

## Sanitation, Open Defecation, and Diarrhea in Tangerang, Banten, Indonesia, in early 2017: A Cross-Sectional Epidemiological Study

Ni Nengah Yustina Tutuanita<sup>1,2</sup>, Zakianis<sup>2\*</sup>

1. Directorate of Environmental Health, Ministry of Health Republic of Indonesia, Jakarta 12750, Indonesia.
2. Department of Environmental Health, Faculty of Public Health, Universitas Indonesia, Depok 16424, Indonesia.

### Abstract

Sanitasi Total Berbasis Masyarakat (STBM), an Indonesian program adopted from Community-Led Total Sanitation, only 17.3% of urban villages in Tangerang, Banten, Indonesia, are open defecation-free. Tangerang has the third highest incidence rate of diarrhea in Banten. This cross-sectional epidemiological study aims to establish a correlation among sanitation, open defecation, and diarrhea to determine the impact of the STBM program, particularly in Tangerang. We obtained open defecation and sanitation data of 104 urban villages from the STBM website of the Ministry of Health. In addition, diarrhea data from January 2017 to June 2017 were obtained from surveillance epidemiology data of the Ministry of Health. We statistically analyzed data using correlation analysis. The results revealed a significant negative correlation ( $P = 0.0005$ ) between open defecation and sanitation access ( $r = -0.975$ ). However, no significant correlation was established between diarrhea and sanitation access ( $r = -0.102$ ) and between diarrhea and open defecation ( $r = 0.124$ ), suggesting a significant correlation between open defecation and sanitation. Thus, all five pillars (i.e., no open defecation, hand washing, water safety, graywater treatment, and waste management) of the STBM should be executed simultaneously to assess the impact of health-related problems, particularly diarrhea.

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### Introduction

Because inadequate sanitation is a global health-related problem, it has become a sustainable development goal (SDG) warranting utmost attention. The universal access to sanitation has been declared as "SDG 6 aims to 'Ensure availability and sustainable management of water and sanitation for all' and comprises six technical targets relating to drinking water, sanitation and hygiene, wastewater management, water efficiency, integrated water resource management and protection of aquatic ecosystems".<sup>1</sup>

In 2015, the WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation reported that two of five people in

the world lack access to sanitation services. Reportedly, 2.4 billion people today have inadequate sanitation access, and 946 million people defecate in open areas.<sup>2</sup> In Indonesia, 20% of people still practice open defecation.<sup>1</sup> In fact, the World Bank reported that Indonesia suffered a loss of 2.4% in its GDP because of the lack of sanitation.<sup>3</sup>

Lately, several sanitation intervention schemes have been implemented to increase the latrine coverage area and its use. Some systematic reviews and meta-analyses about "impact of sanitation interventions on latrine coverage and use" have recognized that Community-Led Total Sanitation (CLTS), Sanitation Education, Sanitation Marketing, and Total Sanitation Campaign (TSC) could accelerate the progress in eliminating open defecation. Of all, the TSC has resulted in 27% increase in sanitation access.<sup>4</sup>

In Indonesia, the government launched the Sanitasi Total Berbasis Masyarakat (STBM) program, which was adopted from the CLTS, in 2008. However, the STBM online monitoring data revealed that only 17.3% of

#### \*Corresponding author:

Zakianis  
Department of Environmental Health  
Faculty of Public Health  
Universitas Indonesia  
Depok, 16424, Indonesia  
E-mail: zakianis@ui.ac.id

urban villages in Tangerang were open defecation-free (ODF). Although 65.3% of people in Banten Province have access to sanitation services, its data is far below the national sanitation access data (67.73%).<sup>5</sup>

Both ODF and sanitation access are the outputs of the STBM program. Apparently, improvement in sanitation access considerably reduces several health-related problems. The CLTS intervention in other countries has recognized a relationship between poor sanitation and several health-related issues, such as child diarrhea and poor child growth in Mali<sup>6</sup> and Kenya,<sup>7</sup> veterinary parasitology in Zambia,<sup>8</sup> parasitological and nutritional status of school-age and preschool-age in the Philippines,<sup>9</sup> and stunting reduction.<sup>10</sup>

Despite its proximity to Jakarta, the capital of Indonesia, Banten is one of the five provinces (Aceh, Papua, DKI Jakarta, and South Sulawesi) with the highest incidence of diarrhea.<sup>11</sup> In addition, Tangerang has the third highest incidence rate of diarrhea in Banten after Serang and the District of Serang.<sup>12</sup> Previous studies only show CLTS and ODF correlation, whereas this study attempts to reveal the importance of STBM in terms of total sanitation. Thus, this study aims to establish a correlation among sanitation, open defecation, and diarrhea to elucidate the impact of the STBM program in Indonesia, particularly Tangerang

## Materials and methods

### Data Collection

This cross-sectional epidemiological study obtained data from 104 kelurahan (Indonesian urban villages), which accounted for the total population of Tangerang. All data were collected from two online monitoring systems. While data of sanitation access and open defecation were obtained from cumulative data on the STBM online monitoring site of the Ministry of Health from 2010 to early 2017, diarrhea data (only acute diarrhea) were obtained from surveillance epidemiology data of the Ministry of Health from January 2017 to June 2017.

Because we obtained sanitation access and open defecation data from all villages, no data adjustments were performed. However, because diarrhea data were based on weekly

reports from *puskesmas* (Indonesian health centers), adjustments were made per urban village level. Of note, one *puskesmas* comprises several urban villages. Because this study design comprised analysis of secondary data, no ethical or intuitional approval was required.

### Statistical Analysis

In this study, we used Mplus (version 8) to analyze the data. We analyzed the strength and direction of correlation among sanitation access, open defecation, and diarrhea using Pearson's or Spearman's correlation analysis owing to the result of the normality test. The normality distribution was tested with a histogram, skewness/standard errors, and Kolmogorov-Smirnov test.

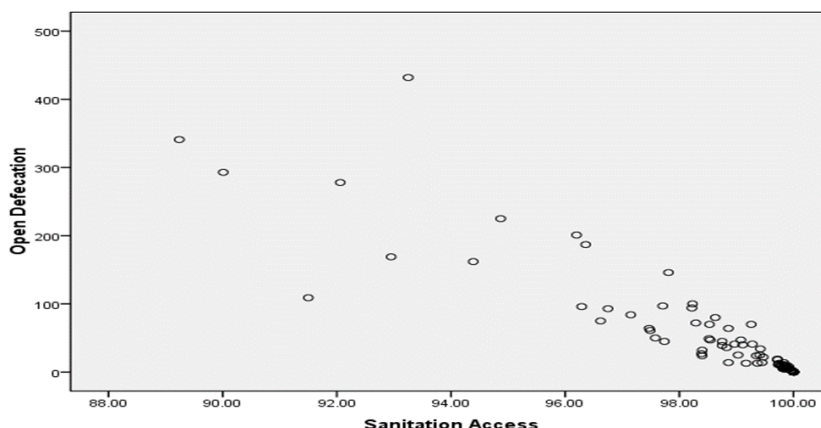
### Results

Table 1 presents all variables with abnormal data distribution in this study. Not only histogram but also skewness/standard errors and Kolmogorov-Smirnov test suggested irregular distribution of data. Based on the normality test results, we analyzed data using a non-parametric analysis, Spearman's correlation analysis method (Table 2), which revealed a significant negative correlation between sanitation and open defecation ( $r = -0.975$ ). However, no significant correlation was established between diarrhea and sanitation access in the negative direction ( $r = -0.102$ ). Furthermore, a positive correlation was determined between diarrhea and open defecation ( $r = 0.124$ ).

Figure 1 shows a significant correlation between open defecation and sanitation. The negative direction (i.e., points on scatter plot moved from the lower right side to the upper left side) implied that a significant proportion of people practiced open defecation and fewer had sanitation access.

Variables	Histogram	Skewness /Standard Error	Kolmogorov -Smirnov	Normality Test
Sanitation access	No bell shape	12.08	Sig	Negative
Open defecation	No bell shape	11.02	Sig.	Negative
Diarrhea	No bell shape	7.38	Sig.	Negative

**Table 1.** Normality Test. \*sig = significant



**Figure 1.** Scatter Plot Correlation Between Sanitation and Open Defecation.

Variables	Spearman Correlations	Sig. Two-tailed
Sanitation access and open defecation	-0.975	Sig.
Open defecation and diarrhea	0.124	No Sig.
Sanitation access and diarrhea	-0.102	No Sig.

**Table 2.** Correlations among sanitation, open defecation, and diarrhea.

## Discussion

### Open Defecation and Sanitation

A significant correlation between open defecation and sanitation suggests that the STBM output (the ODF status) has significantly increased sanitation access in the country. Ironically, several urban sanitation programs occasionally exclude the poor. A qualitative study in India highlighted the situation as follows: “Critical urban research ties sanitation poverty to lack of political and social capital that leaves the poor with little leverage to demand government services or to circumvent elite capture of existing resources.”<sup>13</sup> Thus, the eradication of sanitation poverty is imperative to provide universal access to sanitation services.

With attaining the ODF status, a community’s demand to access sanitation services increases manifold. Thus, governments should set aside sufficient social capital to provide adequate sanitation services before embarking on the journey of attaining the ODF status. The outcomes of the STBM program in other cities have revealed that

mere emphasis on altering the defecation behavior without fulfilling the rising demands of physical sanitation services has serious ramifications. A qualitative study in one of the small cities of Sumatra Island (Indonesia) states, “The Health Agency’s advocacy around community-based total sanitation (STBM), focusing on toilets to stop open defecation, had generated some interest in household toilets, but supply chains to meet this demand were lacking”<sup>14</sup>.

### Sanitation, Open Defecation, and Diarrhea

This study established a weak correlation between diarrhea and sanitation access and between diarrhea and open defecation. Although the direction of correlation was as expected, both correlations were not statistically significant. Another study reported that the CLTS may have prevented the decline in growth by implementing other pathways rather than just reducing incidences of diarrhea. The study stated, “In villages that received a behavioural sanitation intervention with no monetary subsidies, diarrhoeal prevalence remained similar to control villages. However, access to toilets substantially increased and child growth improved, particularly in children <2 years. CLTS might have prevented growth faltering through pathways other than reducing diarrhoea”<sup>6</sup>.

Apparently, diarrhea transmission occurs because of several pathways besides fecal exposure. A study provided evidence that sanitation correlates with a reduction in the

number of flies, slightly affecting the fetal exposure; however, no evidence was provided on other transmission pathways. Per the study, "Overall, the studies found little to no effect from sanitation interventions on these transmission pathways. There was no evidence of effects on water quality (source or household), hand or sentinel toy contamination, food contamination, or contamination of surfaces or soil. There is some evidence that sanitation was associated with reductions in flies and a small effect on observations of feces".<sup>15</sup>

Furthermore, besides focusing on attaining the ODF status, the STBM program should also focus on implementing other pillars of the STBM, including hand washing, water safety, graywater treatment, and waste management. In fact, all five pillars of the STBM must be simultaneously executed to assess the impact on health-related problems, particularly diarrhea. Hence, further extensive studies are warranted to assess the extent of weak correlation between diarrhea and open defecation and between diarrhea and sanitation access.

### Conclusions

This study infers that the objectives like better sanitation access and the ODF status can be attained only when the supply chain catering to the physical needs of sanitation services is fulfilled. Thus, improvements in both political environment and adequate social capital are required to meet the supply and demand. Furthermore, all five pillars of the STBM must be simultaneously executed to assess the impact on health-related problems, particularly diarrhea.

### Declaration of Interest

The authors report no conflict of interest.

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