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## Promotive Health Interventions Through Environmental Sanitation and Water Quality Education for Diarrhea Prevention Among Children in the Medan Sunggal Community Health Center Area

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### Abstract

This study aims to assess the effectiveness of promotive health interventions through environmental sanitation and water quality education for diarrhea prevention among children in the Medan Sunggal Community Health Center area on the knowledge and practices of PHBS among families with toddlers, as well as its relationship with the incidence of diarrhea in toddlers in the working area of the Medan Sunggal Health Center. The study used a quasi-experimental design with a one-group pretest–posttest approach involving 50 families with toddlers selected purposively. Interventions in the form of environmental sanitation and water quality education were provided through structured counseling. Data analysis was conducted using the Wilcoxon signed-rank test and the chi-square test. The results showed a significant increase in maternal knowledge of PHBS after the intervention ( $p < 0.001$ ), while the increase in maternal PHBS practices was not statistically significant ( $p = 0.073$ ), although descriptively it improved. The chi-square test analysis indicated no significant relationship between maternal knowledge and the incidence of diarrhea ( $p = 0.529$ ) or between maternal PHBS practices and diarrhea incidence ( $p = 0.636$ ). These findings suggest that educational interventions effectively improve cognitive aspects but are insufficient to reduce diarrhea incidence without improvements in physical environmental factors. Environmental sanitation and water quality education increase mothers' knowledge of Clean and Healthy Living Behaviors; however, they alone are inadequate to reduce diarrhea incidence in toddlers, as factors such as access to clean water, proper sanitation facilities, and environmental hygiene also play a critical role.

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## INTRODUCTION

Diarrhea remains one of the leading causes of death among children under five worldwide and is largely preventable through improved access to clean water, sanitation, and hygiene (WASH). The World Health Organization reports that diarrhea continues to be a significant cause of mortality among children aged 1–59 months, mostly associated with limited access to safe drinking water, proper sanitation, and inadequate hygiene practices (World Health Organization, 2024). Globally, diarrhea accounts for about 9% of all deaths among children under five each year, with hundreds of thousands of deaths that could be prevented (UNICEF, 2023). Recent evidence from large-scale cluster randomized trials suggests that targeted and context-specific WASH interventions can reduce the risk of diarrhea, especially in low-socioeconomic groups and during the rainy season (Arnold et al., 2024).

In Indonesia, the burden of diarrhea among toddlers remains relatively high, with a prevalence of around 11–12% (Ahinkorah et al., 2022; Ali et al., 2025; Hasanah et al., 2024;

Purnama et al., 2025; Yunitawati et al., 2023). The incidence of diarrhea is strongly correlated with WASH indicators such as drinking water sources, sanitation, and household hygiene practices (Hidayat et al., 2025). Other studies confirm the influence of environmental factors and seasonal patterns on the high incidence of diarrhea in several regions (Pertiwi et al., 2024). Local evidence indicates that poor household drinking water quality increases the risk of diarrhea in children under five, as reported in areas such as West Nusa Tenggara (Suryani & Hapsari, 2024). In addition, a review of national literature identified toilet conditions, sewage disposal systems, availability of clean water, and household characteristics as key determinants of diarrhea incidence in children under five (Rahmawati & Prasetyo, 2025).

In North Sumatra, including Medan City, although access to adequate sanitation has improved, challenges remain in the equitable distribution of facilities and the consistency of household hygiene practices. Data indicate that improvements in sanitation infrastructure have not always been accompanied by healthy behaviors, such as handwashing at critical times, safe drinking water treatment, and proper disposal of children's feces. This is evident in densely populated areas such as Belawan Sicanang, where latrine conditions and environmental sanitation behaviors are significantly associated with diarrhea incidence (Lubis & Nasution, 2023).

Therefore, a promotive approach through structured health education—promotive health interventions through environmental sanitation and water quality education for diarrhea prevention among children in the Medan Sunggal Community Health Center area—that includes counseling, hygiene practice demonstrations, communication, information, and education (KIE) media, as well as strengthening the roles of community health volunteers (cadres) and communities, is an important strategy. Systematic reviews and meta-analyses show that integrating behavioral education with household drinking water management significantly reduces diarrhea incidence (Wolf et al., 2024). Community-based WASH programs emphasizing local empowerment and hygiene promotion have also been shown to improve hygienic behaviors and reduce diarrhea prevalence among toddlers (Balolong et al., 2024).

The novelty of this study lies in its integrated assessment of both cognitive and behavioral outcomes alongside actual disease incidence, using a pre–post design in a community with a high baseline PHBS (Clean and Healthy Living Behaviors) practice. Unlike previous studies that often measure only knowledge change, this study also quantifies the gap between improved knowledge and reduced diarrhea, highlighting the role of relatively fixed physical environmental factors. This approach provides a more realistic evaluation of what stand-alone health education can achieve.

The purpose of this study is to assess the effectiveness of promotive health interventions through environmental sanitation and water quality education for diarrhea prevention among children in the Medan Sunggal Community Health Center area on the knowledge and practices of PHBS among families with toddlers, as well as its relationship with diarrhea incidence in toddlers in the working area of the Medan Sunggal Health Center. This research contributes empirical evidence for policymakers and health practitioners regarding the limitations of education-only interventions and emphasizes the need for integrated WASH infrastructure improvements. The objective is to measure changes in

knowledge and practices before and after the intervention and to analyze their association with diarrhea incidence. The benefits are twofold: for public health practice, it informs the design of more effective diarrhea prevention programs; for academia, it provides a basis for future research on multicomponent interventions.

## RESEARCH METHOD

This study used a quasi-experimental design of one-group pretest–posttest to assess changes in knowledge and practices of families under five related to diarrhea prevention before and after environmental sanitation and water quality education interventions. The research was carried out in the working area of the Medan Sunggal Health Center, Medan City, in October–November 2025.

The research sample consisted of 50 families with children under five years of age 12–59 months, selected using purposive sampling techniques based on inclusion and exclusion criteria. Interventions in the form of health promotive education are provided through structured counseling for 60–90 minutes using presentation media and interactive discussions, with materials including diarrhea, environmental sanitation, hygiene, quality, and drinking water treatment.

Data were collected before and after the intervention using structured questionnaires to assess knowledge and practice. Knowledge was measured by multiple-choice/true-wrong questions, while practice was assessed using a behavioral checklist. Data analysis was carried out descriptively and inferentially, with the paired t-test or the Wilcoxon signed-rank test according to the data distribution, at a significance level of  $p < 0.05$ .

## RESULTS AND DISCUSSION

### Univariate test results

#### A. Data on respondents of mothers who were willing to participate in all research activities

**Table 1. Characteristics of Mother Respondents (N=50)**

|                           | Variable           | Quantity |
|---------------------------|--------------------|----------|
| <b>Age</b>                | < 27 years old     | 34       |
|                           | ≥ 27 years old     | 16       |
| <b>Education</b>          | SD                 | 3        |
|                           | Junior High School | 6        |
|                           | High School        | 21       |
|                           | Colleges           | 20       |
| <b>Jobs</b>               | Housewives         | 25       |
|                           | Domestic Assistant | 3        |
|                           | Self-employed      | 8        |
|                           | Private employees  | 8        |
|                           | PNS                | 5        |
| <b>Number of toddlers</b> | Doctor             | 1        |
|                           | 1 child            | 28       |
|                           | 2 children         | 22       |

## B. Data of toddler respondents brought by their mothers

**Table 2. Characteristics of Toddler Respondents (N=50)**

| Variable  | Category    | Quantity |
|-----------|-------------|----------|
| NEWS DATA | Gender      | Male     |
|           |             | 27       |
|           |             | Women    |
|           |             | 23       |
|           | Toddler age | 1 Year   |
|           |             | 13       |
|           |             | 2 Years  |
|           |             | 17       |
|           |             | 3 Years  |
|           |             | 8        |
|           |             | 4 Years  |
|           |             | 12       |

## C. Practical data on maternal PHBS before educational intervention

**Table 3. Distribution of Maternal PHBS Practice Pretest**

|       |        | Mother's PHBS Practice |         |               |                    |
|-------|--------|------------------------|---------|---------------|--------------------|
|       |        | Frequency              | Percent | Valid Percent | Cumulative Percent |
| Valid | less   | 2                      | 4.0     | 4.0           | 4.0                |
|       | enough | 9                      | 18.0    | 18.0          | 22.0               |
|       | Good   | 39                     | 78.0    | 78.0          | 100.0              |
|       | Total  | 50                     | 100.0   | 100.0         |                    |

Based on the results of the analysis of the frequency of Clean and Healthy Living Behavior (PHBS) practices in 50 respondent mothers in the pretest data, it was found that the majority of mothers had PHBS practices in the good category, namely 39 people (78%). This shows that before being given intervention or counseling, most mothers have implemented clean and healthy living behaviors well in their daily lives. Furthermore, there were 9 mothers (18%) who were in the adequate category, indicating that a small percentage of mothers still need to improve some aspects of their PHBS practice. Meanwhile, only 2 mothers (4%) are included in the underserved category, which shows that only a few respondents have low PHBS practices. Overall, this pretest data shows that the level of practice of maternal PHBS at the beginning of the measurement is in the category that tends to be high.

## D. Maternal knowledge data before educational intervention

**Table 4. Distribution of Maternal Knowledge Pretest**

|       |        | Mother's Knowledge |         |               |                    |
|-------|--------|--------------------|---------|---------------|--------------------|
|       |        | Frequency          | Percent | Valid Percent | Cumulative Percent |
| Valid | less   | 1                  | 2.0     | 2.0           | 2.0                |
|       | enough | 49                 | 98.0    | 98.0          | 100.0              |
|       | Total  | 50                 | 100.0   | 100.0         |                    |

Based on the results of the frequency analysis of maternal knowledge in the pretest data, it was found that most of the respondents had a level of knowledge in the sufficient category, namely 49 people (98%). These findings suggest that almost all mothers had an adequate understanding of the topics being measured before the intervention was given. Meanwhile, only 1 mother (2%) is in the under-performing category, indicating that only a small percentage of respondents have low knowledge. Overall, the results of this pretest showed that the level of knowledge of mothers at the beginning of the measurement was in

the category of a fairly good one, although there were still a few respondents who needed to improve understanding.

#### E. Data on the number of diarrhea incidents in toddlers in the last 3 months

**Table 5. Incidence of Diarrhea in Toddlers (Last 3 Months, Pretest)**

|       |       | Incidence of toddler diarrhea |         |               |                    |
|-------|-------|-------------------------------|---------|---------------|--------------------|
|       |       | Frequency                     | Percent | Valid Percent | Cumulative Percent |
| Valid | No    | 14                            | 28.0    | 28.0          | 28.0               |
|       | Ya    | 36                            | 72.0    | 72.0          | 100.0              |
|       | Total | 50                            | 100.0   | 100.0         |                    |

Based on the results of the frequency analysis of the incidence of diarrhea in 50 respondents under five, it was found that most of the toddlers experienced diarrhea, namely 36 toddlers (72%). This shows that the incidence of diarrhea is still quite high among toddlers who are study respondents. Meanwhile, only 14 toddlers (28%) did not experience diarrhoea, indicating that a small percentage of toddlers are free of the disease. Overall, this data shows that the incidence of diarrhea in the respondent group under five is quite dominant, so interventions related to clean and healthy living behaviors (PHBS) and maternal knowledge are needed to reduce the incidence of diarrhea.

#### F. Data on PHBS practice of mothers after being given educational interventions

**Table 6. Distribution of Maternal PHBS Practice Posttest**

|       |        | PHBS practice of post-test mothers |         |               |                    |
|-------|--------|------------------------------------|---------|---------------|--------------------|
|       |        | Frequency                          | Percent | Valid Percent | Cumulative Percent |
| Valid | enough | 5                                  | 10.0    | 10.0          | 10.0               |
|       | Good   | 45                                 | 90.0    | 90.0          | 100.0              |
|       | Total  | 50                                 | 100.0   | 100.0         |                    |

The results of the analysis showed that the practice of maternal PHBS increased after the intervention. In the post-test, the majority of respondents were in the category of good practice (90%), an increase compared to the pretest (78%). Meanwhile, the proportion of respondents with practice decreased from 18% to 10%, and the less category decreased from 4% in the pretest to 0% in the post-test. These findings show that the educational interventions provided are effective in improving the practice of maternal PHBS.

#### G. Maternal knowledge data after educational intervention

**Table 7. Distribution of Maternal Knowledge Posttest**

|       |        | Post-test mother's knowledge |         |               |                    |
|-------|--------|------------------------------|---------|---------------|--------------------|
|       |        | Frequency                    | Percent | Valid Percent | Cumulative Percent |
| Valid | enough | 2                            | 4.0     | 4.0           | 4.0                |
|       | Good   | 48                           | 96.0    | 96.0          | 100.0              |
|       | Total  | 50                           | 100.0   | 100.0         |                    |

The results of the analysis showed that the mother's level of knowledge increased significantly after the intervention. In the post-test, most of the respondents were in the category of good knowledge (96%), while only 4% were in the category of sufficient and there were no respondents with poor knowledge. On the other hand, in the pretest, the

majority of mothers were in the category of sufficient knowledge (98%), with no respondents in the good category. These findings show that the educational interventions provided are effective in increasing mothers' knowledge about PHBS and health in toddlers.

### Normality test results

#### H. Data from normality test results

**Table 8. Normality Test Results (Shapiro-Wilk)**

| Normality test                         |           |                    |      |  |
|----------------------------------------|-----------|--------------------|------|--|
|                                        | Statistic | Shapiro-Wilk<br>df | Say. |  |
| Respondent's PHBS Practice             | .540      | 50                 | .000 |  |
| Respondents' knowledge                 | .125      | 50                 | .000 |  |
| Incidence of diarrhea                  | .562      | 50                 | .000 |  |
| PHBS Practice of Post-Test Respondents | .344      | 50                 | .000 |  |
| Post-test respondent knowledge         | .198      | 50                 | .000 |  |

The results of the Shapiro–Wilk normality test showed that all study variables had a significance value of  $< 0.05$ , indicating that the data were not normally distributed. Therefore, advanced statistical analysis is carried out using appropriate non-parametric tests to assess the difference between pre-test and post-test.

### Bivariate test results

#### I. Results of the Wilcoxon Signed Rank Test on the PHBS practice variable

**Table 9. Wilcoxon Signed-Rank Test for PHBS Practice**

| Wilcoxon Signed Rank Test       |                |     |           |              |
|---------------------------------|----------------|-----|-----------|--------------|
|                                 |                | N   | Mean Rank | Sum of Ranks |
| PHBS Practice for Post-Test     | Negative Ranks | 4a  | 6.50      | 26.00        |
| Respondents - PHBS Practitioner | Positive Ranks | 10b | 7.90      | 79.00        |
| for Respondents                 | Ties           | 36c |           |              |
|                                 | Total          | 50  |           |              |

The results of the Wilcoxon Signed Rank Test showed that some respondents experienced an increase in PHBS practice scores after the intervention. Of the 50 mothers, as many as 10 respondents experienced an increase in scores, 4 respondents experienced a decrease, and 36 respondents did not experience any changes. However, the value of Asymp. Sig. (2-tailed) of 0.073 ( $> 0.05$ ) shows that the increase in maternal PHBS practice has not been statistically significant. However, descriptively there is a tendency to improve PHBS practices after educational interventions.

#### J. Wilcoxon Signed Rank Test results on knowledge variables

**Table 10. Wilcoxon Signed-Rank Test for Knowledge**

| Wilcoxon Signed Ranks Test                            |                |     |           |              |                        |
|-------------------------------------------------------|----------------|-----|-----------|--------------|------------------------|
|                                                       |                | N   | Mean Rank | Sum of Ranks | Asymp. Sig. (2-tailed) |
| Post-test respondent knowledge - Respondent knowledge | Negative Ranks | 0a  | .00       | .00          | <.001                  |
|                                                       | Positive Ranks | 48b | 24.50     | 1176.00      |                        |

|       |    |
|-------|----|
| Ties  | 2c |
| Total | 50 |

The results of the Wilcoxon Signed Rank Test showed a significant increase in maternal knowledge scores after the intervention. Of the 50 respondents, 48 mothers experienced an increase in knowledge scores, there was no decrease in scores, and only 2 mothers did not experience changes. Asymp value. Sig. (2-tailed) < 0.001 indicates that the increase in maternal knowledge after intervention is statistically significant, so it can be concluded that the education provided is effective in increasing maternal knowledge related to PHBS and health of toddlers.

#### **K. Chi-Square test results to see the effect of maternal PHBS practice level on toddler diarrhea cases**

**Table 11. Chi-Square Test: PHBS Practice vs. Diarrhea Incidence**

| Chi-Square Tests             |       |    |                                      |
|------------------------------|-------|----|--------------------------------------|
|                              | Value | df | Asymptotic Significance<br>(2-sided) |
| Pearson Chi-Square           | .906a | 2  | .636                                 |
| Likelihood Ratio             | 1.437 | 2  | .487                                 |
| Linear-by-Linear Association | .146  | 1  | .702                                 |
| N of Valid Cases             | 50    |    |                                      |

The results of the analysis of the relationship between maternal Clean and Healthy Living Behavior (PHBS) practices and the incidence of diarrhea in toddlers showed that there was no statistically significant relationship. The Pearson Chi-Square test yielded a value of  $\chi^2 = 0.906$  with a degree of freedom of 2 and a significance value of  $p = 0.636$  ( $p > 0.05$ ), so that the Null Hypothesis ( $H_0$ ) was accepted. These findings suggest that maternal PHBS practices, based on the categorization used in this study, were not significantly related to the incidence of diarrhea in toddlers in the study sample.

#### **L. Chi-Square test results to see the effect of maternal knowledge level on toddler diarrhea cases**

**Table 12. Chi-Square/Fisher's Exact Test: Knowledge vs. Diarrhea Incidence**

| Chi-Square Tests                   |       |    |                                      |                          |
|------------------------------------|-------|----|--------------------------------------|--------------------------|
|                                    | Value | df | Asymptotic Significance<br>(2-sided) | Exact Sig. (2-<br>sided) |
| Pearson Chi-Square                 | .397a | 1  | .529                                 |                          |
| Continuity Correction <sup>b</sup> | .000  | 1  | 1.000                                |                          |
| Likelihood Ratio                   | .665  | 1  | .415                                 |                          |
| Fisher's Exact Test                |       |    |                                      | 1.000                    |
| Linear-by-Linear<br>Association    | .389  | 1  | .533                                 |                          |
| N of Valid Cases                   | 50    |    |                                      |                          |

The results of the analysis showed that there was no significant relationship between the level of maternal knowledge about Clean and Healthy Living Behavior (PHBS) and the incidence of diarrhea in toddlers. The Pearson Chi-Square test yielded a value of  $\chi^2 = 0.397$

(df = 1) with a value of  $p = 0.529$  ( $p > 0.05$ ). However, the assumption of the Chi-Square test is not fulfilled because 50% of cells have an expected count of  $< 5$ , so the results of the Fisher's Exact Test are used as the basis for interpretation. An Exact Sig. (2-sided) value of 1,000 corroborates that there was no significant relationship between maternal knowledge level and the incidence of diarrhea in toddlers in this study sample.

## Discussion

In this study, most of the mothers showed that the practice of Clean and Healthy Living Behavior (PHBS) was in the good category since pre-test and increased after the intervention. In addition, mothers' knowledge of PHBS also experienced a significant increase in post-tests. These findings show that health-promoting interventions through environmental sanitation and water quality education are effective in improving maternal understanding and encouraging changes in hygienic behavior related to diarrhea prevention. These results are in line with previous research that states that health education plays an important role in increasing public knowledge and awareness about sanitation and hygiene (Siregar, Razak, Yuniarti, & Handayuni, 2023).

However, the increase in knowledge and practice of PHBS mothers has not been directly followed by a decrease in the incidence of diarrhea in toddlers. Based on the results of the Chi-Square test, no significant relationship was found between the level of knowledge of mothers about PHBS and the incidence of diarrhea in toddlers ( $p = 0.529$ ), nor between the practice of maternal PHBS and the incidence of diarrhea ( $p = 0.636$ ). These findings suggest that although educational interventions have been shown to be effective in increasing knowledge and demonstrating descriptive improvement in PHBS practices, these changes have not been strong enough to significantly affect the incidence of diarrhoea. These results contradict the initial assumption that increased knowledge and practice through education will have a direct impact on reducing the incidence of diarrhea, thus indicating that the causes of diarrhea are multifactorial and not solely determined by behavioral factors.

Furthermore, these non-significant results reflect the complexity of the determinants of the incidence of diarrhea in toddlers. In the context of environmental health, diarrhea is not only influenced by the level of knowledge and family practices, but also strongly influenced by the underlying physical environmental conditions. Several studies show that environmental sanitation and access to clean water facilities have a more dominant role in determining the incidence of diarrhea than the behavior of PHBS alone (Gozali, Astutik, & Ismail, 2023). Interventions that focus on behavior change without improving environmental conditions have the potential to have a limited impact on health outcomes.

This is supported by a systematic review that reports that environmental sanitation and clean water supply have a significant relationship with the incidence of diarrhea in toddlers in Indonesia, so that physical environmental factors are considered more determinant than maternal PHBS behavior alone (Siregar et al., 2023). Research in Pojok Village, Bojonegoro, also showed that households that do not have healthy latrines or closed wastewater disposal systems (SPAL) have a higher risk of experiencing diarrhea in toddlers (Gozali et al., 2023).

Similar findings were also reported in a study in the work area of the Kalideres Health Center, West Jakarta, which confirmed that the habit of washing hands with soap and environmental sanitation conditions, including clean water quality, was significantly related to the incidence of diarrhea in toddlers (Deng & Setiarini, 2022). In addition, a study in Aceh



in 2024 shows that the availability of clean water facilities and latrine conditions is significantly related to the incidence of diarrhea in toddlers, even when the mother's PHBS is relatively good (Elvieta & Ernita, 2024).

Thus, although education and maternal behavior change through increased PHBS are important components in diarrhea prevention, the insignificant Chi-Square test results in this study show that educational interventions alone are not sufficient to significantly reduce the incidence of diarrhea. The absence of such an effect may be due to physical environmental factors that do not change or are not measured in depth during the intervention, such as the availability and quality of clean water, the condition of latrines, fecal and liquid waste disposal systems, and the level of contamination of the household environment. Therefore, effective diarrhea prevention efforts, especially in the context of the Medan Sunggal Health Center's work area, require an integrated approach that combines behavior change education with improving environmental sanitation infrastructure and fulfilling basic WASH facilities (Siregar et al., 2023; Gozali et al., 2023; Deng & Setiarini, 2022; Elvieta & Ernita, 2024).

## CONCLUSION

The findings from promotive health interventions through environmental sanitation and water quality education for diarrhea prevention among children in the Medan Sunggal Community Health Center area indicate that the intervention was effective in significantly improving maternal knowledge of PHBS (Clean and Healthy Living Behaviors) for diarrhea prevention in toddlers; however, improvements in maternal PHBS practices were not statistically significant, despite a descriptive upward trend. Furthermore, no significant association was found between maternal knowledge or practices and the incidence of diarrhea in toddlers. These results suggest that health education alone is insufficient to reduce diarrhea incidence, as unmodified physical environmental factors—such as access to and quality of clean water, latrine conditions, sewage systems, and overall household sanitation—likely play a critical role. Therefore, diarrhea prevention efforts should adopt a more comprehensive approach that integrates behavioral education with improvements in environmental sanitation infrastructure. Future research is recommended to employ longitudinal or controlled study designs that incorporate environmental interventions alongside educational components to better evaluate their combined impact on both behavioral changes and diarrhea incidence outcomes.

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