THE EFFECT OF ENVIRONMENTAL SANITATION ON THE INCIDENT OF STUNTING IN THE WORKING AREA OF THE TANJUNG PINANG COMMUNITY HEALTH CENTER, JAMBI CITY

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Abstract
Stunting in toddlers remains a public health problem in Indonesia, including in Jambi City. Environmental sanitation factors, family hygiene practices, and parental access to health information are suspected to contribute to stunting. This study aims to analyze the relationship between drinking water quality, clean water facilities, family latrines, water storage, exposure to digital parenting, and family hygiene practices with stunting in toddlers in the Tanjung Pinang Community Health Center (Puskesmas) working area of Jambi City. The study design was a case-control study with a total sample of 140 respondents, consisting of 35 cases (toddlers with stunting) and 105 controls (toddlers without stunting). Data were collected through structured questionnaires, observations, and anthropometric measurements. The analysis was conducted using the Chi-square test and followed by adjusted multiple logistic regression to control for confounding variables. The results showed that several variables had a significant relationship with stunting incidence. After being included in the adjusted multivariate model, physical water quality was recorded as the most dominant factor influencing stunting incidence in the study area. This finding confirms that efforts to reduce stunting require not only improving sanitation infrastructure but also strengthening behavior-based health education and the use of digital media for parents. Multisectoral interventions that combine physical sanitation improvements with strengthening digital health literacy are recommended to support accelerated reduction in stunting prevalence.
Keywords: stunting, sanitation, drinking water, latrine

Article Received : September 20, 2025
Article Revised : November 27, 2025
Article Published : November 30, 2025

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INTRODUCTION

Stunting, or failure to thrive in children, is a form of chronic nutritional disorder that remains a major public health challenge in Indonesia. Stunting occurs due to long-term nutritional deficiencies, often accompanied by recurrent infections, particularly during the first 1,000 days of life. In theory, stunting not only results in a child's height being lower than the standard for their age, but also affects brain development, intelligence, and the immune system, and increases the risk of non-communicable diseases in adulthood.(1)

The impact of stunting is multidimensional and long-term, with stunted children at greater risk of falling behind in education, adult work productivity, and intergenerational poverty. Global data suggests that stunting can reduce potential earnings by 10–17% in adulthood and cause a country's economic losses of up to 2–3% of annual GDP.(2) Based on the 2024 SSGI (Indonesian Nutritional Status Survey) report, the national prevalence of stunting is still quite high at 19.8%. In Jambi Province, although the figure is below the national figure (17.1%), this figure is still quite high. (3) At the local level, in the Tanjung Pinang Community Health Center (Puskesmas) area, a recent report stated that the highest number of stunting cases in 2023 reached 67 children, or approximately 4.4% of the total toddler population registered at the center. These data indicate that although the overall prevalence in Jambi is declining, stunting cases continue to occur in the local community, highlighting the

need for specific environmental risk factors such as water quality, sanitation, hygiene, and health literacy to be identified and addressed contextually. Therefore, the selection of the Tanjung Pinang Community Health Center as the research location is highly relevant, as local data indicates that stunting still occurs routinely, making locally data-driven interventions urgent.

One risk factor that significantly contributes to stunting is poor environmental sanitation. An unhealthy environment increases a child's risk of repeated infections, such as diarrhea and worm infestation, which can then interfere with nutrient absorption. Various studies have shown that children living in environments with inadequate sanitation are 1.5 to 2 times more likely to experience stunting than children living in environments with adequate sanitation. (4) A study in Bengkulu also found a significant association between the microbiological quality of household drinking water and stunting in toddlers.(5) Globally, systematic reviews have also confirmed that drinking water contamination by E. coli and poor sanitation practices are important determinants of stunting in various developing countries.(6–8)

Environmental sanitation is a fundamental factor in stunting prevention because it encompasses the physical condition and health infrastructure of households, such as the availability of clean water, adequate Family Latrines, liquid and solid waste disposal systems, and safe drinking water storage facilities. Studies in Indonesia show that toddlers living in households without healthy Family Latrines have a 2.5-fold higher risk of stunting compared to toddlers living in homes with Family Latrine facilities that meet standards.(9) Other research supports this finding that access to clean water and adequate sanitation facilities are significantly correlated with children's nutritional status.(5,8) This confirms that improving sanitation facilities, including the physical quality of water, not only supports environmental health but is also a strategic component in efforts to accelerate stunting reduction.

The variable of family hygiene practices is separated from environmental sanitation because, although the two are interrelated, hygiene practices reflect aspects of individual behavior and compliance, not the physical condition of the facility. Several studies in various regions in Indonesia have shown that poor maternal hygiene practices are consistently correlated with an increased risk of stunting.(10) Thus, sanitation quality and hygiene behavior are two complementary components; Sanitation provides a safe environment, while hygiene ensures its effective use in preventing infections that contribute to stunting.

On the other hand, advances in information technology present new opportunities for stunting prevention through digital parenting. Platforms such as parenting apps, social media, and family WhatsApp groups can increase parents' knowledge regarding nutrition, sanitation, and Clean and Healthy Living Behaviors (PHBS). However, utilization is uneven, and not all parents are able to identify credible health information. To date, most research in Indonesia has focused on environmental sanitation and hygiene behaviors as risk factors for stunting. Meanwhile, studies on the role of digital parenting exposure, particularly in mediating family health behaviors, are still very limited and have not been comprehensively modeled in the local context.

Therefore, this study fills this gap by simultaneously examining the effects of drinking water quality, clean water facilities, sanitation facilities, water storage containers, hygiene

behaviors, and digital parenting exposure on stunting in toddlers. The results are expected to provide scientific evidence based on local data for the development of more targeted multisectoral policies and interventions, particularly in the Tanjung Pinang Community Health Center (Puskesmas) work area, Jambi City, to support the acceleration of sustainable stunting reduction.

METHODS

This study used an observational analytical design with a case-control study approach. This approach was chosen because it is appropriate for examining risk factors associated with stunting. The case group (stunted toddlers) was compared with the control group (non-stunted toddlers) based on their history of exposure to independent factors such as drinking water quality, clean water facilities, Latrine quality, drinking water storage, family hygiene practices, and exposure to digital parenting.

The study was conducted in the Tanjung Pinang Community Health Center (Puskesmas) work area in Jambi City, which has a higher stunting prevalence than the national average. The study period, from preparation to data collection to analysis, lasted three months. The target population in this study included all toddlers aged 24–59 months living in the Tanjung Pinang Community Health Center (Puskesmas) working area, while the source population consisted of toddlers registered in the Puskesmas nutrition program. Participants were selected solely from the source population to ensure ease of data tracking, nutritional status validation, and respondent identity confirmation.

The cases in this study were toddlers aged 24–59 months identified as stunted based on a height-for-age index (HAZ) < –2 SD using the WHO Anthro 2006 standard. A total of 35 cases were taken by total sampling. Controls were toddlers with normal nutritional status (HAZ ≥ –2 SD) selected using the nearest neighborhood matching technique based on age, gender, and socioeconomic level variables to reduce selection bias, with a ratio of 1:3 per case. Children with a history of chronic disease, genetic disorders, or who had recently moved to the area in the last 6 months were excluded from the study. The physical quality of drinking water (physical parameters), hygiene behavior (categorized as good/bad on a Likert scale), and exposure to digital parenting (scoring the level of access and utilization of information) were analyzed using univariate, bivariate using the Chi-square test, and multivariate with multiple logistic regression to control confounding factors and determine the dominant factor. This study has obtained ethical clearance No. LB/02.06/2/1044/2025, with informed consent and guaranteed data confidentiality.

RESULTS

The table 1 shows that the proportion of toddlers exposed to inadequate water quality (IWQ) was higher in the case group (25.71%) than in the control group (8.57%), indicating a more frequent exposure in the stunting group. A similar pattern was also seen in water facilities, where 71.43% of the case group were exposed to inadequate conditions compared to 47.62% in the control group, indicating that exposure was still more prevalent in the stunting group. Furthermore, a striking proportion was found in the quality of latrines, with 54.29% of cases

having inadequate latrines compared to 22.86% in the control group, indicating that exposure to poor sanitation was more common in the stunting group.

Furthermore, water storage containers also influenced the incidence of stunting, with 54.29% of toddlers from families with inadequate water storage containers in families with stunted children, higher than the 33.33% in families without stunted children. The digital exposure variable shows that toddlers from families with lower digital information exposure have a higher proportion of stunting, namely 57.14%, compared to the case group (only 33.33%). Hygiene behavior factors also show a similar pattern, where families with stunted toddlers have poor hygiene behaviors of 62.86%, much higher than families without stunted toddlers with poor hygiene behaviors (38.10%). These findings confirm that environmental quality, family behavior, and access to digital information have contributed to the incidence of stunting in the study area.

Table 1. Distribution of Respondents Based on Independent Variables In the Tanjung Pinang Community Health Center Work Area, Jambi City, 2025

Variable		Case		Control	
		n	%	n	%
1	Physical Water Quality				
	Not Eligible	9	25.71	9	8.57
	Eligible	26	74.29	96	91.43
2	Quality of Drinking Water				
	Not Eligible	25	71.43	50	47.62
	Eligible	10	28.57	55	52.38
3	Quality of Family Latrine				
	Not Eligible	19	54.29	24	22.86
	Eligible	16	45.71	81	77.14
4	Drinking Water Storage				
	Not Eligible	19	54.29	35	33.33
	Eligible	16	45.71	70	66.67
5	Digital Parenting Exposure				
	Less Exposed	20	57.14	35	33.33
	Exposed	15	42.86	70	66.67
6	Hygiene Behavior				
	Bad	22	62.86	40	38.10
	Good	13	37.14	65	61.90
Total		35	100.0	105	100.0

Table 2. Distribution of Respondents According to the Relationship Between Independent and Dependent Variables in the Tanjung Pinang Community Health Center Work Area, Jambi City, 2025

	Variable	OR	95% CI	*p*
1	Physical Water Quality	3.69	1.33 -10.25	0.017
2	Quality of Drinking Water	2.75	1.202 - 6.290	0.024
3	Quality of Family Latrine	4.01	1.790 - 8.974	0.001

4	Drinking Water Storage	2.38	1.09 - 5.176	0.045
5	Digital Parenting Exposure	2.67	1.219 - 5.834	0.022
6	Hygiene Behavior	2.75	1.247 - 6.064	0.018

Based on the results of the bivariate analysis, all independent variables in this study showed a significant relationship with the incidence of stunting in toddlers. Physical water quality was associated with stunting with a p value of 0.017, while the quality of drinking water facilities was also significant with p = 0.024. Similarly, the quality of latrines had a very significant relationship with p = 0.001. Water storage containers showed a significant relationship with p = 0.045, while exposure to digital parenting had a p value of 0.022. Finally, family hygiene behavior was also significant with p = 0.018. This indicates that all environmental factors, behaviors, and access to digital information have a significant contribution to the incidence of stunting in the work area of the Tanjung Pinang Community Health Center, Jambi City.

Table 3. Results of Multivariate Logistic Regression Analysis of Prediction between Physical Water Quality, Family Latrine Quality and Digital Parenting Exposure with Stunting Incidence

No	Variable	Wald	DF	p-value	OR	95 % CI OR	
						Lower	Upper
1	Quality of Drinking Water	5.639	1	0.018	3.89	1.268	11.943
2	Quality of Family Latrine	7.904	1	0.005	3.36	1.443	7.820
3	Digital Parenting Exposure	4.826	1	0.028	2.59	1.108	6.067
	Constant	10.794	1	0.001	0.008		

- 2 Log Likelihood = 136,268 p-value = 0.000 R Square = 0,208

From the results of the modeling analysis of six independent variables, it turns out that three variables have a p-value below <0.05, meaning that these three variables are significantly related to the incidence of stunting and of the three variables, the most related is the one with the largest Odd Ratio (OR), namely the physical water quality variable of 3.891 and with a coefficient of determination of 0.208, which means that the variables of physical water quality, quality of drinking water facilities, quality of family Latrines, exposure to digital parenting and hygiene behavior can only explain 20.8% of the stunting prevalence.

DISCUSSION

The results showed that the physical quality of drinking water (OR=3.89) was the most dominant factor associated with stunting after all other variables were controlled in a logistic regression model. This finding suggests that exposure to physically unsuitable drinking water is a significant determinant because it has the potential to carry microbiological contamination and trigger recurrent infections such as chronic diarrhea, ultimately disrupting optimal nutrient absorption. These results are consistent with studies by Rudy Ferdinand (2025) and Datunsolang (2024), which reported that children who consume unsafe water have a higher risk of intestinal inflammation and stunting than those who consume water that meets

standards.(11,12) Conversely, Lestari's (2021) study found no significant association, likely because water quality in her study area has been standardized through the STBM program and the provision of piped water facilities.(13)

These findings emphasize that stunting prevention interventions should not only focus on clean water access but should also include household water quality inspections, sanitation education, monitoring of refillable drinking water depots, and the integration of affordable and easily implemented water quality testing technology at the community level. Thus, the results of this study confirm that stunting prevention efforts are not sufficient by simply improving sanitation infrastructure, but must be integrated with behavioral education interventions, cadre training, routine monitoring, and the use of digital media to strengthen family hygiene practices on an ongoing basis.)

The analysis shows a significant relationship between the quality of drinking water facilities and stunting (p=0.024), where families with poor water facilities have a higher risk. This result is in line and consistent with the research of Ketut Suarayasa (2022) and Oeissilita (2024) which found that children from households without proper water facilities are at higher risk of stunting.(14,15) Research by Dewi Mustika and Siti Nofianti also shows that access and quality of clean water facilities are related to the incidence of stunting.(11) The implications of these findings indicate that improving drinking water infrastructure must be a priority for local government policy to support the achievement of stunting reduction targets. The limitation of this study is that it has not explored family economic factors that may influence ownership of proper water facilities and it is hoped that further research can test community-based clean water facility rehabilitation interventions in reducing stunting.

Family Latrine quality showed a significant association with stunting (p=0.001), although it was not the dominant variable in the multivariate model because it did not have the highest Adjusted Odds Ratio (AOR) value compared to other variables. This finding suggests that access to and use of proper Family Latrines still play a crucial role in preventing exposure to feces in the household environment, which can trigger recurrent intestinal infections such as diarrhea and environmental enteric dysfunction (EED). This finding aligns with the findings of Zahrawani (2022), who found that children from families without proper Family Latrines had a higher risk of stunting.(16) Conversely, studies by Lestari (2024), Saleh (2025), and Nisa (2022) reported no significant association between Family Latrine ownership and stunting, likely due to stronger implementation of Community-Based Total Sanitation (STBM) and equitable access to sanitation facilities in their study areas.(11,13,17) The implications of these findings suggest that sanitation interventions remain relevant, but need to be combined with other behavioral and educational approaches. The “One House, One Healthy Family Latrine” acceleration program needs to be directed at vulnerable groups, accompanied by further intervention research to assess the effectiveness of Family Latrine rehabilitation as a community-based stunting prevention strategy.

Drinking water storage containers were also significantly associated with stunting (p=0.045; OR=2.38). These results are consistent with research by Gizaw (2022) and Batool (2023), which found that contamination often occurs not at the water source, but during storage in the household.(6,18) Research by Sapta (2025) also showed a significant association between household water storage containers and stunting incidence.(19) The recommendation

is that education on the behavior of storing water in hygienic, closed containers is crucial, while future research can test the effectiveness of interventions distributing healthy containers on reducing stunting prevalence.

The analysis results showed that exposure to digital parenting was significantly associated with stunting (p=0.022). This is consistent with the results of various studies stating that digital health literacy improves parental knowledge in parenting and stunting prevention.(20–23). Research by Fitriami (2021) also shows that digital parenting can improve maternal knowledge and attitudes.(24) The implication of this finding is the need to optimize digital media in health education, especially through platforms that are easily accessible to the public. The limitation of this research is that it has not evaluated the quality and credibility of digital information accessed by parents, so that further studies can focus more on the effectiveness of digital parenting content.

The results of the study showed that family hygiene behavior was significantly associated with stunting (p=0.018; OR=2.75). This finding is consistent with many studies that support the role of handwashing with soap and food hygiene in reducing recurrent infections that lead to impaired nutrient absorption.(25–27) Similar results were also found in several studies that stated that poor hygiene behavior was associated with stunting.(28,29) However, other studies did not show a significant association between poor hygiene behavior and stunting.(30). Some research results also showed that poor hygiene behavior had little effect on stunting.(26,31,32) This difference is likely due to differences in conditions at the study location, operational definitions (DO) of hygiene behavior, for example the frequency of CTPS used, assessment scales, and data sources, may be more sensitive to capturing behavioral variations than other studies; selected samples and case-control ratio (1:3) may strengthen the power to detect associations; while partial or inconsistent local STBM interventions may modify the actual effect of behavior on stunting. In addition, context heterogeneity (water access, hygiene culture, health service support) also influences inter-study findings.

CONCLUSIONS AND RECOMMENDATIONS

Based on the research results in the Tanjung Pinang Community Health Center (Puskesmas) work area in Jambi City, it can be concluded that environmental factors (physical quality of drinking water, clean water facilities, family latrines, and water storage containers), family behavior (hygiene), and access to health information (exposure to digital parenting) are significantly associated with stunting in toddlers. The dominant factors are the quality of family latrines and drinking water, with toddlers from families with inadequate facilities having almost a four-fold greater risk of stunting. Recommendations for local governments and Puskesmas include optimizing the STBM program, providing adequate clean water facilities, and increasing the capacity of health workers in nutrition education, hygiene, and the use of digital media. The community is expected to maintain the cleanliness of drinking water and latrines, implement clean and healthy lifestyles (PHBS), and actively access reliable health information. Future researchers are advised to use a prospective or interventional design and include variables such as parenting patterns, breastfeeding/complementary feeding, and economic status for more comprehensive results.

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