcare, particularly in low socio-economic areas, is essential. Comprehensive health services at posyandu and health centers should be expanded to include child growth monitoring, nutrition counselling, and complete immunization (Toma *et al*., 2023; Kelly *et al*., 2021).

Finally, the results indicate that the physical quality of water used in toddlers' daily lives may not have a direct or significant impact on stunting when other factors are considered simultaneously. Therefore, it is important to examine other variables that may have a greater effect and conduct further analysis to understand the complex relationships between various factors and stunting. This is consistent with research by Sangalang *et al*. (2022) in Manila which found that the physical quality of water does not have a significant direct impact on stunting when other factors are considered. This study indicates that factors such as nutritional status, sanitation, access to healthcare, and socio-economic conditions may have a more dominant influence on stunting compared to the physical quality of water. Additionally, a cross-sectional study by Ngassa *et al*. (2022) in Cameroon showed that while water quality is related to stunting in simple analyses, factors such as diet quality and healthcare are more influential in more complex models. Furthermore, research by Bridgman & von Fintel (2022) in South Africa also found that recurrent infections and poor nutritional status have a greater impact on preventing stunting compared to water quality. To improve public health and reduce stunting related to water quality, steps should include enhancing access to clean water and safe sanitation. Community-level clean water and sanitation infrastructure programs need to be strengthened to ensure that every household has access to potable water and adequate sanitation (Sangalang *et al*., 2022; Ngassa *et al*., 2022). Additionally, education on the importance of clean water and good sanitation practices should be expanded, particularly among parents and caregivers.

Conclusion

The research highlights that hygiene and sanitation factors, along with individual toddler factors, play a more significant role in stunting cases among toddlers compared to family factors. Specifically, toilet ownership and toddler age (49–60 months) account for 33.2% of stunting cases. While the history of illness or infection showed no significant impact on stunting (P = 0.229), other variables such as nutritional status, sanitation, and healthcare access should be prioritized in interventions. Family smoking behaviour and water quality were found to have significant relationships with stunting in bivariate analysis (P = 0.004, OR = 4.245, and P < 0.001, OR = 4.713, respectively); however, these were not significant in multivariate analysis, underscoring the need to focus on more dominant determinants.

Implications for health policy and programs

Strategies to reduce stunting should prioritize improving sanitation infrastructure, promoting proper nutrition, and enhancing access to healthcare services. Smoking cessation programs should be integrated into broader stunting prevention strategies, emphasizing the interplay of multiple factors.

Limitation of the Study

This study has certain limitations. First, it is cross-sectional in nature, which restricts the ability to establish causal relationships. Second, the reliance on self-reported data for certain variables, such as family smoking behavior, may introduce reporting bias. Lastly, the study does not account for all potential confounding variables, such as genetic predisposition or long-term environmental factors, which could influence stunting outcomes.

Conflict of Interest

The authors declare that they have no competing interests.

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