Jurnal Riset Kesehatan, 10 (1), 2021, 12 - 18
DOI: 10.31983/jrk.v10i1.6494

Jurnal Riset Kesehatan

http://ejournal.poltekkes-smg.ac.id/ojs/index.php/jrk

FACTORS WATER CHARACTERISTIC AS PREDICTING DIARRHEA UNDER 5 YEARS

Nugroho Susanto[a*]

[a] Public Health Science ; University of Respati Yogyakarta
Raya Tajem KM 1,5 Maguwo Harjo street ; Yogyakarta 55281 ; Indonesia

Abstract

Risk Factors diarrhea deaths associated to unsafe water and inadequate sanitation. Water supply is very important to decrease of diarrhea disease. Living around canal is a one of risk diarrhea incident. Improved water sanitation, water facilities, and hygiene water decrease of diarrhea disease. Study aims to know dominant factor related water sanitation which is more appropriate than diarrhea in volcano area disaster. Study design used cross sectional community-based survey. Population and sample size were required 1142 household. Data collected such as sufficient of water source, water colored, smelly water, taste water, water cooked, distance of absorption. Data were analyzed performed using SPSS. Data analysis performed a descriptive analysis, statistic test with chi square and logistic regression with confidence interval 95%. Study that sufficient of water 97.2%, no water colored 98.4%, no smelly water (95.3%), no taste water 95.4%, water cooked 98.2%, distance of absorption > 11 meter 78%. Risk factor for diarrhea such as taste water OR = 7.3 (3.7-14.4), smelly water OR = 6.9 (3.5-13.6) and distance of absorption OR = 3.4 (2.0-5.7). Factor highest contribution for diarrhea is distance absorption (Exp β = 1.70 CI; 1.701-4.906). Distance absorption < 11 meters is main factor contributing for diarrhea. Factor dominant contribution for diarrhea is distance of absorption < 11 meter.

Keywords: *diarrhea; distance absorption; water*

1. Introduction

Based data World Health Organization (World Health Organization, 2016) estimate that diarrhea disease account 29% of all child deaths globally. Communicable Disease Control (CDC) that 88% of diarrhea associated deaths are to unsafe water and inadequate sanitation. Study (Eshete, Id, Gari, Hailu, & Alemu, 2020) that diarrhea disease is caused of increasing child morbidity and mortality in Ethiopia. Diarrhea were estimated kill around 2.2 million child every year in developing countries. Indonesia health Government estimated that diarrhea 4.274790 case during 2018 (Kemenkes RI, 2019).

Diarrhea disease caused such as water system, social and economic factors. Previous study (Eshete, Id, Gari, Hailu, & Alemu, 2020) that from 145 countries shows 58% of diarrhea deaths caused unsafe water and poor sanitation. Study (Id & Khalis, 2020) that water for health is urgently for decrease disease related water quality. Previous study (Eshete, Id, Gari, Hailu, & Alemu, 2020) reported water contamination by E. coli was 83.3%. Water supply is very important to decrease of diarrhea disease. CDC estimated virus is caused of acute diarrhea and estimate 40% of hospitalizations for children under 5 years. Based on WHO (World Health Organization, 2016) estimate that 11% population on the world does not have access drinking water source and diarrhea increase 36%.

Previous study (Id & Khalis, 2020) conclude developing country need increased access safe water supplies. Population need regulations to access quality water standards. Study (Chigor, Ibangha, Chigor, & Titilawo, 2020) conclude that treated waste water a reservoir of *E. coli* decrease of diarrhea. Study (Contreras, Trangucci, Felix-arellano, Rodríguez-dozal, Siebe, Riojas-rodríguez, Eisenberg, 2020) addressed 564

*) Corresponding Author (Nugroho Susanto)
E-mail: nugroho_susanto@respati.ac.id

households that water treated decrease of children diarrhea OR = 0.30, 95% (CI: 0.11-0.82). Study (Vally, Mcmichael, Doherty, Li, Guevarra, & Tobias, 2019) that hand washing after toilet decrease diarrhea for children. Children not hand washing significant risk for diarrhea (RR = 2.84; p < 0.0001). Study (Morse, Tilley, Chidziwisano, Malolo, & Musaya, 2020.) conclude that hand washing with soap significant effected reduction of diarrhea in children. Study (Eisenberg, 2020) that diarrhea prevalence with household distance from a canal health risks for diarrhea disease.

Sleman district is volcano area that impacted of water supply. Study (Boloweti, Boloweti, Id, Deniel, Garnier, Mauny, Kasereka, Id, 2020) that in volcanic activities strongly alkaline volcanoes produce very large of acidic gases. Volcano area disaster have significant direct and indirect impacts on water via interactions between acidic rain. Study (Hartinger, Nuño, Hattendorf, Verastegui, Karlen, Ortiz, & Mäusezahl, 2020) that improvement of poor health related water sanitation very important to problem solve infrastructure water supply and behavior risks. Study (Eshete, Id, Gari, Hailu, & Alemu, 2020) that inadequate sanitation water associated with diarrhea disease.

The prevention for diarrhea disease such as improved water sanitation, water facilities, and health water behavior. The Preventing of hands wash important for decrease of diarrhea. Study (Eshete, Id, Gari, Hailu, & Alemu, 2020) conclude that not wash hands before water collection develop diarrhea compare children who live with wash hands (AOR = 4.28; 95% CI: 1.46–12.56). Study (Id & Khalis, 2020) that improve regulations, health facilities water sanitation, and provide drinking water standards is importance to decrease diarrhea develop. Study aims to know dominant factor related water sanitation to develop diarrhea in volcano area disaster.

2. Method

Study design used cross sectional community-based survey was conducted between August 2020 until September 2020. This survey was conducted in sub district Cangkringan with sample Glagaharjo Village. Sub district Cangkringan is one of sub district with status area volcano disaster. Glagaharjo Village is one of Village affected volcano eruption of Merapi mountain. The survey were required in Glagaharjo village of 1142 household.

Sample village were required with indicator very closed in volcano area in sub district Cangkringan. Total of population in area volcano disaster were survey 1142 household. Total of population in Glagaharjo village with 1364 household. Sample required with total population with Inclusion and exclusion criteria with house hold with children under 5 years. Based on survey were required 1142 house hold (Susanto, 2014) .

All households in each of the selected nine sub villages and manually listed to obtain a sampling frame of households. A total of 1142 households were surveyed to list households having children up to five years of age. A total of 1364 households were identified. These households were surveyed, and 1142 children were included in the study after obtaining informed consent from the family head. All households in the sampling frame were visited. Mothers or caregivers (maternal or paternal grandmother/grandfather/aunt/uncle) were interviewed by trained data collectors. The questionnaire were design to obtain information on their perceptions of the causes of diarrhea. The questionnaire collected information on household factors including environment, water source status. Information on water, sanitation, and hygiene related variables were also collected from each household.

Data collected such as sufficient of water source, water colored, smelly water, taste water, water cooked, distance of absorption. Data Sufficient of water source were measuring with interview guideline based, data Water colored were measuring spectrophotometer, Smelly water organoleptik, Taste water with interview based questionnaire, Water cooked with interview based questionnaire, Distance of absorption with "meteran tancap". Data were collected with interview on the paper-based questionnaire. Database was created using excel and data were analysis with SPSS. Data collected and Data entry was performed by trained research assistants and was supervised by senior researchers. All data continuous variables were change nominal data as percent and proportion. Data were analysis performed using SPSS. We performed a descriptive analysis (percentages) for the main household characteristic and for the health characteristics we calculate prevalence and proportions. The Statistic test with chi square for correlation variable independent and dependent. Variable was significantly were

continue analysis with logistic regression with confidence interval 95%.

This study was approved by the Institutional Ethics Committee (IEC) faculty of Health Science University of Respati Yogyakarta with no 189.3/FIKES/PL/IX/2020. Informed consent was obtained from participants before the interview. Participants had the right to withdraw from the study at any time.

3. Result and Discussion

Study addressed for 1142 house hold in volcano area disaster in Cangkringan sub district. Based on data analysis of 1142 house hold were survey, detail describe table below.

Table 1. Distribution Frequency of variable related to Sufficient of Water Source, Water Colored, Smelly Water, Taste Water, Water Cooked, Distance of Absorption

Variable	F	%
Sufficient of water source		
No	32	2.8
Yes	1110	97.2
Water colored		
Yes	18	1.6
No	1124	98.4
Smelly water		
Yes	54	4.7
No	1088	95.3
Taste water		
Yes	52	4.6
No	1090	95.4
Water cooked		
Yes	20	1.8
No	1122	98.2
Distance of absorption		
≤ 11 meters	251	22
> 11 meters	891	78
Diarrhea		
Yes	66	5.8
No	1074	94.2

Table 1. shown that majority participant sufficient of water 97.2%, no water colored 98.4%, no smelly water (95.3%), no taste water 95.4%, water cooked 98.2%, distance of absorption > 11 meters 78%. Analysis data to know relation between variable independent such as sufficient of water source, water colored, smelly water, taste water, water cooked, distance of absorption and variable dependent is diarrhea with chi square test. Based on data analysis bellow.

Table 2. Correlation of Variables Related to Water and Diarrhea

Variable	Diarrhea		OR (95% CI)
	Yes	No	
Sufficient of water			--
No	0 (0)	32 (2.8)	
Yes	66 (5.8)	1044 (91.4)	
Water colored			
Yes			
No	2 (0.2)	16 (1.4)	2.1
	64 (5.6)	1060 (92.8)	(0.4-9.2)
Smelly water			
Yes			
No	14 (1.2)	40 (3.5)	6.9
	52 (4.6)	1036 (90.7)	(3.5-13.6)
Taste water			
Yes	14 (1.2)	38 (3.3)	7.3
No	52 (4.6)	1038 (90.9)	(3.7-14.4)
Water cooked			
Yes			
No	2 (0.2)	18 (1.6)	1.8
	64 (5.6)	1058 (92.6)	(0.4-8.1)
Distance of absorption			
≤ 11 meters	31 (2.7)	220 (19.3)	3.4
> 11 meters	35 (3.1)	856 (75)	(2.0-5.7)

Table 2. shown that house hold water sufficient source no diarrhea 91.4%, no water colored no diarrhea 92.8 %, no smelly water no diarrhea 90.7%, no taste water with 90.9 % proportion no diarrhea, no water cooked have proportion no diarrhea 92.6% and distance > 11 meters proportion no diarrhea 75%. based proportion of diarrhea with distance of absorption ≤ 11 meters with proportion 2.7%. Based on risk factor that highest of risk factor for diarrhea such as taste water OR = 7.3 (3.7-14.4) and smelly water have been high risk for diarrhea OR = 6.9 (3.5-13.6) and distance of absorption < 11 meters OR = 3.4 (2.0-5.7). Variable no significant for incident of diarrhea such as water cooked OR = 1.8 (0.4-8.1), water colored OR = 2.1 (0.4-9.2), and sufficient of water source.

Variable independent were significantly correlation continue to be analyzed with regression logistic. Variable were significant such as smelly water, taste water and distance of absorption. Analysis logistic regression was shown variable highest contribution for diarrhea. Details analyzed regression logistic shown on table below.

Table 3. Analysis Regression Logistic between variables related to water and diarrhea

Variable	β	p	OR	CI 95%
Smelly water	0.590	0.308	1.80	0.580-5.618
Taste water	1.350	0.019	1.25	1.253–11.878
Distance absorption	1.061	<0.001	1.70	1.701-4.906

Based on regression logistic analysis were shown that used smelly water risk for diarrhea (OR = 1.80 CI; 0.580-5.618) compare no used smelly water, but risk no significant. Used taste water significant risk for diarrhea (OR = 1.25 CI; 1.253-11.878) compare no taste water and used distance absorption < 11 meters significant risk diarrhea (OR = 1.70 CI; 1.701-4.906) compare distance absorption.

Study shown that majority sufficient of water source, no water colored, no smelly water, no taste water, water cooked and distance of absorption > 11 meter. Study condition caused an volcano area supply of water is sufficient and good water characteristic. Study (Boloweti, Id, Deniel, Garnier, Mauny, Kasereka, Id, 2020) that the activity of the volcano, characteristics of water predict epidemic risks. Study (Chigor, Ibangha, Chigor, & Titilawo, 2020) have results that intervention water supply decrease incident of diarrhea. Study (Eisenberg, 2020) for households that 1,856 survey that children living 10 meters of canal had save 45% of diarrhea and 100 meter of canal saved 70% of diarrhea. It caused transmitted of diarrhea agent of disease have been contact. Canal or river as media for agent transmitted of diarrhea disease such as *vibrio cholera*, *E. Coli*.

Study shown that proportion of diarrhea 5.8% and incidence of diarrhea state low. This condition caused proportion subject with diarrhea higher in order absorption < 11 meter still high. Compare with other study (Gizaw, 2020) shown that incident of gastrointestinal more high 61.8%. Study differences shown caused that Gizaw, 2020 study area with risk factor diarrhea. Study just survey on household. Study (Shrestha, Six, Dahal, Marks, & Meierhofer, 2020) that 55.5% of children 51.1% had intestinal parasitic infections and 52.2% had diarrhea. Study (Shine, Muhamud, Adanew, Demelash, & Abate, 2020) that during two week prevalence of diarrhea among children under-five was 16.4% (69/351).

The Taste water significant correlation with diarrhea. It condition caused water taste potential microorganism develop in the water taste relate environment condition. Study was shown that diarrhea case highest subject with distance absorption < 11 meters. That situation one of potential hint that environment factors related diarrhea case. State study in supported with (Boloweti, Boloweti, Id, Deniel, Garnier, Mauny, Kasereka, Id, 2020) that air temperature, rainfall, and water characteristics (pH and oxygen concentration) were related with diarrhea. Study (Gizaw, 2020) result that unclean living houses risk factors for diarrhea case OR=9.06.

Taste water significant related diarrhea. It's caused water taste potential isolated any microorganism related diarrhea such as *Escherichia coli, Vibrio cholera*. Water taste improved with intervention and management water. Study (Contreras, Trangucci, Felix-arellano, Rodríguez-dozal, Siebe, Riojas-rodríguez, Eisenberg, 2020) found that water sanitation intervention have been prevent diarrhea. Study (Vally, Mcmichael, Doherty, Li, Guevarra, & Tobias, 2019) reported hand washing with soap after toilet decreased diarrhea case in school p < 0.0001. Study (Bhandari, Bak, Lee, Chon, & Bhattachan, 2019) that a toilet facility at home significantly lower risk diarrhea (OR 0.49, p = 0.01). Study (Gizaw, 2020) result that gastrointestinal symptoms significantly associated parasitic infections OR=13.69.

Smelly water was significant factor related diarrhea. Water condition with smelly indicated that microorganism have been develop around household environment. Water smelly potential that water have been contaminating of *E. coli or Vibrio cholera* or other microorganism. Previous study (Lim, Kim, Acharya, Bajgain, Park, Yoo, & Lee, 2020) conclude that the diarrhea *Escherichia coli* infection was consumption of water-contaminated and water samples tested detected of *Escherichia coli*.

Water absorption < 11 meters have been correlation with diarrhea. Condition caused distance of source environment pollution so very close is factor microorganism develop to water supply household. Previous study (Shrestha, (Shrestha, Six, Dahal, Marks, & Meierhofer, 2020) diarrhea was positively associated with intermittent water supply (AOR = 2.72, 95% CI = 1.18–6.31). Water sanitation supply is essential factors decrease diarrhea. Previous study conducted especially in low-middle countries was reported that low quality water associated with diarrhea. Previous study (Bhandari, Bak,

Lee, Chon, & Bhattachan, 2019) that improved water supply was associated with decrease risk (OR 3.07, p = 0.005), complete vaccination toxic during antenatal checkups decrease risk of diarrhea (OR 12.9, p < 0.001).

The Regression Analysis shown that variable highest contribution for diarrhea children is distance absorption < 11 meter. Water absorption < 11 meter potential microorganism transmitting by water such *Escherichia Coli*, *vibrio cholera*. Environment transmitted water is factor Escherichia coli and vibrio cholera on process portal of exit or entry infected. Potential *E. coli* and *Vibrio cholera* for outbreak diarrhea disease, Sample were isolated around environment water area outbreak.

Transmitted pathogens with water contamination have been occurred of pathogens in environmental and irrigation waters became pathogens transmitted. Previous study (Titilawo, Obi, & Okoh, 2015) was occurrence of pathogens in environmental. Study (Lim, Kim, Acharya, Bajgain, Park, Yoo, & Lee, 2020.) was investigation among elementary school children was environmental samples tested detected strains of *E. coli*. Study (Shrestha, (Shrestha, Six, Dahal, Marks, & Meierhofer, 2020) that personal hygiene correlation significant for diarrhea (AOR = 0.83, 95% CI = 0.51–1.35). Based sample water drinking source presence coliforms (AOR = 10.44, 95% CI = 1.61–67.4).

Concept of epidemiology transmitted of disease that three factors contributing for disease such as agent, host and environment. Basically of natural history diarrhea disease that portal of entry and exit agent, environment factor main focused transmitting. Previous study (Gizaw, 2020) result that inadequate living environment sanitation correlation with diarrhea OR=2.37.

Education is decrease of diarrhea for children with promotion for water supply, water sanitary. Diarrhea in South Korean have been advocated to health education promotion for water sanitary. CDC that (CDC, 2017) prevention of diarrhea disease with household water treatment, safe water sanitation.

Previous study (Morse, Tilley, Chidziwisano, Malolo, & Musaya, 2020.) that interventions with hand washing with soap significant reduction of diarrhea disease in children. Water management interventions have been impacted existing environmental contamination in the household. Study (Vally, Mcmichael, Doherty, Li, Guevarra, & Tobias, 2019) result that intervention after toilet reduced diarrhea case. The Intervention diarrhea disease curative on previous study shown that intervention with treated antibiotic. Study (Chigor, Ibangha, Chigor, & Titilawo, 2020) that ampicillin, tetracycline. The Intervention have been effective for decrease diarrhea incidence. Study (Boloweti, Id, Deniel, Garnier, Mauny, Kasereka, Id, 2020) that management strategies to prevent water-borne diarrhea caused in the environment. Study (Gizaw, 2020) that symptoms include abdominal discomfort, abdominal cramp, nausea, vomiting.

Environment factors importance for diarrhea case. Water environment pollution increase contaminating microorganism around household. Previous study in Japan (Aoyama, Fukumoto, Shigita, Asayama, Mukai, & Nagata, 2020) show that bowel around environment can transmitting for microorganism diarrhea agent. Patients with diarrhea significantly transmitting agent around environment. Contamination with agent such water supply increase of diarrhea. Study (Eisenberg, 2020) that canal is factors transmitted of agent diarrhea disease. Based on survey 1,856 household that children living canal with distance canal 10 meter more risk for diarrhea. Distance of canal just 10 meters have been potential agent of diarrhea transmitting. Children long distance from canal protected diarrhea 70% (OR = 0.30, 95% CI: 0.11, 0.82). Study (Poernomo, 2016) that under < 2 years risk probability for diarrhea (AOR=2.617; 95%CI=1.063-6.444; p=0.036), but water facility not significant for diarrhea.

Water sanitation main focused to improve health state especially diarrhea case. Study (Aoyama, Fukumoto, Shigita, Asayama, Mukai, & Nagata, 2020) about normal bowel habit compare non normal habit bowel that normal habit bowel decrease diarrhea. Constipation on bowel indicated of organism contact transmission. Intervention promotive and preventive decrease diarrhea. Study (Helps, Chard, Garn, Chang, Clasen, & Freeman, 2019) that based school effectively agent of change behavior for community. Study (Pahmi, 2019) that variable dominant for incidence diarrhea is toilet facilities compare other such as drinking water, mother education.

Decrease of diarrhea importance role a local participating for environment intervention such as water sanitation and health behavior. Water sanitation with improve water supply hygiene around household (Yenni, 2019) . Improve health behavior with educating and promoting to prevent population behavior to fecal defect on river. Locally expertise help to support for

program intervention especially water environment sanitary (Mathur, Baghel, Jaat, & Diwan, 2019). The sufficient of water supply for community as factor for decrease diarrhea disease. Management of environment and water supply main focused for decrease diarrhea case. Research study were used cross-sectional thus low in causality association.

4. Conclusion and Suggestion

Factors smelly water, taste water, and distance of absorption are significant risk for diarrhea. Distance of absorption < 11 meter is main factor dominant contribution for diarrhea. Further research to developing about component of water microorganism.

5. Acknowledgments

The authors would like to thank for staff in Sub District Cangkringan (Camat, Lurah Glagaharjo) and Staff of Puskesmas Cangkringan help during research and especially for subject all community in around volcano Merapi Mountain.

6. References

Aoyama, T., Fukumoto, A., Shigita, K., Asayama, N., Mukai, S., & Nagata, S. (2020). *Bile pigment in small-bowel water content may reflect bowel habits : a retrospective analysis of a capsule endoscopy imaging series*. 1–9.

Bhandari, P., Bak, J., Lee, K., Chon, Y., & Bhattachan, A. (2019). *Assessment of Socio-Demographic Factors , Mother and Child Health Status , Water , Sanitation , and Hygienic Conditions Existing in a Hilly Rural Village of Nepal*. 1–12.

Boloweti, D. B., Id, P. G., Deniel, C., Garnier, E., Mauny, F., Kasereka, C. M., … Id, G. B. (2020). *Volcanic activity controls cholera outbreaks in the East African Rift*. 1–20. https://doi.org/10.1371/journal.pntd.0008406

CDC. (2017). *Global Burden of Disease Study 2017*.

Chigor, V., Ibangha, I., Chigor, C., & Titilawo, Y. (2020). Heliyon Treated wastewater used in fresh produce irrigation in Nsukka , Southeast Nigeria is a reservoir of enterotoxigenic and multidrug-resistant Escherichia coli. *Heliyon*, *6*(May 2019), e03780. https://doi.org/10.1016/j.heliyon.2020.e03780

Contreras, J. D., Trangucci, R., Felix-arellano, E. E., Rodríguez-dozal, S., Siebe, C., Riojas-rodríguez, H., … Eisenberg, J. N. S. (2020). *Modeling Spatial Risk of Diarrheal Disease Associated with Household Proximity to Untreated Wastewater Used for Irrigation in the Mezquital Valley , Mexico*. *128*(July), 1–9.

Eisenberg, J. N. S. (2020). *Does Basic Sanitation Prevent Diarrhea ? Contextualizing Recent Intervention Trials through a Historical Lens*.

Eshete, N., Id, S., Gari, S. R., Hailu, A. B., & Alemu, M. (2020). *Association between microbial water quality , sanitation and hygiene practices and childhood diarrhea in Kersa and Omo Nada districts of Jimma Zone , Ethiopia*. *396*, 1–17. https://doi.org/10.1371/journal.pone.0229303

Gizaw, Z. (2020). *Common Gastrointestinal Symptoms and Associated Factors Among Under-5 Children in Rural Dembiya , Northwest Ethiopia : A Community-Based Cross- Sectional Study*. https://doi.org/10.1177/1178630220927361

Hartinger, S. M., Nuño, N., Hattendorf, J., Verastegui, H., Karlen, W., Ortiz, M., & Mäusezahl, D. (2020). *A factorial cluster-randomised controlled trial combining home-environmental and early child development interventions to improve child health and development : rationale , trial design and baseline findings*. 1–12.

Helps, W., Chard, A. N., Garn, J. V, Chang, H. H., Clasen, T., & Freeman, M. C. (2019). *and hygiene intervention on school absence ,*. *9*(2). https://doi.org/10.7189/jogh.09.020402

Id, O. J., & Khalis, A. (2020). *Urban water systems : Development of micro- level indicators to support integrated policy*. 1–19. https://doi.org/10.1371/journal.pone.0228295

Kemenkes RI. (2019). *Profil Kesehatan Indonesia 2018 [Indonesia Health Profile 2018]*. Retrieved from http://www.depkes.go.id/resources/download/pusdatin/profil-kesehatan-indonesia/Data-dan-Informasi_Profil-Kesehatan-Indonesia-2018.pdf

Lim, M., Kim, J., Acharya, D., Bajgain, B. B., Park, J., Yoo, S., & Lee, K. (2020). *A Diarrhoeagenic Enteropathogenic Escherichia coli (EPEC) Infection Outbreak That Occurred among Elementary School Children in Gyeongsangbuk-Do Province of South Korea Was Associated with Consumption of Water-Contaminated Food Items*. (4).

Mathur, A., Baghel, D., Jaat, J., & Diwan, V.

(2019). *Community-Based Participatory Research and Drug Utilization Research to Improve Childhood Diarrhea Case Management in Ujjain , India : A Cross-Sectional Survey*. *16*, 1646.

Morse, T., Tilley, E., Chidziwisano, K., Malolo, R., & Musaya, J. (2020). *Health Outcomes of an Integrated Behaviour-Centred Water , Sanitation , Hygiene and Food Safety Intervention – A Randomised before and after Trial*. 1–19.

Pahmi, L. (2019). *HOUSEHOLD RISK FACTORS FOR DIARRHOEA DISEASE IN CHILDREN UNDER FIVE YEARS OLD IN INDONESIA FAKTOR-FAKTOR DALAM RUMAH TANGGA YANG MEMPENGARUHI*. *10*(March), 50–58.

Poernomo, H. et al. (2016). *Faktor Risiko Kejadian Diare Akut pada Anak Balita (Studi Epidemiologis di Puskesmas Baamang Unit I Kabupaten Kotawaringin Timur)*. *1*(2).

Shine, S., Muhamud, S., Adanew, S., Demelash, A., & Abate, M. (2020). *Prevalence and associated factors of diarrhea among under-five children in Debre Berhan town , Ethiopia 2018 : a cross sectional study*. 1–6.

Shrestha, A., Six, J., Dahal, D., Marks, S., & Meierhofer, R. (2020). *Association of nutrition , water , sanitation and hygiene practices with children ' s nutritional status , intestinal parasitic infections and diarrhoea in rural Nepal : a cross-sectional study*. 1–21.

Susanto, N. (2014). *Besar Sampel Dalam Penelitian Kesehatan, Digibooks, Yogyakarta*.

Titilawo, Y., Obi, L., & Okoh, A. (2015). Occurrence of virulence gene signatures associated with diarrhoeagenic and non-diarrhoeagenic pathovars of Escherichia coli isolates from some selected rivers in South-Western Nigeria. *BMC Microbiology*, 1–14. https://doi.org/10.1186/s12866-015-0540-3

Vally, H., Mcmichael, C., Doherty, C., Li, X., Guevarra, G., & Tobias, P. (2019). *The Impact of a School-Based Water , Sanitation and Hygiene Intervention on Knowledge , Practices , and Diarrhoea Rates in the Philippines*. 1–14.

World Health Organization. (2016). Diarrhea report mortality. *World Health Organization*, 1. Retrieved from https://www.who.int/diabetes/country-profiles/bra_en.pdf

Yenni, M. (2019). Factors Related To The Event Of Gastritis Disease In Kelurahan Tanjung Pinang , Jambi City In 2018. *Jurnal Formil (Forum Ilmiah) KesMas Respati*, *4*(April), 99–106.