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THE EFFECT OF POVERTY, INADEQUATE SANITATION, AND ACCESS TO IMPROVED WATER SOURCE ON STUNTING IN THE CONTEXT OF THE SDGs IN SAMARINDA SEBERANG DISTRICT

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ABSTRACT
There has been a decreasing trend in stunting prevalence in Indonesia; however, it has not yet met the 14,2% target set in the 2025-2029 RPJMN, necessitating strengthened cross-sectoral efforts. This study analyzes the effects of poverty, inadequate sanitation, and access to improved water sources on stunting incidence in Samarinda Seberang District within the SDGs framework. This study employed proportionate stratified sampling. The population comprised 383 respondents, with a sample of 200 households with stunted children under five, based on EPPGBM data from Baqa and Mangkupalas Community Health Centers in August 2024. Data was collected through questionnaires and government reports. Classical assumption tests, multiple linear regression, including t-tests and F-tests, were applied. The results show that poverty and inadequate sanitation have a significant positive effect, while access to improved water sources has a significant negative effect on stunting incidence. Simultaneously, these variables have a significant positive effect. The study concludes that poverty, inadequate sanitation, and access to improved water sources significantly influence stunting, both partially and simultaneously. Policy implications emphasize the need to integrate specific and nutrition-sensitive interventions.

Keywords: poverty, sanitation, clean water, stunting

INTRODUCTION
Stunting is a disorder of growth and development in early childhood caused by chronic malnutrition and recurrent infections, which has long-term impacts on health, cognitive development, and the future productivity of human resources (Patimah, 2021). From the perspective of the Sustainable Development Goals (SDGs), stunting is closely related to several SDG targets (Widari et al., 2021), namely no poverty (Goal 1), zero hunger (Goal 2), and adequate access to clean water and proper sanitation (Goal 6) (SDGs, 2026). These three goals indicate that stunting is not solely a nutritional issue but is also influenced by poverty (Hamzah & Sofilda, 2025; Putri A. R., 2020; Sihite & Chaidir, 2022), inadequate sanitation (Bhutta et al., 2025; Maliga et al., 2022; Soboksa et al., 2021), and access to clean water (Melese et al., 2024; Paramasatya & Wulandari, 2022).

Beyond its inclusion in the global development framework under the Sustainable Development Goals (SDGs), the program to accelerate stunting reduction is also one of the priorities outlined in the Asta Cita of the President of the Republic of Indonesia, particularly the fourth Asta Cita, which focuses on strengthening the development of human resources, science, technology, education, health, sports achievement, gender equality, and the empowerment of women, youth, and persons with disabilities. The strong emphasis on stunting arises from its extensive impacts on the health and well-being of future generations. Therefore, stunting prevention and reduction programs are designated as national priority programs.

According to data from UNICEF and the World Health Organization (WHO), Indonesia ranks 27th out of 154 countries with a high prevalence of stunting and is positioned fifth in Asia.

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These figures reflect the magnitude of the challenges faced by Indonesia in addressing and reducing stunting (Sihite & Chaidir, 2022).

Although there has been a reduction in stunting prevalence in Indonesia, the 2025–2029 RPJMN target of 14.2% has not been achieved (Kemensesneg RI, 2025). At the regional level, disparities in stunting reduction persist, including in Samarinda City, particularly Samarinda Seberang District, which has consistently recorded the highest prevalence of stunting compared to other districts (Dinas Kesehatan Kota Samarinda, 2025).

Table 1. Stunting Prevalence Data

No	Year	National	East Kalimantan	Samarinda
1	2013	37,6	37,2	
2	2018	30,8	30,8	26,26
3	2019	27,7	28,1	24,7
4	2021	24,4	22,8	21,6
5	2022	21,6	23,9	25,3
6	2023	21,5	22,9	24,4
7	2024	19,8	22,2	20,3

Source: Riskesdas 2013, 2018; SSGI 2019 - 2022; SKI 2023; SSGI 2024

Table 1 presents the trend of stunting prevalence in Indonesia from 2013 to 2024. Nationally, the prevalence of stunting has shown a consistent decline, decreasing from 37.6% in 2013 to 19.8% in 2024. A similar downward trend is observed in East Kalimantan, where the prevalence decreased from 37.2% to 22.2% over the same period. Likewise, in Samarinda City, the prevalence declined from 26.26% in 2018 to 20.3% in 2024.

However, despite this improvement, the prevalence of stunting in East Kalimantan and Samarinda remains higher than the national average. Therefore, more targeted and comprehensive intervention efforts are still required to further reduce stunting rates in these areas.

In order to support the acceleration of stunting reduction, the Government of Samarinda City enacted Mayor Regulation (Perwali) No. 45 of 2023, which replaces Mayor Regulation No. 102 of 2021. This regulation functions as an implementing instrument of the regional strategic development plan. It is integrated into the Samarinda City Regional Medium-Term Development Plan (RPJMD) for the 2025–2029 period, particularly under the pillar of human resource development and health.

This policy is expected to synergize cross-sectoral programs covering health, education, environmental, and social sectors in a more coordinated and targeted manner.

Table 1.2 shows that Samarinda Seberang Subdistrict recorded the highest prevalence of stunting. The stunting rate was 22.4% in 2024 and increased to 25.3% in 2025. These findings indicate that Samarinda Seberang remains a priority area for stunting intervention.

This condition is in line with the Mayor's Decree Number: 000.9391/HK-KS/VIII/2023, which designates stunting locus areas in each urban village. The decree was issued as part of an effort to accelerate the reduction of stunting in Samarinda City.

Geographically, Samarinda Seberang is directly adjacent to the Mahakam River. The area is characterized by high population density, limited access to adequate sanitation, and the continued use of river water by some households for daily needs. According to data published by the Department of Public Works and Spatial Planning (PUPR) (2024), Samarinda Seberang District has eight wastewater treatment facilities (IPAL) located in Sungai Keledang, Mesjid, and Tenun sub districts the highest number among all districts, while PDAM clean water service coverage reached 81%. On the other hand, poverty further constrains households' ability to meet nutritional needs (Sihite & Chaidir, 2022). According to the National Integrated Social and Economic Data (DTSEN), the number of poor households in Samarinda Seberang District (deciles

1 and 2) reached 2,961 families (Dinas Sosial dan Pemberdayaan Masyarakat Kota Samarinda, 2025). This situation indicates that stunting in Samarinda Seberang is a multidimensional problem that requires cross-sectoral collaboration.

Table 2. Stunting Data in Samarinda City, 2024 and 2025

No	Subdistrict	Stunting (%)		Remarks
		2024	2025	
1	Samarinda Seberang	22,4	25,3	Increased
2	Sungai Pinang	22	16,8	Decreased
3	Loajanan Ilir	19,6	18,4	Decreased
4	Sungai Kunjang	17,6	16,9	Decreased
5	Samarinda Ilir	17,4	7,4	Decreased
6	Palaran	16,2	14,6	Decreased
7	Sambutan	14,7	11,8	Decreased
8	Samarinda Utara	13,4	14,3	Decreased
9	Samarinda Kota	9,7	18,1	Increased
10	Samarinda Ulu	7,6	13,7	Increased

Source: Stunting publication data from the Health Office, 2024 and 2025.

Previous studies have examined the determinants of stunting from the perspectives of clean water, sanitation, and socioeconomic conditions. However, these studies tend to analyze these factors partially and separately. The risk of stunting among children under five is higher due to poor drinking water quality, and inadequate sanitation facilities (absence of latrines and septic tanks) are associated with increased stunting (Olo et al., 2021). This study employed a systematic review of several electronic databases with criteria focusing on factors such as water, sanitation, and stunting among children under five during the 2015–2020 period, using observational study designs. Poverty is also directly associated with stunting incidence (Sihite & Chaidir, 2022). That study applied a cross-sectional design with a sample of 33 individuals selected using the Lemeshow formula through purposive sampling. Studies that integrate poverty, inadequate sanitation, and access to clean water at the sub-district level within the SDGs framework remain relatively limited. Moreover, there is still a lack of study utilizing local, cross-sectoral data as an empirical basis for formulating policies to enhance efforts to reduce stunting at the local level.

Therefore, the novelty of this study lies in its integrated approach, which simultaneously analyzes the effects of poverty, inadequate sanitation, and access to clean water on stunting incidence from an SDGs perspective at the sub-district level. This approach is designed to provide a deeper understanding of nutrition-sensitive determinants of stunting and to serve as a foundation for local policy formulation.

This study aims to analyze and demonstrate the effects of poverty, inadequate sanitation, and access to clean water on the incidence of stunting, both partially and simultaneously, in Samarinda Seberang District, Samarinda City. The findings are expected to contribute to the development of public and population policies, particularly those related to environmental- and socioeconomic-based stunting prevention. In practice, this study will be useful for local governments and cross-sectoral stakeholders in formulating more targeted, integrated, and sustainable policies and interventions to support the achievement of the SDGs targets and accelerate stunting reduction at the local level.

METHOD

This study was conducted in Samarinda Seberang District in accordance with the Decree of the Mayor of Samarinda Number: 000.9/391/HK-KS/VIII/2023 concerning the Determination of Stunting Locus Sub-districts in the Framework of Accelerating Stunting Reduction in Samarinda

City in 2024 (Samarinda, 2024), which designates Samarinda Seberang District as one of the stunting reduction loci in Samarinda City. This research was conducted in Samarinda Seberang District from November to December 2025 and was analyzed using multiple linear regression analysis.

A quantitative approach was applied in this research, employing multiple linear regression to analyze the effects of poverty, inadequate sanitation, and access to improved water sources on the prevalence of stunting. The study population consisted of 383 households with stunted children under five, based on EPPGBM data from Mangkupalas and Baqa Community Health Centers (Puskesmas) in August 2024. A total of 200 households were selected as the sample using proportionate stratified random sampling and simple random sampling, with the Slovin formula applied at a 5% margin of error. The samples were distributed across six sub-districts (kelurahan): Sungai Keledang (50 samples), Mesjid (48 samples), Mangkupalas (35 samples), Baqa (29 samples), Tenun (28 samples), and Gunung Panjang (10 samples).

The primary data was collected through questionnaires employing a Likert scale. The questionnaires were administered by six Family Planning Cadres (TPK-Family Planning cadre elements) according to their respective working areas. Secondary data were obtained from documents and reports of Mangkupalas and Baqa Community Health Centers, the Samarinda City Health Office, the Samarinda City Office of Social Affairs and Community Empowerment, and the Samarinda City Office of Public Works and Spatial Planning.

Prior to primary data collection, validity and reliability tests were conducted for each questionnaire item. These tests involved 30 respondents drawn from the main study population. Primary data were collected by TPK cadres through the administration of questionnaires to households with stunted children under five, identified based on EPPGBM records from the Mangkupalas and Baqa Community Health Centers. Respondents who participated in the validity and reliability testing received the questionnaire again 14 days later.

Subsequently, the collected questionnaire data collected using Microsoft Excel and SPSS version 25. Data analysis was performed using classical assumption tests, multiple linear regression analysis, t-tests (partial), and F-tests (simultaneous).

RESULTS AND DISCUSSION

1. Descriptive Statistics

Table 3 presents the demographic characteristics of the respondents. It shows that all respondents in this study were female, totaling 200 respondents (100.0%), while there were no male respondents (0.0%).

The majority of respondents were in the age range of 26–30 years, totaling 61 respondents (30.5%), followed by those aged 31–35 years with 49 respondents (24.5%), 36–40 years with 40 respondents (20.0%), 41–45 years with 28 respondents (14.0%), and 21–25 years with 19 respondents (9.5%). Meanwhile, the smallest proportion was found in the 15–20 age group, with only 3 respondents (1.5%). Based on these findings, 1.5% of women delivered at a young maternal age, 34.0% at an advanced maternal age, and 64.5% within the optimal reproductive age range of 21–35 years.

Regarding education level, most respondents completed senior high school, accounting for 89 respondents (44.5%). This was followed by respondents with higher education at 40 respondents (20.0%), junior high school graduates at 38 respondents (19.0%), primary school graduates at 30 respondents (15.0%), and those who did not complete primary school at 3 respondents (1.5%). Based on these findings, the majority of respondents were senior high school graduates (44.5%), whereas those with lower educational attainment (incomplete primary education and primary school graduates) accounted for 16.5%.

In terms of employment, the majority of participants were not employed, totaling 178 respondents (89.0%). This was followed by private sector employees with 12 respondents (6.0%), traders with 9 respondents (4.5%), and the smallest proportion was laborers or casual workers with only 1 respondent (0.5%). No respondents were recorded as farmers, fishermen, or civil

servants/military/police personnel. Based on these data, it can be concluded that the majority of respondents were not employed, indicating that, economically, households are likely to rely on the income of other household members.

Household size analysis showed that most respondents had 1–2 children, totaling 107 respondents (53.5%). This was followed by respondents with 3–4 children at 78 respondents (39.0%), those with 5–6 children at 14 respondents (7.0%), while the smallest proportion was respondents with 7–8 children, with only 1 respondent (0.5%). Based on these findings, most respondents had a relatively small family size, with 1–2 children (53.5%), followed by those with 3–4 children (39.0%). Only 7.5% of respondents reported having five or more children.

Table 3. Demographic Characteristics of Respondents (n=200)

No	Characteristic	Category	Frequency	Percentage
1	Gender	Male	0	0%
		Female	200	100%
2	Age Group	15 - 20	3	1.5%
		21 - 25	19	9.5%
		26 - 30	61	30.5%
		31 - 35	49	24.5%
		36 - 40	40	20%
		41 - 45	28	14%
3	Education Level	Did Not Complete Primary School	3	1.5%
		Completed Primary School	30	15%
		Completed Junior High School	38	19%
		Completed Senior High School	89	44.5%
		Completed Higher Education	40	20%
4	Type of Education	Not Employed	178	89%
		Farmer	0	0%
		Fisherman	0	0%
		Laborer/Casual Worker	1	0.5%
		Trader	9	4.5%
		Private Sector Employee	12	6.0%
		Civil Servant/Military/Police	0	0%
5	Number of Children	1 - 2	107	53.5%
		3 - 4	78	39%
		5 - 6	14	7%
		7 - 8	1	0.5%
Total			200	100%

Source: Processed Primary Data, 2025

2. Validity and Reliability Test

a. Validity Test

The instrument test was conducted on November 4, 2025. This test used SPSS 25 with Pearson Correlation with r-table 0.361. Of the 33 statement items given to respondents, only 24 statements were valid, including 10 statements on poverty variables, 5 statements on inadequate sanitation, 6 statements on clear water access variables, and 3 statements on stunting variables.

b. Reliability Test

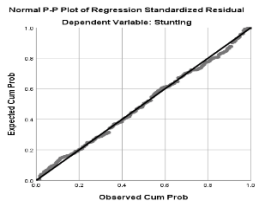
The reliability test used SPSS 25 and Cronbach's alpha. A questionnaire is considered reliable if the reliability value is ≥ 0.60; conversely, if it is < 0.60, it is considered unreliable. The reliability test results show that all variables, both independent and dependent, have a Cronbach's alpha coefficient > 0.60, indicating that all measurement concepts in the variables are reliable

3. Classical Assumption Test

a. Normality Test

Based on Figure 1, the residual points are observed to follow and lie close to the diagonal line. Therefore, it can be concluded that the normality assumption is fulfilled.

Figure 1. P–P Plot Graph



Source: SPSS Data Processing Results, 2025

b. Multicollinearity Test

Based on table 4, the poverty variable (X_1) has a tolerance value of 0.790 and a Variance Inflation Factor (VIF) of 1.265. The inadequate sanitation variable (X_2) has a tolerance value of 0.809 and a VIF of 1.236, while access to improved water sources variable (X_3) has a tolerance value of 0.883 and a VIF of 1.133. Therefore, The result indicates that no multicollinearity is present in the regression model.

Table 4. Results of the Multicollinearity Test

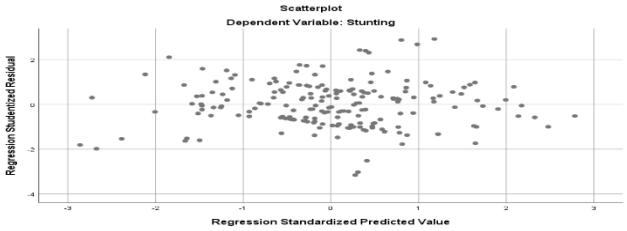
Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	10057.691	331.181		30.369	.000		
	Poverty	.042	.013	.208	3.275	.001	.790	1.265
	Inadequate sanitation	.088	.016	.344	5.473	.000	.809	1.236
	Access to improved water source	-.104	.011	-.575	-9.550	.000	.883	1.133
a. Dependent Variable: Stunting								

Source: SPSS Data Processing Results, 2025

c. Heteroscedasticity Test

Based on Figure 2, the points are observed to be randomly distributed and do not form a specific pattern. Therefore, it can be concluded that heteroscedasticity does not occur in the regression model.

Figure 2. Results of the Heteroscedasticity Test



Source: SPSS Data Processing Results, 2025

d. Autocorrelation Test

Based on table 5, the Durbin–Watson value is 1.854 with a sample size of 200 (n) and three independent variables (k = 3). The corresponding upper bound value (dU) obtained from the Durbin–Watson table is 1.7990. Since the DW value is greater than the upper bound (dU) and less than 4 – 1,7990 (dU < DW < (4-dU), that is, 1.7990 < 1.854 < 2.201. The results indicate that no autocorrelation is present in the regression model.

Table 5. Results of the Durbin–Watson

Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.610[a]	.373	.363	572.18666	1.854
a. Predictors: (Constant), Poverty, Inadequate Sanitation, Access to Clean Water					
b. Dependent Variable: Stunting					

Source: SPSS Data Processing Results, 2025

4. Multiple Linear Regression Analysis

Multiple linear regression analysis was employed to evaluate the effect or relationship between the independent variables and the dependent variable, both partially and simultaneously. The predictor variables in this study were poverty, inadequate sanitation, and access to clean water, while the dependent variable was stunting. The regression equation used to test the research hypotheses is as follows:

$$Y = a + b_1X_1 + b_2X_2 + \cdots + b_nX_n + e \text{.....(1)}$$

Table 5. Results of Multiple Linear Regression Analysis

Coefficientsa						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	10057,691	331,181		30,369	0,000
	Poverty	0,042	0,013	0,208	3,275	0,001
	Inadequate Sanitation	0,088	0,016	0,344	5,473	0,000
	Access to Improved Water Sources	-0,104	0,011	-0,575	-9,550	0,000
a. Dependent Variable: Stunting						

Source: Processed Data, SPSS Output, 2025

As shown in the table above, the following regression equation is obtained:

$$Y = 10057{,}691 + 0{,}042X_1 + 0{,}088X_2 - 0{,}104X_3 + e \text{.....(2)}$$

Based on the results of the multiple linear regression equation, the following conclusions can be drawn:

a. The constant value obtained is 10057.691, indicating that when all independent variables are equal to zero, the dependent variable is valued at 10057.691;
b. The regression coefficient of the poverty variable (X_1) is positive (+) at 0.042, which indicates that every one-unit increase in poverty will have a positive effect on stunting by 0.042 units. Conversely, a one-unit decrease in poverty will reduce stunting by 0.042 units, assuming that variables X_2 and X_3 remain constant.
c. The regression coefficient of the inadequate sanitation variable (X_2) is positive (+) at 0.088, which means that every one-unit increase in inadequate sanitation will positively affect stunting by 0.088 units. Conversely, a one-unit decrease in inadequate sanitation will reduce stunting by 0.088 units, assuming that variables X_1 and X_3 remain constant.
d. The regression coefficient of the access to improved water source variable (X_3) is negative (–) at –0.104, indicating that every one-unit increase in access to clean water will have a negative effect on stunting by 0.104 units. Conversely, a one-unit decrease in access to improved water sources is associated with a 0.104-unit increase in stunting, holding X_1 and X_2 constant.

5. t-Test (Partial Test)

To determine the partial effect of poverty, inadequate sanitation, and access to improved water sources on stunting, the t-test was applied, with significance assessed by contrasting the t-statistic p-value with $\alpha = 0.05$.

Based on Table 5, the following conclusions can be drawn:

a. Poverty has a statistically significant partial effect on stunting incidence ($t = 3.275$, $p < 0.05$); therefore, H_0 is rejected.
b. Inadequate sanitation also demonstrates a statistically significant partial effect on stunting incidence ($t = 5.473$, $p < 0.05$), leading to the rejection of H_0.
c. Access to improved water sources shows a statistically significant partial effect on stunting incidence ($t = –9.550$, $p < 0.05$); thus, H_0 is rejected.

6. F-Test (Simultaneous Test)

The t-test was used to examine the magnitude of the partial effect of the independent variables, namely poverty, inadequate sanitation, and access to improved water sources, on the dependent variable, stunting. The t-test was conducted by comparing the significance value of the t-statistic with the significance level α (0.05).

The table below shows that the F-value is 38.798 with a significance value of 0.000, which is less than 0.05. Therefore, it can be concluded that poverty, inadequate sanitation, and access to improved water sources simultaneously have a statistically significant effect on the incidence of stunting.

Table 6. Results of the Simultaneous (F) Test

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38107292,914	3	12702430,971	38,798	.000[b]
	Residual	64169923,371	196	327397,568		
	Total	102277216,284	199			
a. Dependent Variable: Stunting						
b. Independent Variable: (Constant), Poverty, Inadequate Sanitation, Access to Clean Water						

Source: Processed Data, SPSS Output, 2025

DISCUSSION

1. The Partial Effect of Poverty on the Incidence of Stunting

The poverty variable (X_1) has a significant effect on stunting (Y). This is indicated by the results of the t-test (t = 3.275, $p < 0.05$). The positive regression coefficient (B = 0.042; β = 0.208) shows that higher poverty levels are associated with stunting prevalence. Respondent data show that 47% of households have irregular income, 57% report expenditures exceeding income, and 89% of respondents are not employed. These economic constraints reduce families' ability to meet the nutritional needs of children under five, limiting early childhood development.

From a human capital perspective (Patimah, 2021), proper nutrition is a foundational investment in children's physical and cognitive development. Poverty restricts this investment, limiting the accumulation of human capital from early childhood.

Similar findings were reported by Nurhayani (2025), who stated that living under relatively limited conditions is related by low income levels. Low income affects both the quality and quantity of food consumed by the family.

The same finding is reported by Melese et al. (2024), who found that nutritional problems among infants are more prevalent in children whose mothers are not employed compared to those cared for by working mothers. This situation may limit the family's ability to meet the nutritional needs of infants, particularly in terms of the availability of nutritious food and the allocation of household resources. Economic constraints faced by families with non-working mothers may negatively affect the quality and sustainability of infant nutrition.

These findings are consistent with the study by Agustin and Rahmawati (2021), which revealed that many children with growth disorders originate from families earning income at or below the minimum wage level. This condition contributes to inadequate nutritional intake (Sihite & Chaidir, 2022). Putri A.R. (Putri A. R., 2020) also stated that nutritional problems in children may occur when the head of the household is unable to fulfill children's nutritional needs, both in terms of quality and quantity.

All these findings highlight that children from low-income or non-working households are more prone to growth and nutritional deficiencies. Improving family economic resilience aligns with SDG 1 (No Poverty) and SDG 2 (Zero hunger) by ensuring children's nutritional needs are met, strengthening human capital formation.

2. The Partial Effect of Inadequate Sanitation on the Incidence of stunting

The inadequate sanitation variable (X_2) has a significant effect on stunting (Y), based on the results of the t-test (t = 5.473, $p < 0.05$). The positive regression coefficient (B = 0.088; β = 0.344) shows that inadequate sanitation is associated with stunting prevalence. Seventeen percent of respondents still rely on pit latrines. This situation indicates that some households still have inadequate sanitation facilities, characterized by the absence of proper toilets and septic tanks. Poor sanitation relates to exposure to pathogens, leading to repeated infections and reduced nutrient absorption, which contributes to stunting.

According to Hendri L Blum's health theory (Nuryati & Epid, 2022), one of the key determinants of population health is the environment. Children living in environments that do not meet standards are at higher risk of illness, which reduces their growth and developmental potential. In line with human capital theory. Inadequate sanitation impairs early development, limiting children's ability to accumulate human capital. Addressing sanitation aligns with SDG 3 (Good Health and Well-being) and SDG 6 (Clean Water and Sanitation), as it improves environmental health conditions critical for child development.

These findings are consistent with the study by Olo et al., (2021), which reported that the use of latrines failing to meet health standards and improper disposal of young children's feces relates to children's susceptibility to environmental contamination. This condition raises the likelihood of pathogen transmission from feces and increases the risk of stunting among children under five. Similarly, Sukmawati et al. (2021) reported that families without latrines have a 90.2% risk of experiencing stunting.

Similar findings were also reported by Sopianti et al. (2024), who found that ownership of a healthy latrine is associated with the nutritional status of toddlers. The Regulation of the Minister of Health on Community-Based Total Sanitation (2014) states that the indicators of a healthy latrine include the availability of a toilet facility and a septic tank. This implies that inadequate sanitation is directly proportional to the occurrence of stunting, with a risk of 5.982 times higher (Ihsan et al., 2020).

3. The Partial Effect of Access to Improved Water Sources on the Incidence of Stunting

The access to improved water sources variable (X_3) has a significant effect on stunting (Y), based on the results of the t-test (t = -9.550, $p < 0.05$). The negative regression coefficient (B = –0.104; β = –0.575) shows that access to improved water sources is associated with stunting prevalence. Households with safe water reduce exposure to waterborne diseases such as diarrhea, improving nutrient absorption and supporting growth. While 87% of respondents reported safe water use, 13% still rely on unsafe sources, which increases stunting risk.

From a human capital and SDGs perspective, access to clean water is a health investment that supports optimal childhood growth, cognitive development, and productivity in later life. These results reinforce SDG 3 (Good health and Well-being) and SDG 6 (Clean Water and Sanitation), as it improves environmental health conditions for child development.

These findings are consistent with Astuti (2022), who found that families without access to improved water sources have a 2.182 times higher risk of stunting compared to families with adequate water sources. Households without access to adequate clean water are more vulnerable to stunting than those with adequate access, with differences of 7.7% in 2013 and 6.6% in 2018 (Widari et al., 2021). Similar findings were also reported by Olo et al. (2021), who found that water-related factors, particularly unimproved water sources, increase the likelihood of stunting among children under five.

Similar findings were also reported by Febriawati et al. (2021), who stated that there is a relationship between access to clean water and the occurrence of stunting. Families without access to clean water have a 5.99 times higher risk of stunting. This condition is associated with infectious diseases such as diarrhea. Clean water sources that meet health standards have been shown to reduce the risk of diarrhea (Sukmawati et al., 2021).

4. The Simultaneous Effect of Poverty, Inadequate Sanitation, and Access to Improved Water Sources on the Incidence of stunting

Based on the results of the F-test with $df_1 = 3$ and $df_2 = 196$, the variables poverty (X_1), inadequate sanitation (X_2), and access to improved water source (X_3) have a significant effect on stunting (Y). Based on these results, it can be concluded that poverty, inadequate sanitation, and access to improved water sources simultaneously contribute to the incidence of stunting in Samarinda Seberang District. This reinforces that stunting is a multifactorial problem, affected by socioeconomic conditions, environmental health, and access to essential services.

Several previous studies, including "The Relationship between Family Income and the Incidence of Stunting" (Agustin & Rahmawati, 2021), "Parenting Patterns, Dietary Patterns, and Family Income in Relation to Stunting Incidence" (Putri A. R., 2020), and "The Association of Poverty, Energy and Protein Adequacy with the Incidence of Stunting among Under-Five Children at 11 Ilir Public Health Center, Palembang" (Sihite & Chaidir, 2022), have shown that poverty contributes to limited access to nutritious food. The Relationship Between Maternal Education, Family Income, and Exclusive Breastfeeding and the Incidence of Stunting Among Toddlers in the Working Area of South Paringin Community Health Center in 2023 (Nurhayani, 2025). Chronic nutritional deficiencies during the early years of life increase the likelihood of stunting in children.

Furthermore, studies such as "The Effect of Sanitation and Drinking Water on Stunting in Papua and West Papua" (Astuti, 2022), "The Relationship between Water and Sanitation Factors and the Incidence of Stunting among Under-Five Children in Indonesia" (Olo et al., 2021), and "The Correlation between Access to Sanitation and Access to Drinking Water with the Incidence of Stunting among Under-Five Children in Serang Regency in 2022" (Paramasatya & Wulandari,

2022) indicate that stunting is caused by limited access to adequate sanitation and clean water. This is in line with the theory proposed by Hendri L. Blum, as cited by U. Achmadi (2013, p. 32), which states that one of the components influencing human health is the environment. Although illness is not the sole determinant of health status, a population cannot achieve good health if it lives in an environment that does not meet health standards, which ultimately leads to poor health outcomes.

Integrated Hendri L Blum Theory, the human capital framework, and SDGs principles, this study highlights that improving household economic resilience, sanitation infrastructure, and water access simultaneously is essential for sustainable stunting prevention. Such integrated interventions enhance child health, nutrition, and cognitive development, contributing to long-term human capital accumulation and progress toward SDG 1, 2, 3, and 6

CONCLUSION

This study concludes that poverty, inadequate sanitation, and access to improved water sources significantly influence stunting incidence in Samarinda Seberang District, both partially and simultaneously. Poverty and inadequate sanitation increase stunting risk, while improved water access reduces it. Stunting is therefore a multidimensional problem, influenced by socioeconomic and environmental factors in addition to nutrition. The regression model explains 36.3% of the variation, indicating that other factors, such as maternal health and feeding practices, may also contribute.

Policy and practical recommendation: Accelerating stunting reduction requires a pentahelix approach that integrates local government, health offices, social services, community organizations, and the private sector. Priority should be given to vulnerable households, particularly low-income families with pregnant women, breastfeeding mothers, and children under five. Through strengthened social protection and programs to enhance family economic resilience. In addition, improving sanitation and access to safe water by maintaining wastewater treatment facilities and expanding safe drinking water services, especially in underserved areas, is crucial. These efforts should be complemented with sensitive and specific interventions to ensure sustainable stunting prevention.

Research limitations and future directions: This study is limited to Samarinda Seberang District, which may affect the generalizability of the findings. In addition, model explains only 36.3% of the variation in stunting, indicating that other determinants, such as maternal health, dietary practices, and access to health services, require further investigation. Future research is recommended to employ longitudinal or mixed method designs to better capture causal.

AI Disclosure Statement

AI was not used by the authors in the prosesses of data analysis interpretation of research findings, or preparation of the substantive content of this article. The authors used AI in limited capacity solely for language and spelling checks. The authors have also conducted verification revision, and validation of the content presented in this article and take full responsibility for its content.

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