JHE 9 (2) (2024)

Journal of Health Education

http://journal.unnes.ac.id/sju/index.php/jhealthedu

Sanitation coverage and diarrhea outcomes among children aged under five years in Matabeleland, South Province of Zimbabwe

Brightwell Sibanda [1], Dewi Susanna[2]✉
[1]Environmental Health Officer, Ministry of Health and Childcare, Lupane District, Zimbabwe
[2]Master Program in Public Health, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia

Article Info

Article History:
Submitted 22 June 2024
Accepted 16 July 2024
Published 30 December 2024

Keywords:
Children under five of age, Diarrhea, Sanitation Coverage

DOI
https://doi.org/10.15294/jhe.v9i2.7863

Abstract

Background: Diarrhea remains a prominent factor contributing to the high rates of child mortality, particularly observed in children under the age of five. The study assessed the relationship between sanitation coverage and diarrhea outcomes among children under five years of age in the Matabeleland, South Provinces of Zimbabwe.
Methods: The study utilized a Quantitative Cross-Sectional study using a Demographic Health Survey and assessed from the Multiple Indicator Cluster Survey (MICS) 2019 dataset. This DHS data is freely available at https://mics.unicef.org/surveys. A total of 518 mothers were analyzed in this research based on the secondary data from the 2019 MICS findings. The variables studied were the mother's education, wealth, handwashing, sanitation coverage, shared sanitation facilities, child age, residence, and religion.
Results: The analysis revealed significant associations for both the age of the child and residence in Matabeleland, South Province. For age, the p-value was 0.039 with an OR of 0.594 and a 95% CI (0.362-0.974), and Residence with a p-value of 0.004 and an OR of 2.442 and a 95% CI (1.329-4.484).
Conclusion: Sanitation coverage was not significant in this study. Therefore, health and hygiene education campaigns should be conducted to equip caregivers with adequate knowledge that is essential for the prevention of diarrhea.

✉ Correspondence Address:
Email : dsusanna@ui.ac.id

p-ISSN 2527-4252
e-ISSN 2528-2905

INTRODUCTION

The World Health Organization defines Diarrhea as the excretion of three or more loose or liquid bowel movements per day (or a more frequent excretion rate than is typical for the specific individual). The regular excretion of well-formed stools does not meet the criteria for diarrhea, nor does the excretion of loose, soft stools in breastfed infants (World Health Organization, 2024). Diarrhea commonly presents as a manifestation of an infection within the gastrointestinal tract stemming from a range of bacterial, viral, and parasitic agents. The transmission of this infection typically occurs through consuming contaminated food or water or via interpersonal contact due to inadequate hygiene practices (World Health Organization, 2024).Diarrhea remains a prominent factor contributing to the high rates of child mortality, particularly observed in children under the age of five residing in economies characterized by low to moderate income levels (Rosenberg, 2007).

Diarrhea illness ranks as the third most prominent contributor to mortality among children below the age of five and is linked to the demise of approximately 443,832 children annually (UNICEF, 2024). In 2016, on a global scale, approximately 1.2 million deaths were attributed to inadequate drinking water, sanitation, and poor hand hygiene practices. Among the deceased were close to 300,000 children under the age of five who succumbed to diarrhea (World Health Organization, 2024). Globally, approximately 946 million individuals continue to practice open defecation, with the majority of them residing in rural areas, constituting 9 out of every 10 individuals. Moreover, a staggering 2.4 billion people lack access to fundamental sanitation facilities, with 7 out of every 10 individuals in rural areas being affected. In addition, a significant proportion of the global population, around 663 million people, face obstacles in accessing basic water sources (United Nations Children`s Fund and World Health Organisation, 2019).

The mortality rate resulting from diarrhea in children under the age of 5 is most prevalent in South Asia and sub-Saharan Africa(UNICEF, 2024). The consequential impact of diarrhea in low- and middle-income nations, attributed to these factors, totals 502,000 fatalities related to insufficient water and 280,000 fatalities attributed to inadequate sanitation out of a sum of 1.50 million deaths caused by diarrhea in the year 2012(Prüss-Ustün et al., 2014). The prevalence of diarrhea among children under the age of five in Zimbabwe was 15% in 2019, marking the lowest recorded percentage to date. Previous data indicated higher rates of up to 30% in 1995 and 25% in 2015 (Garatsa et al., 2023). The occurrence of various health issues, notably diarrhea, can be mitigated through the practice of positive health behaviors (Mufida et al., 2021).Therefore, this study seeks to assess the relationship between sanitation coverage and diarrhea outcomes in Matabeleland South Province of Zimbabwe, using the 2019 Multiple Indicator Cluster Survey (MICS) survey findings.

METHODS

Data Sources and Statistics Used

This research utilized a Quantitative Cross-Sectional study design to analyze the relationship between sanitation coverage and diarrhea outcomes among children under five in the Matabeleland, South Province of Zimbabwe. A research population typically refers to a vast assemblage of individuals or objects that is the primary point of interest in a scientific investigation (Mohamed Adam, 2024). The survey used the 2012 population data for the under five years of age as the sample frame. Standard surveys conducted by the Demographic and Health Surveys (DHS) encompass substantial sample sizes, typically ranging from 5,000 to 30,000 households. These surveys are regularly carried out at intervals of approximately five years, facilitating the ability to make comparative analyses over time (Corsi et al., 2012).

A total of 6223 caretakers/mothers were eligible for the interview, and 6102 were then interviewed, with a 98.1% response rate. This was at the national level; the sample size for the Matabeleland South Province is 518 caretakers/mothers. For this research, the MICS 2019 dataset was analyzed. This DHS data is freely available at https://mics.unicef.org/surveys. Data processing involved data cleaning through examination of entered data

to ascertain the presence or absence of errors. Missing values were excluded from the analysis. Data integration was performed. It was done by merging selected variables from two datasets (Household data and caregiver`s data) to create one dataset with the required variables for analysis. These Datasets were extracted from the Zimbabwe MICS6 SPSS Datasets.

Data transformation was done to create new variables that suited the required analysis. For example, the outcome variable (Diarrhea), which has four (4) responses (Yes, No, Dk, and No responses had only two (2) responses (1=Yes and 0 = No). The variable Types of Sanitation Facilities was recoded into different. For example, it was recoded into Sanitation Coverage, which was either Improved = 0 or Unimproved = 1. The education variable was recoded into High (0) and Low (1).

Wealth was recoded into Rich (0) and Poor (1), Residence or Area variable was recoded into Urban (0) and Rural (1), Religion into Religion (0) and No religion (1), Age of child into More than 2 years (0) and less than 2 years (1), Shared sanitation facilities into No (0) and Yes (1), Hand washing facilities into Yes (0) and No (1). This was done according to the Operational Definition of Improved and Unimproved Sanitation Facilities. Data filtering through the command select cases and the if command was done as well in order to maximize the required data analysis. In this scenario, the dataset was filtered to extract data per province using the province variable. The Matabeleland South dataset was then produced for analysis.

Data analysis was carried out using IBM SPSS Statistics. Bivariate analysis was performed. The variables that had the potential to be included in the multivariate model are the variables that were analyzed with a p-value (p-value) less than 0.25. In Multivariate Analysis, The Binary Logistic Regression Model with all the significant variables from the bivariate analysis was used. As indicated earlier the outcome variable (Diarrhea) is a categorical variable (1 and 0, 1 for having Diarrhea and 0 for not having Diarrhea). Hastono (2014) defines Logistic regression analysis as a statistical technique that employs a mathematical model to examine the association between one or more independent variables and a categorical dependent variable that is dichotomous or binary(Sukandar, 2006). The study proposal was reviewed and approved by the Research and Community Engagement Ethical Committee of the Faculty of Public Health Universitas Indonesia No.: Ket- 442/ UN2.F10.D11/PPM.00.02/2024.

RESULTS AND DISCUSSIONS

The relationship between diarrhea and independent variables in the study

The results of the bivariate analysis of the relationship between diarrhea and all independent variables such as mother education, wealth, religion, residence, age of the child, shared sanitation facilities, handwashing, and sanitation coverage can be seen in Table 1.

Table 1 shows that the child's Residence and age were statistically significant at 0.25 and are eligible to be included in the multivariate analysis.

Multivariate analysis

Table 2 shows that the residence and age of the child are significant at 0.05. It shows that the probability of diarrhea occurring among children residing in the rural area category is 2.442 as compared to the occurrence of diarrhea among children residing in an urban area. It can be noted again that the age of a child less than two years has 0.594 reduced odds of suffering from diarrhea as compared to the above two years counterparts.

Model Evaluation: The Model explains a small proportion of the variance in the dependent variable, as shown by the Cox & Snell R Square (0.026) and Nagelkeke R Square of 0.043. Despite the low power, the Hosmer-Lemeshow test indicates that the model fits the data well, with a p-value of 0.824.

The aim of this study was to assess the relationship between sanitation coverage and diarrhea outcomes among those under five years of age in Matabeleland, South Province of Zimbabwe. Bivariate analysis using cross-tabulation and Multivariate Binary Logistic Regression was performed with the data from the Multiple Indicator Cluster Survey of 2019 (MICS 2019). Approximately 17% of the under-five years children in the province had

Table 1: Results of the Bivariate Analysis between diarrhea and various independent variables in Matabeleland South province, Zimbabwe, in 2019

	Diarrhea				
Variables	**Yes**	**No**	**Total**	**OR(95%CI)**	**p-Value**
Education					
Low Education	32(17.7)	149(82.3)	181(100%)	1.083(0.661-1.774)	0.752
High Education	47(16.5)	237(83.5)	284(100%)		
Total	79(17)	387(83)	465(100%)		
Wealth					
Poor	40(16.9)	197(83.1)	237(100)	0.989(0.610-1.605)	0.965
Rich	39(17)	190(83)	229(100)		
Total	79(17)	387(83)	466(100)		
Residence (Area)					
Rural	60(14.9)	343(85.1)	403(100)	0.405(0.221-0.741)	0.003**
Urban	19(30.2)	44(69.8)	63(100)		
Total	79(17)	387(83)	466(100)		
Sanitation Coverage					
Unimproved	21(16.8)	104(83.2)	125(100)	0.985(0.570-1.703)	0.958
Improved	58(17)	283(83)	341(100)		
Total	79(17)	387(83)	466(100)		
Religion of the head of H/H					
No Religion	10(13.3)	65(86.7)	75(100)	1.393(0.682-2.847)	0.362
Religion	69(17.6)	322(82.4)	391(100)		
Total	79(17)	387(83)	466(100)		
Age of child					
Less than 2 years	37(21.9)	132(78.1)	169(100)	1.702(1.043-2.776)	0.032**
More than 2 years	42(14.1)	255(85.9)	297(100)		
Total	79(17)	387(83)	466(100)		
Shared Sanitation Facilities					
Yes	34(17.6)	159(82.4)	154(100)	1.053(0.601-1.845)	0.858
No	26(16.9)	128(83.1)	193(100)		
Total	60(17.3)	287(82.7)	347(100)		
Place for Handwashing					
No	2(16.7)	10(83.3)	454(100)	0.979(0.210-4.558)	0.979
Yes	77(83)	377(83)	12(100)		
Total	79(17)	387(100)	466(100)		

*The ones marked with two stars** qualify for the multivariate analysis with a p-value of less than 0.25.*

Table 2: Results of the Multivariate Analysis between diarrhea and independent variables in Matabeleland South Province, Zimbabwe, in 2019

Variables in the Equation					
	B	Sig.	Exp(B)	95% C.I.for Exp(B)	
				Lower	Upper
Residence (Rural)	.893	.004	2.442	1.329	4.484*
Age of child (Less than 2 years)	-.521	.039	.594	.362	.974*
Constant	1.059	.000	2.883		

diarrhea in the past two weeks. The findings of this study were not consistent with the two studies from Ethiopia, which got 10% and 12%, respectively(Central Statistical Agency and ICF, 2016; Fetensa et al., 2020).

This study revealed that the age of a child less than two years has 0.594 reduced odds of suffering from diarrhea as compared to the above two years' counterparts. The results of this study are not consistent with a study in Thailand, which demonstrated that children aged 6-23 months experienced the greatest susceptibility to developing diarrhea(Wilunda & Panza, 2009).

Additionally, another study in Central Indonesia noted different results from the current study that age plays a predominant role in the occurrence of diarrhea among toddlers, as evidenced by an odds ratio of 2.421. This indicated that toddlers aged between 6 to 23 months are at a 2.4-fold higher likelihood of experiencing diarrhea(Mubarokah and Sartika, 2022). Further, other studies observed the occurrence of diarrhea among those under five years of age in the 12-23 months(Mosisa et al., 2021; Musa Mohammed, 2024).

The protective nature of the child's age in Matabeleland South province could reinforce the already known facts that young children who are breastfeeding are protected by breastmilk as it provides defense against diseases. Children have a tendency to pick things and put them into their mouths, leading to diarrhea. It becomes better for the children who are breastfed because of the immunity conferred by breastmilk(Tampubolon et al., 2021).

According to the current study, children living in rural areas were more likely to develop diarrhea as compared to those children residing in urban areas. It was highly significant at 0.001, which showed that children residing in urban areas had 0.338 lower odds of suffering from diarrhea than their rural residence counterparts. Looking at the current findings, it can be noted that they are consistent with other studies in similar subject matter(Anteneh et al., 2017; Mamo & Hailu, 2014). Urban areas have better access to infrastructure, which is possibly the best explanation for the observed results, and the water supply situation is usually good.

However, another study found that diarrhea was more prevalent in urban areas. It suggested that effective strategies should be implemented more frequently to reduce the occurrence of diarrhea in urban areas. This can be achieved by strengthening protective elements like urban sanitation promotion initiatives and focusing on expediting the availability of improved sanitation facilities and hand-washing resources(Mohammed & Zungu, 2016).

More so, another study in Indonesia discovered the increased occurrence of diarrhea cases in children under five years old who reside in rural residential areas compared to their urban counterparts(Santri & Wardani, 2023). However, the results of this study are not consistent with the results of another study that was carried out in Yemen. The study in Yemen revealed that 61% of the diarrhea cases were from the urban areas and 31% from the rural areas(Bahartha & AlEzzi, 2015). This is a rare finding, as the social tide always favors the urban population compared to the rural population.

Another study in Pakistan found no notable relationship in diarrhea between rural and urban regions (13.9% compared to 12.9%) (Jabeen et al., 2023). This indicates that other factors may have contributed to the occurrence of diarrhea besides residence. This could be true with the current study, as the province shares borders with Botswana and South Africa. With that, the diarrhea disease burden could be explained in terms of cross-border activities.

In this study, wealth was not associated with diarrhea among children under the age of 5. Wealth remains a very important factor in explaining disease occurrence. Wealth impacts access to resources like clean water, good food, and the general seeking of healthcare services. Wealth is very important. The findings regarding its lack of significance are consistent with a meta-analysis in 36 countries, which revealed a negative association between wealth quantile and diarrhea(He et al., 2023).

More so, on education, the study revealed that education was not associated with diarrhea. The results of this study were consistent with the results from another study which indicated that there was no statistically significant

relationship between maternal education and the incidence of diarrhea in children under the age of five years(Arifin et al., 2022). The lack of significance of education in this study might be related to the aspect that the quality and type of education that the mothers receive might not adequately cover health related knowledge and practices to the extent of producing a positive association. Mothers need to be sufficiently educated in diarrhea-related issues.

Shared sanitation facilities were not significant in this study. It is generally believed that sharing of sanitation facilities pose some health dangers that`s putting children under the age of five years at increased risk. However, other findings found a positive association between sharing of sanitation facilities and the occurrence of diarrhea(Fuller et al., 2014; Ramlal et al., 2019). Further studies in relation to the current findings needs to be pursued in order to come up with well-informed findings for future reference.

Regarding sanitation coverage, this study revealed that it was not significant. Sanitation is a very crucial aspect in relation to the occurrence of fecal-oral routes of transmission leading to the occurrence of diarrhea. Therefore, more studies should be conducted to confirm the current findings because of its importance as a disease determinant. However, the results of the current study are consistent with the study conducted in Ghana in a similar subject matter where there was no association between sanitation coverage and the occurrence of diarrhea (Danquah et al., 2015).

Additionally, in the absence of sanitary facilities that are universally utilized, there is a heightened susceptibility among households and societies to illnesses, stress, and conflict. Sanitation coverage is generally lower in rural areas, and only a few are on track to eradicate open defecation (United Nations Children`s Fund and World Health Organization, 2020). Improper disposal of feces creates many problems not only to humans but to animals as well as it can lead to beef measles in cattle.

The province also found that handwashing facilities were insignificant. The insignificance could be due to inconsistencies in reporting or the fact that people are utilizing the facilities; therefore, no case was associated with its lack thereof. The results of this study were consistent with those from a study in Indonesia about the relationship between handwashing and diarrhea occurrence. There was no significant relationship between handwashing and diarrhea occurrence(Arini et al., 2021).

The study has several strengths which include the ability to bypass the lengthy data collection process. Secondary data provides the already collected data, makes the research process very fast, and provides the ability to meet the scheduled research timelines. It also contains all the information that might be otherwise difficult to get due to the remoteness of some areas. It is cost-effective as the actual data collection requires a lot of activities to be done before, during, and after the actual data collection process. It has a very large sample size, which also comes in handy regarding generalization issues. The research also provides a starting point for the incidence of diarrhea to be further explored through primary data.

However, this study has several limitations as well. It contains missing data, requiring the reader to factor in the plausibility and dependability issues when dealing with the data and the report. The study also failed to analyze other variables, such as Rotavirus vaccination, because it had more than 60% missing values. Also failed to analyze the breastfeeding variable as it had 90% missing values. More so, bottle feeding had missing values of more than 60% as well. Data accuracy might be tempered since the data is manipulated to create new variables or recode into different variables.

CONCLUSIONS

Based on the results of this study, it can be concluded that Sanitation coverage was not statistically associated with diarrhea in the province. Age of child and wealth were associated with the occurrence of diarrhea in Matabeleland South Province. The residence and age of the child were statistically associated with diarrhea in children under the age of five. Handwashing facilities, shared sanitation facilities, religion, and education were not associated with the occurrence of diarrhea. At multivariate analysis, the residence and age of the child showed their significance at 0.05.

Health and hygiene education campaigns be conducted targeting areas of high diarrhea incidence to equip them with adequate knowledge that is essential for the prevention of diarrhea. Allocate funds for sanitation projects to increase basic sanitation coverage in the province. Strong government policies be put forward that can promote the construction of sanitation facilities across all families. Promotion of targeted interventions on breastfeeding, rotavirus vaccinations, and education of caregivers on hygiene should be promoted. This study should be used for future studies as it provides insights for further studies.

Acknowledgment

All authors would like to express their sincere gratitude to the Multiple Indicator Cluster Survey (MICS), Zimbabwe Government, for providing the data for this research. Further, we would like to thank the supervisor, Prof. Dr. Budi Haryanto, SKM, M.Kes., MSc., for the thoughtful guidance, comments and recommendations throughout this thesis research.

Conflict of interest statement

There are no conflicts of interest to declare.

REFERENCES

Anteneh, Z. A et al. (2017). Prevalence and determinants of acute diarrhea among children younger than five years old in Jabithennan District, Northwest Ethiopia, 2014. *BMC Public Health*, 17(1), 99. https://doi.org/10.1186/s12889-017-4021-5

Arifin, H et al. (2022). Prevalence and determinants of diarrhea among under-five children in five Southeast Asian countries: Evidence from the demographic health survey. *Journal of Pediatric Nursing,* 66, e37–e45. https://doi.org/10.1016/j.pedn.2022.06.005

Arini, S. et al. (2021). RELATIONSHIP BETWEEN HANDWASHING HABITS WITH DIARHEA INCIDENT IN CHILDREN UNDER TWO YEARS. *Jurnal Ilmu Kesehatan Masyarakat,* 17(1), Article 1. https://doi.org/10.19184/ikesma.v17i1.22420

Bahartha, A. S., & AlEzzi, J. I. (2015). Risk factors of diarrhea in children under 5 years in Al-Mukalla, Yemen. *Saudi Medical Journal*, 36(6), 720–724. https://doi.org/10.15537/smj.2015.6.11266

Corsi, D. J et al. (2012). Demographic and health surveys: A profile. *International Journal of Epidemiology,* 41(6), 1602–1613. https://doi.org/10.1093/ije/dys184

Danquah, L et al. (2015). Risk Factors Associated with Diarrhea Morbidity Among Children Younger than Five Years in the Atwima Nwabiagya District, Ghana: A Cross-Sectional Study. *Science Journal of Public Health,* 3(3), Article 3. https://doi.org/10.11648/j.sjph.20150303.17

Central Statistical Agency (CSA) [Ethiopia] and ICF. 2016. Ethiopia Demographic and Health Survey 2016: Key Indicators Report. *Addis Ababa,* Ethiopia, and Rockville, Maryland, USA. CSA and ICF.

Fetensa, G. et al. (2020). Diarrhea and associated factors among under-5 children in Ethiopia: A secondary data analysis. *SAGE Open Medicine,* 8, 2050312120944201. https://doi.org/10.1177/2050312120944201

Fety Fathimah Al Mubarokah andRatu Ayu Dewi Sartika. (2022). Factors Associated with the Incidence of Diarrhea on Toddlers in Central Indonesia Region (IFLS 2014) | *Jurnal kesehatan komunitas (Journal of community health).* https://jurnal.htp.ac.id/index.php/keskom/article/view/1185

Fuller, J. A et al. (2014). Shared Sanitation and the Prevalence of Diarrhea in Young Children: Evidence from 51 Countries, 2001–2011. *The American Journal of Tropical Medicine and Hygiene,* 91(1), 173–180. https://doi.org/10.4269/ajtmh.13-0503

Garatsa, C et al. (2023). Risk Factors of Diarrhoea Among Under-Five Children in Zimbabwe: A Systematic Review. *American Journal of Biomedical Science & Research,* 19(3), 334. https://biomedgrid.com/index.php

He, Z., Ghose, B., & Cheng, Z. (2023). Diarrhea as a Disease of Poverty Among Under-Five Children in Sub-Saharan Africa: A Cross-Sectional Study. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing.* https://doi.org/10.1177/00469580231202988

Mamo, A., & Hailu, A. (2014). Assessment of Prevalence and Related Factors of Diarrheal Diseases among Under-Five Year's Children in Debrebirehan Referral Hospital, Debrebirehan Town, North Shoa Zone, Amhara Region, Ethiopia. *Open Access Library Journal,* 1(1), Article 1. https://doi.org/10.4236/oalib.1100283

Mohamed Adam, H. (2024). Research Population.

https://www.academia.edu/5563491/Research_Population

Mohammed, A. I., & Zungu, L. (2016). Environmental health factors associated with diarrhoeal diseases among underfive children in the Sebeta town of Ethiopia. *Southern African Journal of Infectious Diseases*, 31(4), Article 4. https://doi.org/10.4102/sajid.v31i4.71

Mosisa, D et al. (2021). Determinants of diarrheal diseases among under five children in Jimma Geneti District, Oromia region, Ethiopia, 2020: A case-control study. *BMC Pediatrics,* 21(1), 532. https://doi.org/10.1186/s12887-021-03022-2

Mufida, L., Yunitasari, E., & Ulfiana, E. (2021). Health Education of Clean and Healthy Lifestyle using Card Telling Methods towards Diarrhea Prevention Among Children in Elementary School. *Pediomaternal Nursing Journal,* 7(1), Article 1. https://doi.org/10.20473/pmnj.v7i1.21184

Musa Mohammed, M. O. (2024). Prevalence and risk factors associated with under-five years children diarrhea in Malawi: Application of survey logistic regression. *Heliyon,* 10(7), e29335. https://doi.org/10.1016/j.heliyon.2024.e29335

Prüss-Ustün et al. (2014). Burden of disease from inadequate water, sanitation and hygiene in low- and middle-income settings: A retrospective analysis of data from 145 countries. *Tropical Medicine & International Health: TM & IH,* 19(8), 894–905. https://doi.org/10.1111/tmi.12329

Prüss-Ustün, A et al. (2019). Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. *International Journal of Hygiene and Environmental Health,* 222(5), 765–777. https://doi.org/10.1016/j.ijheh.2019.05.004

Ramlal et al. (2019). Relationships between shared sanitation facilities and diarrhoeal and soil-transmitted helminth infections: An analytical review. *Journal of Water, Sanitation and Hygiene for Development,* 9(2), 198–209. https://doi.org/10.2166/washdev.2019.180

Rosenberg, M. (2007). Global Child Health: Burden of Disease, Achievements, and Future Challenges. *Current Problems in Pediatric and Adolescent Health Care,* 37(9), 338–362. https://doi.org/10.1016/j.cppeds.2007.07.003

Santri, I. N., & Wardani, Y. (2023). Environmental risk factors for diarrhea Children under five years of age: A Cross-Sectional study in Indonesia. *Public Health and Preventive Medicine Archive,* 11(1), Article 1. https://doi.org/10.53638/phpma.2023.v11.i1.p01

State of the World's Sanitation: An urgent call to transform sanitation for better health, environments, economies and societies. New York: United Nations Children's Fund (UNICEF) and the World Health Organization, 2020

Sukandar, R. (2006). Analisis Data . https://www.academia.edu/13131341/SUTANTO_PRIYO_HASTONO_Analisis_Data_SUTANTO_PRIYO_HASTONO

Tampubolon, C. H., . R., & Rahabeat, F. (2021). Differences in the Incidence of Diarrhoea in Children Aged 6-24 Months Who Receive Exclusive and Non-Exclusive Breastfeeding. *International Journal of Health Sciences and Research,* 11(10), 378–386. https://doi.org/10.52403/ijhsr.20211048

UNICEF. (2024, January 1). *Diarrhoea*. UNICEF DATA. https://data.unicef.org/topic/child-health/diarrhoeal-disease/

Wilunda, C., & Panza, A. (2009). *FACTORS ASSOCIATED WITH DIARRHEA AMONG CHILDREN LESS THAN 5 YEARS OLD IN THAILAND: A SECONDARY ANALYSIS OF THAILAND MULTIPLE INDICATOR CLUSTER SURVEY 2006.*

World Health Organization. (2024, March 7). Diarrhoeal disease. *Diarrhoeal Disease.* https://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease

United Nations Children's Fund (UNICEF) and World Health Organization. (2019). *Progress on household drinking water, sanitation and hygiene 2000-2017.* Special focus on inequalities. New York: United Nations Children's Fund (UNICEF) and World Health Organization, 2019.