



## The Effect of Community Based Total Sanitation with Diarrhea Among Toddlers

Doni Pranciskus Sinaga<sup>1✉</sup>, Sri Malem Indirawati<sup>2</sup>, Nurmaini<sup>3</sup>

<sup>1</sup>Student of Graduate Program of Public Health Sciences, Faculty of Public Health, University of North Sumatra, Medan, 20155, Indonesia

<sup>2,3</sup> Department of Environmental Health, Faculty of Public Health, University of North Sumatra, Medan, 20155, Indonesia

### Article Info

#### Article History:

Submitted August 2020

Accepted June 2020

Published October 2021

#### Keywords:

diarrhea, children, community, hand washing, household

#### DOI

<https://doi.org/10.15294/kemas.v17i2.25901>

### Abstract

The high rate of diarrhea associated with hygiene and environment. Prevalence of diarrhea still high in Indonesia although community total sanitation program (STBM) has done. Proportion of diarrhea balita in Samosir regency more than 40 % in 2019. The objective of the research was to analyze community based total sanitation with child diarrhea among toddlers. This was an analytic study design, based on its time used cross-sectional study design. The data was collected by observation and interviews. The sample selection was done by purposive sampling with 200 samples, which responden is the mother who have toddlers around 3 district in Samosir regency. Data analysis used chi square test and multiple-logistic regressions. This result showed that stop open defecation (p value 0.001), hand washing (p value = 0.039), water and household food management, household waste management, and household liquid waste significantly affected diarrhea among toddlers. Hand washing with soap with Exp B=6 and waste disposal management more effect with diarrhea, therefore its suggested for all stake holder to increase campaign of hand washing and household waste management in community.

### Introduction

Diarrhea in toddlers in the world is still the most common cause of death, although there has been a decline in cases of diarrheal deaths from 2005-2015 by 20 percent. Every year there are 1.7 billion cases of diarrhea in children in the world, where as many as 525,000 cases of death occur in toddlers. Diarrhea in the toddler group is the most vulnerable group and has the potential to cause death and is not treated seriously. The highest incidence of diarrhea cases occurs in the first two years of life and will decrease with increasing age (Troeger C et. al, 2017)

According to Adane M et.al (2017) Diarrhea cases in toddlers are more common in developing countries than in developed countries. This is caused by several factors, including the lack of drinking water that is suitable for consumption, lack of awareness of

hygiene and sanitation and poor nutritional status and public health status. It is estimated that around 2.5 billion people still have poor sanitation facilities and 1 billion people do not have access to safe drinking water. Diarrhea in Indonesia is still an endemic disease and is still a potential outbreak disease (KLB) accompanied by death. The results of Riskesdas in 2018 stated that the prevalence of diarrhea in toddlers in Indonesia based on the diagnosis of health workers increased from 2.4 percent in 2013 to 11 percent in 2018..

Based on data from the Indonesian Health Profile (2018), it was found that the number of children with diarrhea under five in North Sumatra in 2018 was 255,909 cases with a service coverage of 16.73 percent. The highest cases of diarrhea in toddlers were found in West Java province as many as 732,324 cases, while the lowest cases of diarrhea in toddlers

✉ Correspondence Address:

Postgraduate Program in Public Health Sciences, Faculty of Public Health, University of North Sumatra, Medan, Indonesia  
Email : donisinagasantar@gmail.com

were in the province of North Kalimantan with 12,551 cases. In 2017, the number of cases of diarrhea in toddlers in Samosir was the highest in addition to the Kepulauan Nias.

Diarrhea disease is still included in the 10 (ten) most cases of disease in Samosir Regency, where diarrhea occupies the 6th (six) most position of the ten largest diseases in Samosir Regency in 2018 and 2019. In 2018 the number of detection targets cases of diarrhea from all ages was 3,397 cases. Most diarrhea sufferers are in the toddler age group with a proportion of 43 percent. The number of diarrhea cases found and treated was 3,124 cases (92%). The highest findings were in Tuktuk Siadong Health Center (251.8%) and Lottung Health Center (219.3%). The lowest number of cases was at the Onan Runggu Health Center (36.6%).

Study Results of Environmental Health Risk Assessment (EHRA) or Health Risk Assessment Study in the Samosir Regency Environment in 2014 showed that the population behaved in open defecation by 37.3 percent. In general, people defecated in Samosir Regency in 2014 using private latrines (69.1%), public toilets (2.1%), dug holes (0.5%) and helicopter toilets (0.5%). 1%). There are still households that do not use defecation facilities so that they practice open defecation, which is 35.3 percent. This shows that the population who has access to proper sanitation or healthy latrines has increased every year which has an effect on decreasing the incidence of diarrhea (Mosler H-J, Mosch S & Harter M, 2018)

One of the government's strategies in reducing diarrhea cases is the Community-Based Total Sanitation strategy (STBM) as stated in the Minister of Health Regulation No. 3 of 2014. The results of the research by Nyambe S, Angestik & Yamauchi (2020) stated that the success of STBM is not only in increasing access to sanitation but also aspects of behavior change and community hygiene. In addition, a good economic aspect of the community also improves sanitation facilities so that it can reduce the incidence of diarrhea (Sumampouw et.al, 2019).

This study aims to analyze the effect of the Community-Based Total Sanitation program on the incidence of diarrhea in toddlers in Samosir Regency.

## Methods and Materials

This type of research is an analytical survey using a cross sectional research design, which is a study that studies the dynamics of the correlation between risk factors and effects, by approaching, observing or collecting data all at once (point time approach). The time of the research was carried out starting from the initial Research Survey in August 2019 until June 2020.

Population is a collection of all subjects that have certain characteristics. The population in this study is mothers who have toddlers who live in the work area of the Samosir Regency Health Office, where there are 1893 toddlers in 12 (twelve) health centers in Samosir Regency. The sample is the object under study and is considered to represent the entire population. The samples in this study were some mothers who had toddlers and were in the working area of the Samosir Public Health Center.

The samples in this study were obtained from 4 Health Center areas in Samosir Regency, namely Tuktuk Siadong Health Center, Lottung Health Center, Buhit Health Center, and Onan Runggu Health Center. Purposive sampling by making inclusion and exclusion criteria. The inclusion criteria for mothers of toddlers who were used as samples in this study were: 1) Registered at the integrated service post in the Health Center areas and have settled in the working area of the Lottung Health Center, Tuktuk Health Center, Buhit Health Center, and Onan Runggu Health Center for at least the last one year, 2) Mothers of toddlers who are willing to be respondents and have good communication. Exclusion criteria for mothers of toddlers, namely: 1) Mothers of toddlers who are not willing to sign the informed consent, 2) Mothers of toddlers who experience mental illness/disorders.

The sample size in this study was obtained from the ISSAC and MICHAEL tables based on the total population in the four working areas of the Samosir District Health Center with an error degree of 10% (ten percent). Based on the table obtained a sample of 200 people. The sample size of 200 mothers of toddlers is believed to have been representative of the population in Samosir Regency. Sources of data in this study are primary and secondary

data. Primary data is data obtained directly from the results of interviews and observations using a questionnaire regarding defecation behavior (stop devecate), habit of washing hands with soap (ctps), drinking water and household food management (pammrt), household waste management (psrt), household liquid waste management (plcrt). Secondary data is data obtained from the Health Office, Health Center, books, internet, and other references. The data that has been obtained were analyzed by chis square and multiple logistic-regression using SPSS software.

**Results and Discussion**

The majority of the education of mothers of toddlers is Senior High School (SMA) by 61.5% or as many as 123 people and the lowest education is not graduating from Elementary School (SD) or completing Elementary School by 2.5% or 5 people. The highest income for mothers of toddlers is below the Regional Minimum Wage of Samosir Regency. Samosir’s Regional Minimum Wage (UMR) in 2019 was 2 million/month. The income of mothers under the UMR is 75%, while the income above the Regional Minimum Wage is 25%.

The age category of toddlers based on the results obtained was at the age of 1 to 2 years as many as 62% or totaling 124 toddlers while the age category of toddlers at the age of more than 2 years to 5 years was 38% or amounted to 76 people. Diarrhea in toddlers is 25.5% or 51 toddlers while toddlers who do not

experience diarrhea are 75.5% or 149 toddlers. The characteristics of respondents and toddlers are presented in table 1 as follows.

Table 1. Characteristics of Respondents and Toddlers

| Characteristics  | Number | %         |
|--|--------|-----------|
| <b>Mother’s Education</b>  |        |           |
| Did not finish Elementary School and finished <b>Elementary School</b> | 5      | 2.5<br>24 |
| <b>School</b>  |        |           |
| Junior High School   | 48     | 61.5      |
| Senior High School Academy and College                                 | 123    | 12<br>24  |
| <b>Mother’s Income</b>   |        |           |
| UMR below  | 149    | 25        |
| Bigger than UMR  | 51     | 75        |
| <b>Toddler Age</b>   |        |           |
| 1 – 2 years old  | 124    | 62        |
| > 2 – 5years old   | 76     | 38        |
| <b>Diarrhea Status</b>   |        |           |
| Diarrhea   | 51     | 25.5      |
| Not Diarrhea   | 149    | 74.5      |
| <b>Total</b>   | 200    | 100       |

Source: Primary Data, 2020

Bivariate analysis was conducted to determine the relationship between each variable STBM and sociodemography with the variable incidence of diarrhea in children under five. This analysis uses the chis square statistical test at the 95% confidence level. The variables that will enter the multivariate model are variables that have a p-value <0.25 as the initial stage of multivariate analysis. The results of the bivariate test are listed in table 2 below.

Table 2. Relationship between Sociodemography and STBM with the Incidence of Diarrhea in Toddlers

| Variable                  | Diarrhea |      | No Diarrhea |      | Total |     | PR   | P     |
|---------------------------|----------|------|-------------|------|-------|-----|------|-------|
|                           | F        | %    | F           | %    | f     | %   |      |       |
| <b>Mother's Education</b> |          |      |             |      |       |     |      |       |
| Low                       | 31       | 28.2 | 79          | 71.8 | 110   | 100 | 1.26 | 0.424 |
| High                      | 20       | 22.2 | 70          | 77.8 | 90    | 100 |      |       |
| <b>Income</b>             |          |      |             |      |       |     |      |       |
| < UMR                     | 32       | 26.7 | 88          | 73.3 | 120   | 100 | 1.12 | 0.76  |
| > UMR                     | 1        | 23.8 | 61          | 76.2 | 80    | 100 |      |       |
| <b>Age of toddlers</b>    |          |      |             |      |       |     |      |       |
| 1 – 2 years old           | 28       | 23   | 94          | 77   | 124   | 100 | 0.77 | 0.385 |
| > 2 – 5 years old         | 23       | 30   | 55          | 70   | 76    | 100 |      |       |
| <b>Stop Devecate</b>      |          |      |             |      |       |     |      |       |
| Not Safe yet              | 26       | 46   | 30          | 54   | 56    | 100 | 2.67 | 0.001 |
| Safe                      | 25       | 17   | 119         | 83   | 144   | 100 |      |       |
| <b>CTPS</b>               |          |      |             |      |       |     |      |       |
| Poor                      | 49       | 30   | 115         | 70   | 164   | 100 | 5.37 | 0.005 |
| Good                      | 2        | 6    | 34          | 94   | 36    | 100 |      |       |
| <b>PAMMRT</b>             |          |      |             |      |       |     |      |       |
| Not Safe yet              | 27       | 35.5 | 49          | 64.5 | 76    | 100 | 1.83 | 0.017 |
| Safe                      | 24       | 19.4 | 100         | 80.6 | 149   | 100 |      |       |
| <b>PSRT</b>               |          |      |             |      |       |     |      |       |
| Not Safe yet              | 43       | 28   | 112         | 72   | 155   | 100 | 1.56 | 0.248 |
| Safe                      | 8        | 18   | 37          | 82   | 45    | 100 |      |       |
| <b>PLCRT</b>              |          |      |             |      |       |     |      |       |
| Poor                      | 44       | 24   | 143         | 76   | 187   | 100 | 0.43 | 0.023 |
| Good                      | 7        | 54   | 6           | 46   | 13    | 100 |      |       |

Source: Primary Data, 2020

Based on Table 1 above, it can be seen that the socio-demographic variable has no relationship with the incidence of diarrhea in toddlers with p value > 0.05. There is a relationship between stop devecate and the incidence of diarrhea in toddlers where p value  $0.000 < \alpha (0.05)$  where the prevalence ratio (PR) is 2.67 which means that mothers who have not stopped devecate have a 2.67 times risk of developing diarrhea in toddlers than mothers who have stopped devecate. There is a relationship between hand washing with soap (ctps) and the incidence of diarrhea in toddlers where p value is  $0.005 < \alpha (0.05)$ . The prevalence ratio is 5.37, which means that poor CTPS have five times the chance of getting diarrhea than mothers who do CTPS well.

There is a relationship between PAMMRT and the incidence of diarrhea in toddlers where

p value  $(0.01) < 0.05$ . The prevalence ratio is 1.08, which means that PAMMRT is still neutral where mothers who are not good at managing food and beverages have a 1.08 times risk of getting diarrhea in toddlers than mothers who have poor food and beverage safety. Multivariate analysis used logistic regression to determine the most dominant variable influencing the incidence of diarrhea in toddlers by selecting variables that could potentially be included in the model, namely variables that had a value  $p < 0,25$  on bivariate analysis. Based on the results of statistical tests on variables, the variables included in the multivariate analysis are Stop open defecation, wash hands with soap, food and beverage management, household waste security, and household liquid waste security. The method used in this test is Backward as shown in table 3 below.

Table 3. Stages of Multiple Logistic Regression Test for Diarrhea in Toddlers in Samosir Regency

|                     | B        | Sig.   | Exp(B) | 95% CI for EXP (B) |       |        |
|---------------------|----------|--------|--------|--------------------|-------|--------|
|                     |          |        |        | Lower              | Upper |        |
| Step 1 <sup>a</sup> | Ctps     | 1.777  | .021   | 5.915              | 1.315 | 26.604 |
|                     | Stop     | 1.234  | .001   | 3.434              | 1.641 | 7.185  |
|                     | devecate |        |        |                    |       |        |
|                     | Psrt     | 1.413  | .015   | 4.109              | .805  | 3.387  |
|                     | Plcrt    | -2.119 | .009   | .120               | 1.318 | 12.813 |
|                     | Pamrt    | .502   | .171   | 1.651              | .025  | .584   |
|                     | Constant | -2.468 | .014   | .085               |       |        |
| Step 2 <sup>a</sup> | Ctps     | 1.840  | .016   | 6.298              | 1.411 | 28.118 |
|                     | Stop     | 1.325  | .000   | 3.761              | 1.820 | 7.772  |
|                     | devecate |        |        |                    |       |        |
|                     | Psrt     | 1.423  | .014   | 4.151              | 1.342 | 12.841 |
|                     | Plcrt    | -2.074 | .009   | .126               | .026  | .599   |
|                     | Constant | -2.389 | .016   | .092               |       |        |

Source: Primary Data, 2020

Based on the results of the logistic regression test, it is known that the variables that have the greatest influence on the incidence of diarrhea in toddlers are washing hands with soap and securing household waste to prevent diarrhea in toddlers. The multiple logistic regression equation models that are formed are as follows: If the CTPS and PSRT variables are bad (1), then the probability for the occurrence of diarrhea can be projected as follows.

$$P(y) = \frac{1}{1 + e^{-(2.389 + 1.840(X1) + 1.325(X2) + 1.423(X3) - 2.074(X4) )}}$$

Description:

- P (y) : Probability of diarrhea in toddlers
- X1 : CTPS, regression coefficient 1.840
- X2 : PSRT, regression coefficient 1.325
- X3 : Stop devecate, regression coefficient 1.423
- X4 : PLCRT, regression coefficient -2.074
- a : Constant -2.389
- e : Natural number 2,7

Based on the probability calculation from the multiple logistic-equation, the probability of diarrhea occurring if the STBM program is not carried out is 53 percent, while if the STBM program is carried out the probability of diarrhea in toddlers is only 8 percent. This

shows that mothers of toddlers who do not wash their hands with soap properly have a 53 percent risk, while 47 percent are determined by other influences not included in this study. The comparison or risk group of mothers of toddlers who do not practice CTPS with mothers of toddlers who do CTPS well is 6 times for the occurrence of diarrhea in toddlers in Samosir Regency.

Based on the results of the study, it was found that there were 144 mothers of toddlers who had stopped devecating or 72 percent, while 56 percent of mothers of toddlers who had not stopped devecate or 28 percent. Stop devecate is a condition where people have safe and healthy habits in defecating, where there are no more people who defecate not in sanitary latrines. This study is in line with the results of Ayawale (2018). About environmental risk assessment factors on the incidence of diarrhea in toddlers in Dangla District, eastern Ethiopia which states that environmental factors such as ownership of healthy latrines have a significant influence in reducing the incidence of diarrhea. Total sanitation also increases ownership of healthy latrines which reduces the incidence of diarrhea in toddlers with OR=2.48 (Tessema, 2017). Areas with Open defecation free (ODF) or Stop devecate have the percentage of bacteria e. coli which is less than the area that has not stopped devecate (Babb, et al., 2018).

The results showed that the prevalence



ratio (RP) of stop defecate tends to affect 2.67 times for diarrhea compared to families who have not stopped defecate. This study is in accordance with the study of Troeger C et al (2017), which stated that there was a significant relationship between the application of stop defecate and a decrease in the incidence of diarrhea in toddlers. Increasing access to healthy latrines must be accompanied by increasing public knowledge so that increased access to sanitation is also in line with the reduction in the incidence of diarrhea in the community.

The increase in the STBM program, the first pillar of stop defecate in Samosir Regency, is increasing over time, where 85 percent of the population's homes already have sanitary latrines, so it is believed to have an effect on reducing diarrhea cases in children under five in Samosir Regency. This is the commitment of the stakeholders, especially the central and local governments in order to improve sanitation facilities and infrastructure, especially the ownership of latrines in supporting health and tourism progress in Samosir Regency. The improvement of sanitary latrine facilities in Samosir has shown the commitment of the local government to stop open defecation. This study is in line with research results of Harter, et.al (2019) and Modern, et.al (2020), that Community-Based Total Sanitation can affect family sanitary latrine ownership which has an impact on reducing diarrhea cases in toddlers.

The results showed that the habit of washing hands with soap for mothers of toddlers in Samosir Regency obtained data that as many as 164 mothers of toddlers or 78 percent had not done CTPS well while mothers of toddlers who did CTPS well were 36 people or 22 percent. Research of Briceno B et al (2017) in Tanzania which states that there is an effect of hand washing with soap with a decrease in diarrhea cases. Several research results show that the promotion of hand washing behavior, improvement of clean water quality and environmental sanitation have been shown to reduce the incidence of gastrointestinal and respiratory diseases. The action of maintaining hand washing habits needs to be maintained by evaluating whether hand washing is still being carried out. Structural constraints (providing

clean water facilities) can affect hand washing behavior. The mass media have an important role in the promotion of personal hygiene, including hand washing, so it needs to be used properly in the current era of sophisticated technology (Tidwell JB et.al, 2020).

Based on the results of the multivariate test, washing hands with soap is the most influential variable on the incidence of diarrhea in toddlers where mothers who do not get used to washing their hands with soap have the possibility of diarrhea in toddlers 6 times compared to mothers who get used to washing their hands with soap Oloruntoba (2014), stated that mothers of toddlers who do not wash their hands with soap have 3 times the risk of developing diarrhea in their toddlers (OR=3). Based on the results of observations, most of the mothers of toddlers have managed food and drinks well, namely already boiling drinking water before consumption, placing food ingredients in closed places or cooking food immediately after purchase, consuming food that is still fresh and not moldy or rotting and always cover the food served with a serving hood. So the possibility of fly vectors or other vectors to land on food is quite small. Mothers of toddlers who manage food and beverages safely are 124 people, while mothers of toddlers who do not manage food and beverages safely are 76 people.

In this study, multivariate results showed that the processing of food and beverages in Samosir did not show any effect on the incidence of diarrhea in toddlers. This shows that the food and beverage security of the community is quite good. This research is in line with Suriadi (2016), which states that there is no influence of hygiene and sanitation of drinking water depots with an increase in e coli which is one of the causes of diarrhea.

The decrease in the prevalence of diarrhea can occur by managing safe drinking water in the household. Families who use drinking water by boiling, chemical processing or filtering are known to have a lower chance of suffering from diarrhea than children whose families do not treat water. The stored water can be contaminated during the collection, transportation and storage processes which in turn can increase the risk of diarrhea

(Wanzahun & Mengiste, 2013). This is also in line with research of (Soboksa, Garl, Hallu, & Alemu, 2020) which states that drinking water treatment reduces the incidence of diarrhea in toddlers in Ethiopia. Unprotected drinks and food result in an increase in bacterial contamination so that there is a risk of causing diarrhea (Kapwata, Mathee, Roux, & Wright, 2018). This happens vulnerable to the condition of families or communities living in rural areas. Households that do not have safe drinking water sources are at a higher risk of having diarrhea (Patunru, 2015).

Safe household waste security from the research results obtained in Samosir Regency there were 22 percent or 45 people while 78 percent did not secure household waste. The number of trash bins close to people's homes is one of the risk factors for diarrhea where garbage close to homes contains lots of germs and brings in fly vectors. Household waste security that is already good only focuses on the district center in Pangururan, not evenly distributed in other areas in the Samosir Regency.

There is an influence between households disposing of waste in a place that has been provided in the form of a closed trash can (TPS) with a decrease in the incidence of diarrhea in toddlers. Households that throw garbage in any place can cause unpleasant odors and cause aesthetic problems and can be a breeding ground for insects (flies), rodents (rats), and other animals that transmit germs which in turn live on food, enter the body of toddlers fecal-orally, resulting in the incidence of diarrhea. This is in line with studies of Harter (2019), Modern (2020), and Melese (2019), stated that poor waste disposal has the potential to cause diarrhea in toddlers 3 times.

Based on the results of observations, most of the mothers of toddlers already have sewerage and it runs smoothly so that there is no stagnant wastewater, but the waste water is not managed properly, that is, it does not drain waste into infiltration wells or is channeled into public sewerage. Most households still channel their house liquid waste water into a ditch that will lead to Danau Toba without a temporary sewage pond. The results of the chi square test show that there is a relationship

between household wastewater treatment and the incidence of diarrhea in toddlers ( $p = 0.036 < \alpha (5\%)$ ), but the prevalence ratio shows that the liquid waste factor does not indicate a possible risk where  $PR = 0.43 < 1$ . The results of this study are in accordance with the research Ramanathan (2019), on improving access to sanitation including household waste water to reduce the incidence of diarrhea in toddlers. There is a synergy between access to total sanitation with a decrease in the prevalence of diarrhea in toddlers in India.

## Conclusion

Community-based total sanitation has an effect on the incidence of diarrhea in toddlers, namely hand washing with soap, stop devecate, household food and beverage processing, household waste security, and household wastewater treatment. The multi-variate modeling obtained shows that hand washing with soap, Stop devecate, poor food and beverage management and household waste processing have a 53 percent risk for the occurrence of diarrhea in toddlers. Mothers of toddlers who do not wash their hands with soap well have 6 times the chance of having diarrhea in their toddlers than mothers of toddlers who do CTPS well. Cooperation from all cross-sectors from the government, religious leaders, community leaders, community participation, and the private sector can improve sanitation facilities and the habit of washing hands with soap.

## Acknowledgement

The author would like to thank the Agency of Development and Empowerment of Health Quality and Human Resources (BPPSDMK), Ministry of Health, who has helped fund research and the author's study assignments during the study assignment program at the Postgraduate Program in Public Health, University of North Sumatra.

## References

- Adane, M., Mengistie, B., Kloos, H., Medhin, G., & Mulat, W., 2017. Sanitation Facilities, Hygienic Conditions, and Prevalence of Acute Diarrhea Among Under-five Children in Slums of Addis Ababa, Ethiopia: Baseline

- Survey of A Longitudinal Study. *PLoS ONE*, 12(8), pp.e0182783.
- Ayawale, M.A., Mekonnen, W.T., Abaya, S.W., & Mekonnen, Z.A., 2018. Assessment of Diarrhea and Its Associated Factors in Under-Five Children among open Defecation-Free Rural Setting of Dangla District, Northwest Ethiopia. *Journal Of Environmental and Public Health*, 2018, pp.1-8.
- Babb, C., Makotsi, N., Heimler, I., Bailey, R. C., Hershov, R. C., Masanga, P., & Mehta, S.D., 2018. Evaluation of the Effectiveness of A Latrine Intervention in the Reduction of Childhood Diarrhoeal Health in Nyando District, Kisumu County, Kenya. *Epidemiology and Infection*, 146, pp.1079-1088.
- Briceno, B., Coville, A., Gertler, P., & Martinez, S., 2017. *Are There Synergies from Combining Hygiene and Sanitation Promotion Campaigns: Evidence from A Large-scale Cluster-randomizedtrial in Rural Tanzania.* *PLoS ONE*, 12(11), pp.e0186228.
- Degebasa, M.Z., Zenebe, D., Weldemichael., & Marrama, M.T., 2017. Diarrhea Status and Associated Factors in Under Five Years Old Children in Relation to Implemented and Unimplemented Community-led Total Sanitation and Hygiene in Yaya Gulele in 2017. *Pediatric Health, Medicine and Therapeutics*, 9(1), pp.109-121.
- Harter, M., Inauen, J., & Mosler, H.J., 2019. How does Community-Led Total Sanitation (CITS) Promote Latrine Construction, and Can It Be Improved? A Cluster-Randomized Cotrolled Trial in Ghana. *Social Science & Medicine*, 245(112705).
- Kapwata, T., Mathee, A., Roux, W.J., & Wright, C.Y., 2018. Diarrhoeal Disease in Relation to Possible Household Risk Factors in South African Villages. *International Journal Of Environmental Research and Public Healath*, 15(1665).
- Melese, B., Paulos, W., Astawesegn, F., & Gelgelu, T., 2019. Prevalence of Diarrheal Diseases and Associated Factors Among Under-five Children in Dale District, Sidame zone, Southern Ethiopia: A Cross-sectional Study. *BMC Public Health*, 19(1235).
- Modern, G., Sauli, E., & Mpolya, E., 2020. Correlates of Diarrhea and Stunting Among Under-five Children in Ruvuna, Tanzania; A Hospital-based Cross-sectional Study. *Scientific African*, 8(e00430).
- Mosler, H-J., Mosch, S., & Harter, M., 2018. Is Community-Led Total Sanitation connected to the rebuilding of latrines? Quantitative evidence from Mozambique. *PLoS ONE*, 13(5).
- Nyambe, S., Agestika, L., & Yamauchi, T., 2020. The Improved and The Unimproved: Factors Influencing Sanitation and Diarrhoea in A Peri-urbansettlement of Lusaka, Zambia. *PLoS ONE*, 15(5).
- Oloruntoba, E.O., Folarin, T.B., & Ayede, A.I., 2014. Hygiene and Sanitation Risk Factors of Diarrhoeal Disease Among Under-five Children in Ibadan Nigeria. *African Health Sciences*, 14(4), pp.1001-1011.
- Patunru, A.A., 2015. Access to Safe Drinking Water and Sanitation in Indonesia. *Asia & The Pacific Policy Studies*, 2(2), pp.234-244.
- Ramanathan, M., & Vijayan, B., 2019. Covariates of Diarrhoea Among Under-five Children in India: Are They Level Dependent?. *Plos One*, 14(8).
- Soboksa, N.E., Garl, S.R., Hallu, A.B., & Alemu, M.A., 2020. Association between Microbial Water Quality Sanitation and Hygiene Practise and Childhood Diarrhea in Kersa and Omo Nada district of Jimma Zone Ethiopia. *Plos One*, 15(2).
- Sumampouw, O.J., Nelwan, J.E., & Rumayar, A.A., 2019. Socioeconomic Factors Associated With Diarrhea among Under-Five Children in Manado Coastal Area Indonesia. *Journal Of Global Infectious Diseases*, 11(4), pp.140-146.
- Tessema, R.A., 2017. Assessment of the Implementation of Community-led Total Sanitation, Hygiene, and Associated Factors in Diretiyara district, Eatern Ethopia. *Plos One*, 12(4).
- Tidwell, J.B., Gopalakrishnan, A., Unni, A., Sheth, E., Daryanani, A., Singh, S., & Sidibe, M., 2020. Impact of a Teacher-led School Handwashing Program Onchildren's Handwashing with Soap at School and Home in Bihar, India. *PLoS ONE*, 15(2).
- Troeger, C., Forouzanfar, M., Rao, P.C., Khalil, I., Brown, A., Swartz, S., [Fullman, N.](#), [Mosser, J.](#), [Thompson, R.L.](#), [Reiner-Jr, R.C.](#), [Abajobir, A.](#), [Alam, N.](#), [Alemayohu, M.A.](#), [Amare, A.T.](#), [Antonio, C.A.](#), [Asayesh, H.](#), [Avokpaho, E.](#), [Barac, A.](#), [Beshir, M.A.](#), [Boneya, D.J.](#), [Brauer, M.](#), [Dandona, L.](#), [Dandona, R.](#), [Fitchett, J.R.A.](#), [Gebrehiwot, T.T.](#), [Hailu, G.B.](#), [Hotez, P.J.](#), [Kasaecian, A.](#), [Khoja, T.](#), [Kissoon, N.](#), [Knibbs, L.](#), [Kumar, G.A.](#), [Rai, R.K.](#), [Razek, H.M.A.E.](#), [Mohammed, M.S.K.](#), [Nielson, K.](#), [Oren, E.](#), [Osman, A.](#), [Patton, G.](#),



- [Qorbani](#), M., [Roba](#), H.S., [Sartorius](#), B., [Savic](#), M., [Shigematsu](#), M., [Sykes](#), B., [Swaminathan](#), S., [Topor-Madry](#), R., [Ukwaja](#), K., [Werdecker](#), A., [Yonemoto](#), N., [Zaki](#), M.E.S., [Lim](#), S.S., [Naghavi](#), M., [Vos](#), T., [Hay](#), S.I., [Murray](#), C.J.L., & [Mokdad](#), A.H., 2017. Estimates of the Global, Regional, and National Morbidity, Mortality, and Aetiologies of Lower Respiratory Tract Infections in 195 Countries: A Systematic Analysis for the Global Burden of Disease Study 2015. *The Lancet Infectious Diseases*,17(11), pp.1133–61.
- [Wanzahun](#)., & [Mengiste](#)., 2013. Environmental Factors Associated with Acute Diarrhea among Children Under Five Years of Age in Derashe District Southern Ethiopia. *Science Journal of Public Health*, 2013, pp.119-124.