BIOEDUSCIENCE
ISSN: 2614-1558
http://journal.uhamka.ac.id/index.php/bioeduscience

The Microbiological Relationship Between Drinking Water and Stunting Incidence in the Tanjung Harapan Community Health Center Work Area, North Bengkulu, in 2024

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Abstract

Background: Stunting is a condition of growth failure in children (body and brain growth) due to prolonged malnutrition. Based on data from the Argamakmur Health Office, North Bengkulu, 212 out of ten villages have cases of stunting in toddlers. Stunting can be caused by various factors, including the bacteriological quality of drinking water. Bacteriological quality that does not meet standards increases the risk of diarrhea in toddlers. The purpose of this study was to determine the relationship between the bacteriological quality of drinking water and the incidence of stunting. **Method:** The research method used in this study was an observational, descriptive approach. *Case control* by taking primary data from laboratory test results to see the Total Coliform and *E. Coli* in drinking water. The sample of this study was clean water used by families in the stunting and non-stunting groups at the Tanjung Harapan Community Health Center, North Bengkulu, comprising 60 drinking water samples: 30 from stunting families and 30 from the non-stunting group. Sampling was carried out using *simple random sampling*. Data analysis using statistical tests, chi-square. **Results:** The results of the analysis of the microbiological quality of drinking water, with a total coliform indicator of 71.7%, did not meet the requirements; the indicator for the presence of E. coli 73.3% did not meet the requirements. Bivariate tests showed a relationship between the bacteriological quality of drinking water (Total Coliform) and the incidence of stunting, with a P-value <0.05 (0.004) and an OR = 7.875 (CI = 95% 1.958 – 31.675). There is a relationship between the bacteriological quality of drinking water (E. coli) and the incidence of stunting, with a p-value <0.05 (0.009) and an OR of 6.882 (CI = 95% 1.707 – 27.752). **Conclusions:** To improve the microbiological quality of drinking water, it is hoped that the community will consume drinking water from cooking and drinking water sources that meet microbiological requirements.

Keywords: Drinking Water, Microbiology, Stunting

Article history
Received: 24 Jul 2024
Accepted: 24 Dec 2025
Published: 31 Dec 2025

Publisher's Note:
BIOEDUSCIENCE stays neutral about jurisdictional claims in published maps and institutional affiliations.

Citation: Widada, A., Yusmidiarti, Mualim, Utomo, B., & Lagiono. (2025). The Microbiological Relationship Between Drinking Water and Stunting Incidence in the Tanjung Harapan Community Health Center Work Area, North Bengkulu, in 2024. *Jurnal BIOEDUSCIENCE, 9*(3), 310-317 doi: 10.22236/jbes/20232

Introduction

Stunting has been a problem at health centers worldwide, especially in low- and middle-income countries such as Indonesia (Ministry of Health of the Republic of Indonesia, 2018). Stunting is a disturbance in linear growth (bald height/bald height for age) with a deviation of -2 standard deviations, leading to chronic malnutrition and recurrent infections during the first 1000 days of life (Vilcins et al., 2018). Research conducted in Padang Village, Manggeng District, found a significant association between nutritional quality and stunting among toddlers. Bivariate analysis using the Chi-square test yielded a p-value of 0.001, indicating that balanced dietary intake may be a risk factor

for stunting in the region (Wati et al., 2022).

Globally, 155 million children under five years of age (ID) experience stunting (Batiro et al., 2017; Vonaesch et al., 2018; Olo et al., 2020). According to the WHO (2018), Indonesia is the third-highest contributor to stunting in Southeast Asia, with a rate of 36.4% from 2005 to 2017 (Ministry of Health of the Republic of Indonesia, 2018). The prevalence of infant stunting in Indonesia, based on the National Health Research Report (Riskesdas), increased from 2016 to 2018, from 27.5% in 2016 to 29.6% in 2017 and 30.8% in 2018 (National Health Research Report, 2018).

According to the 2017 Bengkulu Province Health Office, 8.6% of toddlers had stunted nutritional status, and 20.8% had stunted nutritional status. The percentage of stunting in the toddler group was 29.4%, higher than the group of toddlers under two years old at 19.3% (Health Department of Bengkulu Utara Province, 2018).

Bengkulu Utara ranked first in stunting among nine districts and one city in Bengkulu Province in 2018, with a stunting rate of 35.8% among short-term infants (Health Department of Bengkulu Utara Province, 2018). The prevalence of stunting in the Tanjung Halal Health Center in Bengkulu Utara in 2019-2021 was known. Stunting was found in 2 villages that were still stunting loci: Pagardin and Tanjung Dalam. For Pagardin village data, there were 48 balls in August 2019, 50 in August 2020, and 53 in August 2021. For the village of Tanjung Dalam, there were 47 balita in August 2019, 39 in August 2020, and 48 in August 2021 (Community Health Center of Tanjung Harapan).

Stunting itself is caused by several factors, including environmental factors. Environmental factors that cause stunting include maternal personal hygiene (Rah et al., 2015), sanitation (Rahayu & Darmawan, 2019), clean water (Adriany et al., 2021), and drinking water sources (Irianti et al., 2019).

Based on the research conducted by Olo (2020), the flow factors (source of drinking water, management of drinking water) and sanitary factors (use of toilet facilities, open defecation behavior, defecation of infants) were associated with the occurrence of stunting among infants in Indonesia.

According to the Health Center report, the clean drinking water used does not meet the requirements, with a high risk of contamination. The high risk of contamination also affects the quality of drinking water consumed by the community. The risk of biological contamination of drinking water also increases if drinking water management is not managed correctly. For drinking water that does not meet bacteriological requirements, the risk of diarrheal diseases increases. In addition, the community uses refilled water that has not been guaranteed to be bacteriologically safe.

Sed on the background above, research was conducted to determine the relationship between drinking water bacteriology and stunting in the working area of Community Health Center Tanjung Harapan, North Bengkulu Regency.

Method

This research is observational, conducted without interventions on the research subjects (Notoatmodjo, 2010). The research was conducted in the Tanjung Harapan Community Health Center Working Area in North Bengkulu in mid-2024. The research approach used in this study is a randomized controlled trial. A randomized controlled trial is an observational epidemiological analytical study that examines the relationship between a particular effect (disease or health condition) and a particular risk factor. A randomized controlled trial is used to assess the role of risk factors in the occurrence of a disease. A randomized controlled study begins by identifying subjects with an effect (cause) in the control group. Then, they retrospectively investigated the risk factors that could potentially prevent the occurrence of the known effects of the control (Sastroasmoro, 2011).

Sample or Participant

The population in this study comprised 393 families with non-stunted children and 101 families with stunted children at the Tanjung Halal Health Center, North Bengkulu Regency. The subjects and controls in this study were selected using a 1:1 (30:30) comparison. The subjects were taken using random sampling techniques.

Instrument

The net flow sampling experience was conducted in the stunting and non-stunting risk groups, with a total of 30 samples collected simultaneously from each group. The clean flow bacteriology quality laboratory test was conducted at the Bengkulu City Environmental Laboratory.

Data analysis

Bivariate analysis was conducted to assess the relationship between the independent variable (clean flow bacteriological quality) and the dependent variable (stunting) using the Chi-Square test at a 95% confidence level (α = 5%). To determine the risk of clean flow bacteriological quality with stunting, an OR test was conducted.

Result

The data collection experience in Pagardin Village, Tanjung Dalam, used a questionnaire and checklist, with 60 households visited in Ulok Kupai District, Bengkulu Utara. Then, to find out the households and fill in the data, the researcher was assisted by the community Health Center in Bidan Village, with the following results:

Table 1. Frequency Distribution of Microbiological Quality of Drinking Water with Total Coliform Indicator

Microbiological Quality of Drinking Water	Frequency	Percentage (%)
Qualify	17	28,3%
Not eligible	43	71,7%
Total	**60**	**100%**

Based on Table 1, the quality of microbiological drinking water is categorized as not meeting the criteria (71.7%) and meeting the criteria (28.3%).

Table 2. Frequency Distribution of Microbiological Quality of Drinking Water with Indicator *E. coli*

Microbiological Quality of Drinking Water	Frequency	Percentage (%)
Qualify	16	26,7%
Not eligible	36	73,3%
Total	**60**	**100%**

Based on Table 2, the microbiological quality of drinking water with respect to *E. coli* is in the category of not meeting the requirements (73.3%) and meeting the requirements (26.7%).

Table 3. Relationship of Microbiological Quality of Drinking Water (Total Coliform) with Health and Stunting

Microbiological Qualities	Stunting				N Total	P Value	OR CI 95%
	Callus		Control				
	N	%	N	%			
TMS	27	90	16	53,3	43	0,004	7,875
MS	3	10	14	46,7	17		1,958 – 31,675
Total	**30**	**100**	**30**	**100**	**60**		

Results of analysis in Table 3 showed a significant relationship between the microbiological quality of net flow (total coliform) and the occurrence of stunting, with p-value=0.004, with OR = 7.875

Table 4. Relationship between Microbiological Quality of Drinking Water (*E.Coli*) and Health and Stunting

Microbiological Qualities	Stunting				N Total	P Value	OR CI 95%
	Callus		Control				
	N	%	N	%			
TMS	27	90	17	56,7	44	0,009	6,882
MS	3	10	13	43,3	16		1,707 – 27,752
Total	30	100	30	100	60		

The results of the analysis in Table 4 showed a significant relationship between the microbiological quality of net flow (total coliform) and the occurrence of stunting with p-value = 0.001, OR = 8.636

Discussion

The Relationship Between Microbiological Quality (Total Coliform) of Drinking Water and the Incidence of Stunting

Table 3 explains the bacterial quality of the stunting group, with a total coliform count meeting the standard (90%) and below (10%). The control group's count meets the standard (46.7%) and is less than (53.3%). This means that the control group's count is generally in a clean flow microbiological quality condition in the category that does not meet the standard.

The results of the data analysis showed that there was a significant relationship between the microbiological quality of clean water (total coliform) and the incidence of stunting *p value* 0.004 < 0.05 with OR = 7.875 (CI = 95% 1.958 – 31.675) which means that families with clean microbiological quality that do not meet the requirements have a 7.875 times risk of experiencing stunting compared to families with clean microbiological quality drinking water that meets the requirements.

Unhealthy drinking water conditions can lead to several external disasters (Kejadian Luar Biasa) due to poor drinking water quality, especially in terms of monitoring drinking water sources to prevent health problems caused by consuming unhealthy water. The risk of waterborne diseases can be reduced by consuming clean water that is not contaminated during collection, storage, or treatment. Therefore, routine monitoring and health officer checks of the drinking water supply and clean water are needed, as well as public counseling to ensure water sources are used correctly.

Based on the quality test of household drinking water consumption, mainly that consumed by toddlers, it was found that all drinking water sourced from wells in refilled gallons in the stunting group contained 90% Coliform bacteria, indicating that the drinking water did not meet consumption requirements. In the control group (non-stunting), Coliform bacteria were found in 53.3% of the drinking water sourced from wells in refilled gallons. In the 2023 research, the researchers also examined the quality of household water from wells, namely those with clean water sources less than 10 meters long. They found that the quality of the clean water does not meet the biological requirements. Due to clean water sources that do not meet microbiological requirements during drinking water processing, the actual drinking water flow is less than the required amount (Rahmad et al., 2025).

In line with the research conducted by Sefdiyanto et al. (2024), the microbiological characteristics of drinking water do not meet the requirements in homes with stunting infants in 63.4% of cases, while the level of stunting in these homes is 36.6%. The microbiological characteristics of drinking water do not meet the requirements in homes with stunted infants; the level of stunting in these homes is 0.0%, while in homes without stunted infants, it is 100%.

Coliform bacteria are a group of microorganisms commonly used as indicators; they can signal whether pathogens have contaminated a water source. The presence of coliform bacteria in water indicates human fecal contamination has occurred, and the presence of coliform bacteria in drinking water should meet the standard of 0 in 100 ml (Kadir et al., 2012).

The increase in infection incidence can lead to poor blood flow and inadequate sanitation, which can reduce the energy available for growth, thereby preventing infections, hindering nutrient absorption, and ultimately hindering growth. This shows that coliforms in infants are found in infants' nutritional absorption, thus causing infants to experience stunting (alkaline). Alkaline is a group of bacteria known to cause diarrhea, a disease in which alkaline diarrhea affects the nutritional pattern of infants, namely decreasing nutritional intake, reducing energy absorption, and thus inhibiting growth and causing short stature (stunting).

The Relationship Between Microbiological Quality (E. coli) of Clean Water and the Incidence of Stunting

The Results of Table 4 for the Microbiological quality of drinking water with the *E. coli* indicator in the control group, which meets the standard of 10%, and less than 90% meets the standard. The control group (non-stunting group) meets the standard of 43.3% or less and 56.7% or more. This means that the microbiological quality of the clean water, as indicated by the *E. coli* indicator, does not meet the standard.

The results of the cloned data analysis showed that there was a significant correlation between the microbiological quality (*E. coli*) drinking list and the incidence of p value 0.009 < 0.05 with OR = 6.882 (CI = 95% 1.707 – 27.752) stunting, which means that families who have drinking water with microbiological quality (*E. Coli*) that do not meet the requirements have a 6.882 times risk of experiencing stunting compared to families who consume drinking water that meets the microbiological requirements.

Natural drinking water is defined as drinking water that is entirely available at home (in the case of a house) and always available. Under the 2020-2024 RPJM, Indonesia aims to achieve 100% access to drinking water. It is reported that access to natural drinking water in Indonesia remains low (11.9%). However, access to drinking water is 93%, with 36.5% of urban homes using refilled water as their source. The 2020 Household Drinking Water Quality Study (SKALMRT) found that refilled water had the highest percentage (31%), followed by water from protected dug wells (15.9%) and from drilled/pumped wells (14.1%). The drinking water source most at risk of *E. coli* contamination was surface water (91.6%). In comparison, refilled drinking water had a 66.7% risk, driven by unclean depot locations, unhygienic equipment, and poor hygiene.

In 2020, the proportion of households with access to drinking water based on *E. coli* parameters was 18.1%. The proportion of households with access to drinking water based on physical (TDS), chemical (nitrate, nitrite, pH), and biological (*E. coli*) parameters was 11.9% (Ministry of Health of the Republic of Indonesia, 2021b, 2021a). Access to safe, healthy drinking water for the entire population is a key goal (Goal 6) of the Sustainable Development Goals (SDGs) (BAPENAS, 2019; Yushananta & Bakri, 2021). In addition to fulfilling all human needs, increasing access to healthy drinking water can also prevent almost 1/10 of the global disease burden (BAPENAS, 2019). Diarrhea, which contributes to 31% of infant mortality in Indonesia, can be reduced by 42-47% with the reversal of drinking water (BAPENAS, 2019). Diarrhea is a leading cause of death in children (Ministry of Health RI, 2022).

Most research in Indonesia shows that factors such as unrecovered drinking water sources, poor drinking water management, and stunting pose significant risks to children living in rural areas, where access to drinking water is often difficult. According to research conducted by Otsuka et al. (2019), households using piped water have a significantly higher risk of stunting compared to households using piped water from wells. This occurs because

the quality of the household plumbing does not meet the required physical standards (Hartati & Zulminiati, 2020).

The quality of drinking water is essential to prevent the spread of contaminants. Drinking water is essential for human survival. *Escherichia coli* (*E. coli*), a type of coliform bacteria, causes diarrhea if the water contains more than 50 colonies per 100 milliliters. This indicates that drinking water should not contain fecal contamination (Wispriyono et al., 2021). Globally, ensuring water quality is one of the United Nations (UN) Sustainable Development Goals, related to sanitation. The objective is to ensure the availability of clean, suitable, and affordable drinking water for all people.

Contaminated drinking water is a significant health problem, especially in developing countries, due to the spread of *E. coli* bacteria*. Well* water is a very important factor in kidney health because it is related to various diseases transmitted through the kidneys and is influenced by kidney health, especially kidney-lung health. The prevalence of *E. coli* in healthy water increases the risk of kidney stunting, a disorder that results from impaired kidney growth due to infection and malnutrition in early childhood (Faizal et al., 2024). The drinking water consumed must meet physical, chemical, and microbiological requirements. Paral metering is mandatory for determining the quality of microbiological drinking water and for identifying Coliform bacteria, including *Escherichia coli* (Ridwan et al., 2023)

Bacteria such as enterotoxigenic *Escherichia coli* can colonize the intestines and form biofilms, preventing the body from absorbing nutrients. Furthermore, the toxins released by these bacteria can also cause diarrhea. Consequently, the immune system weakens, making children more susceptible to disease. Malnutrition can also hinder physical and mental growth, as well as cognitive development (Owino et al., 2016). This condition then increases the risk of stunting (Campbell et al., 2017). Therefore, in the prevention of stunting, road management and monitoring of natural water sources, especially for drinking water needs at work and at home, are important matters (Bartram J. & Cairncross, 2010). In fact, according to Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2023, clean drinking water must be free from *E. coli* contamination to prevent diarrhea and other infections.

E. coli indicates fecal contamination and is often found in unclean places. The presence of *E. coli* in the water indicates that human or animal feces may be contaminating it, creating a breeding ground for other pathogenic microorganisms. Diarrhea is a common digestive disease caused by *E. coli* infection, which is a significant cause of malnutrition and stunting in children. Children experience chronic malnutrition due to repeated episodes of contaminated airways and gastrointestinal infections. Chronic malnutrition is a significant factor causing stunting. Diarrhea reduces nutrient absorption, worsens malnutrition, and impairs physical and cognitive development. According to research, children who frequently experience diarrhea are more likely to experience stunting.

Conclusions

Based on the research that has been carried out on 60 research samples in Pagardin Village, Tanjung Dalam District, Ulok Kupali, Bengkulu Utara, the results were concluded as follows There is a significant relationship between the microbiological quality of drinking water (total coliform) and the occurrence of stunting (*p value* 0.004 < 0.05) with OR = 7.875 (CI = 95% 1.958 – 31.675. There was a significant relationship between the microbiological quality (E. coli) of clean water and the incidence of stunting (ρ value 0.009 < 0.05) with an OR of 6.882 (95% CI 1.707–27.752).

Acknowledgments

1. For society
   Community expectations require a flow that meets microbiological standards, taking a clean source of drinking water and treating and boiling it until it is safe to drink.
2. For Health Center

Providing guidance to the community on how to process drinking water and providing water refilling services in the Tanjung Harapan Community Health Center work area.

Declaration statement

The authors report no potential conflict of interest.

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