AFRICAN JOURNAL OF NUTRITION AND DIETETICS

https://doi.org/10.58460/ajnd.v1i1.19

RESEARCH ARTICLE

Open Access

MJM BIOLABS

Relationship Between Hygiene Practices and Occurrence of Diarrhea among Under-Five Children: A Case of East Pokot Sub County

Miriam Adoyo MUGA[1], Mary Chemutai TARUS[1], and Wesley BOR[1]

[1]*Department of Nutrition and Dietetics, School of Medicine and Health Sciences, Kabarak University, P.O. Box Private Bag, Kabarak, 20157, Kenya*

Corresponding Author;
mmuga@kabarak.ac.ke

Article History
Submitted: 4th May 2023
Accepted: 30th August 2023
Published Online: 5th September 2023

To read this paper online, please scan the QR code below:

ABSTRACT

Communicable diseases continue to persist in developing countries with diarrhea being one of the conditions that affect children under- five years of age resulting to numerous morbidities and mortality. Despite the interventions that have been put in place, Kenya still had an estimated 14% of children with diarrhea in 2022. Consequently, there is still need to determine the actual practices associated with diarrhea at community level. This will ensure that community specific interventions are developed to curb diarrhea. Therefore, this study sought to determine hygiene practices that are associated with diarrhea.

The study employed a descriptive cross-sectional design, and the fisher's formula was used to calculate a sample of 384 caregivers from East Pokot Sub-County. Both purposive, proportional and simple random sampling were used to reach the determined sample size. All ethical approvals- ethical clearance from Baraton Research and ethics committee and a research permit from NACOSTI were sought before the commencement of the study and participants consented before recruitment into the study. All collected data was de-identified, cleaned and analyzed using STATA version 24. Chi-square test and logistic regression were used to determine the relationship between hygiene practices and the occurrence of diarrhea. All data were presented in tables.

Open defecation was 2.24 times more likely to result to diarrhea, hand washing equipment, washing hands after toilet use, helping the child to wash hands after visiting the toilet and washing hands with soap were 0.25, 0.58, 0.59, and 0.56 times less likely to result to diarrhea before adjustment respectively. However, after adjustment, only open defecation AOR: 1.78 (0.94 – 3.37), hand washing facility AOR: 0.17 (0.10 – 0.30) and age of the caregiver for the categories above 25 years that is 25-30 years, 31-36 years and above 36 years remained significant at $P=\leq 0.01, \leq 0.10$ *and* ≤ 0.05 respectively.

This study therefore recommends health education on the detriments of open defecation while encouraging community members and most importantly young caregivers on the benefits of handwashing practices and supporting community members to build latrines for safe disposal of faecal matter.

Keywords: Open defecation, Hygiene practices, Under-five children

INTRODUCTION

Currently, the world is grappling with the double burden of disease - communicable and non-communicable diseases (United Nations, 2011). Of concern, is the persistent burden of communicable diseases- pneumonia, diarrhea and malaria- in majority of the low and middle income countries WHO, 2011). Among these infectious diseases, diarrhea has been shown to be the second leading cause of morbidity and mortality among young children hence impeding the achievements of both the MDGS as well as SDGs on reducing child mortalities as and environment sanitation (Boutayeb, 2010; World Health Organization, 2023). It is further estimated that the condition results to 1.7 billion cases annually (WHO, 2018). Among children under-5 years of age, diarrhea is often caused by infections or consuming contaminated food or even poor sanitation and hygiene practices. If diarrhea episodes are not managed it could often lead to severe dehydration and death. Of the 5 million under-5 children deaths that occurred globally in 2019, more than 80% were from sub-Saharan Africa with the main cause of death being communicable diseases including diarrhea (WHO, 2020).

Over the years, Kenya has been grappling with the occurrence of frequent diarrhea cases among the under-five children. According to Kenya Demographic Health Survey 2022, 14% of the children under-5 years experienced diarrhea related symptoms and 57% of the caregivers never sought advice or treatment for the children. This further increases the risk of morbidities and mortalities among the under 5 (KNBS & ICF, 2023). While treatment and or seeking health care advice is good in managing diarrhea, proper environmental related practices are also important for diarrhea management. Moreover, identifying and having the knowledge of key risk factors could further help in its management.

Various studies have identified risk factors for diarrhea. An analysis of the Kenya demographic Health Survey 2014 showed that low level of caregiver education and unsafe disposal of children feces as key risk factors for diarrhea (Mulatya & Ochieng, 2020). Furthermore, providing health education to community members despite their level of education helps in making conscious decisions to avoid open defecation (Tamilarasan et al., 2022). According to a study conducted in India, open defecation was often practiced because of challenges in putting up latrines and the availability of land (Tamilarasan et al., 2022). In Turkana, Kenya poor structural designs and the condition of latrines encouraged open defecation (Busienei et al., 2019). Similarly, having latrines and improving on their condition has more benefit in reducing the occurrence of diarrhea (Adane et al., 2017; Cha et al., 2017). This mean that the social-economic status of a person, the community they live in and not merely the presence of latrines may be a contributing factor to open defecation and reduce the occurrence of diarrhea. Other factors such as quality water from clean sources, environmental sanitation that includes proper disposal of garbage to avoid flies were shown to reduce significantly reduces the chances of diarrhea occurrence. In addition, poor hygiene practices- particularly in food handling increase the chances of diarrhea occurrence. (Ejemot-Nwadiaro et al., 2021; Ogbo et al., 2017).

According to the World Health Organization, hand washing with clean water and soap as interventions may decrease the occurrence of diarrhea. Furthermore, personal and food hygiene are some of the strategies used to prevent diarrhea (World Health Organization, 2017) . In as much as the risk factors and prevention strategies are well known, embracing the information and actual practices that enable behavior change still remains a challenge especially in resource poor settings. Therefore, this study sought to establish the hygiene practices that are associated with occurrence of diarrhea in East Pokot sub-county.

MATERIALS AND METHODS

Study design

This study employed a descriptive cross-sectional research design using a quantitative data collection approach. The study was conducted in East Pokot Sub-County. The study site was purposively selected based on previous reports that showed a high prevalence of diarrhea in the area (Baringo County Government et al., 2016).

Study area

East Pokot sub-county is found within Baringo County in Kenya. The sub-county is located in the eastern part of the county and is majorly arid and semi-arid. East Pokot has 2 livelihoods where ¾ of the population are pastoralist while ¼ are agro-pastoralist. The sub-county occupies almost 1/3 of Baringo County and is 4524.8Km2 in land mass. The sub-county has 27 Locations and 61 sub locations that are served by 36 functional health facilities. In a recent census (2019), the sub-county was estimated to have a general population of 153347 (2019 census) where the under-five population was estimated to be 24075 and under one year 3190.

Sample size determination

The sample size was determined using the Fisher et al. (1998) as used by Daniel (Daniel, 1999) For a population more than 10,000. The estimated children population for the purposively selected wards was 13, 324. Therefore, the formula: $N=Z^2p(1-p)/d^2$ was applied as follows -where: Z value of 1.96, a proportion of 50% was used since the diarrhea prevalence is unknown, with a 5% (0.05) error and 95% CI and a sample size of 384 was determined.

Sampling procedure

In this study, a multistage sampling technique was employed to reach the targeted participants. First, purposive sampling was used to sample the study site as well as 3 wards within the sub-county so that participants who are in the wards free from insecurity would participate in the study. These include: Kolowa, Ripkwo, and Tirioko with an under 5 population of 3504, 5,304 and 4499 children respectively. Each of these wards have been subdivided into locations which include Secondly, proportion sampling was thereafter employed to determine the number of children to be sampled per ward that is: Kolowa n=3504/13324*384=101, Ripkwo n=5304/13324*384=153 and Tirioko n=4499/13324*384=130. Finally, simple random sampling and ballots was used to select the required number of children per ward and to ensure that only one child is selected per household.

Study variables

The following were considered as independent variables include socio-demographic and social economic characteristics such as: age of household head, marital status of household head, source of income, location, child's gender and the hygiene related practices such as: defecation, hand washing facility (water and soap), hand washing after using toilet (for the household head /caregiver), hand washing after helping child use the toilet, hand washing with soap, before cooking and before eating. The dependent variable was occurrence of diarrhea in the last 2-weeks among the children under five.

Data collection

Before data collection, all the per-requisite approvals were obtained. These included ethical clearance, research permit, permission from the county Ministry of Health and the Ministry of Education. Thereafter, research assistance who are community health volunteers in the

community and have previously participated in research activities were identified recruited and trained on the data collection tool. During the actual data collection, the research team together with the trained research assistants identified the participants who met the inclusion criteria, consented them then recruited them to participate in the study. A validated researcher administered semi-structured questionnaire that included all the study variables was used to collect data from the recruited and consented participants. Data was collected in a private space free of distractions as a way of upholding the participants privacy and confidentiality. All questionnaires that were filled were reviewed to ensure that all questions were accurately completed.

Data management and analysis

Before analysis, data was cleaned, coded and entered into an excel file that was later transferred to STATA version 24. All data was analyzed according to the study objective and presented in tables. In this study the categorical data were analyzed using descriptive statistics such as frequencies and percentages, Chi-square test ($\chi 2$) was used to determine the difference between categories and Logistic regression was used to determine the relationship between hygiene practices and the occurrence of diarrhea among children under the age of 5 years at. The results were presented as Odds ratio with 95% CI at a p-value of ≤ 0.05. A sample size of 384 was determined however, only 361 questionnaires were properly filled hence responses with missing values were excluded in the final analysis. An overall response rate of 94% was achieved and deemed adequate for analysis.

Ethical Considerations

Ethical clearance was obtained from University of Eastern Africa Baraton Ethics Committee Ref No B0605032021, followed by a research permit from the National Council for Science and Technology (NACOSTI) Ref No 574103. Permission was also sought from the County's ministry of health and the ministry of education. Before the eligible participants were recruited and any form of data collected from them, the participants were taken through a detailed informed consent form. The participants were informed on the objectives of the study, the eligibility criteria, the risks, benefits, and that participation was on voluntary basis hence they had the rights to withdraw from the study at their discretion including how data collected will be safeguarded. All the recruited participants were assured of privacy-the environment as they filled out the questionnaires and confidentiality- there will be no use and or collection of any identifiable information.

RESULTS

Social-demographic and socioeconomic characteristics of the participants

Table 1 shows the social-demographic and the social-economic characteristics of the participants by occurrence of diarrhea in the last 2 weeks. The findings showed that majority of the household heads were between 25-30years of age and married. Of those who were married, over half of the children 184 (54.4%) had diarrhea while only those < 25years had children with diarrhea in the last 2-weeks 56 (62.2%). In addition, majority of the participants reared livestock which is their main source of income and over half of the children had diarrhea (56.6%). With regards to the child's gender, there were more males than females with more female children having diarrhea. Furthermore, majority of the children who stayed home 155 (53.6%) had diarrhea in the last two weeks. Nevertheless, none of these variables were significant.

Table 1. Social-demographic and Socio- economic characteristics of participants by diarrhea among under-five children in East Pokot sub-county

Variables		In the last 2 weeks, child had diarrhea		P-value
	Total *n=361*	No	Yes	
		n (%) = 166 (46.0)	*n* (%) = 195 (54.0)	
Age of household head				0.318
< 25	90	34 (37.8)	56 (62.2)	
25-30	107	54 (50.5)	53 (49.5)	
31-36	94	44 (46.8)	50 (53.2)	
> 36	70	34 (48.6)	36 (51.4)	
Marital status				0.538
Married	338	154 (45.6)	184 (54.4)	
Single	23	12 (52.2)	11 (47.8)	
Source of income				0.505
Livestock	205	89 (43.4)	116 (56.6)	
Employment	81	41 (50.6)	40 (49.4)	
Other	75	36 (48.0)	39 (52.0)	
Ward				0.649
Tirioko	99	52 (52.5)	47 (47.5)	
Ripkwo	161	71 (44.1)	90 (55.9)	
Kolowa	101	43 (42.5)	58 (57.4)	
Child's gender				0.223
Male	181	89 (49.2)	92 (50.8)	
Female	180	77 (42.8)	103 (57.2)	
Child started school				0.770
No	289	134 (46.4)	155 (53.6)	
Yes	72	32 (44.4)	40 (55.6)	

Hygiene practices of the participants

The hygiene practices observed in relation to occurrence of diarrhea among under five children in East Pokot sub-county are presented in Table 2.

The findings showed that more than half of the population practiced open defecation of which 184 (57.9%) of the children had diarrhea in the last 2-week (57%) *P*= 0.003. Hygiene practices such as having hand washing equipment, washing hands after toilet use, and washing hands with soap were statistically significant with majority of the children not having diarrhea episodes at 110 (58.5%); *P*= < 0.001,108 (51.7%); *P*= 0.011, and 99 (52.9%); *P*=0.006 respectively.

Table 2. Hygiene related practices of participants by diarrhea among under-five children in East Pokot sub-county

Variables	In the last 2 weeks, child had diarrhea			P-value
	Total *n=361*	No *n* (%) = 166 (46.0)	Yes *n* (%) = 195 (54.0)	
Defecation				0.003
Latrine	71	44 (62.0)	27 (38.0)	
Open defecation	290	122 (42.1)	184 (57.9)	
Hand washing facility				< 0.001
No	119	62 (52.1)	57 (47.9)	
Yes	188	110 (58.5)	78 (41.5)	
Wash hand after toilet use				0.011
No	152	58 (38.2)	94 (61.8)	
Yes	209	108 (51.7)	101 (48.3)	
Wash hand after helping child to use toilet				0.023
No	113	42 (37.2)	71 (62.8)	
Yes	248	124 (50.0)	124 (50.0)	
Wash hand with soap				0.006
No	174	67 (38.5)	107 (61.5)	
Yes	187	99 (52.9)	88 (47.1)	
Wash hand before cooking				0.224
No	80	32 (40.0)	48 (60.0)	
Yes	281	134 (47.7)	147 (52.3)	
Wash hand before eating				0.909
No	20	9 (45.0)	11 (55.0)	
Yes	339	157 (46.3)	182 (53.7)	

Association between hygiene practices and occurrence of diarrhoea

The findings on the association between hygiene practices and the occurrence of diarrhea among under-five children in East Pokot showed that while households where open defecation was practiced, the under-five children were 2.24 (95% CI: 1.32 – 3.82; $p \leq 0.01$) times more likely to have diarrhea before adjustment Table 3. Households where there was hand washing equipment, participants washing hands after toilet use, helping the child to wash hands after visiting the toilet and washing hands with soap were 75% (0.16 – 0.39; *P*=≤ 0.001), 42% (0.38 – 0.88; *P*= ≤0.05), 41% (0.38 – 0.93; *P*= ≤0.05), 44% (0.37 – 0.85; P= ≤ 0.01) times less likely to have diarrhea episodes respectively. Additionally, the age of the household head was also an important factor in determining the occurrence of diarrhea among under-5 children.

Table 3. Unadjusted logistic regression of diarrhea occurrence among under-five children in East Pokot sub-county

Variables	Crude Odds Ratio (95% CI)
Defecation	
Latrine	1
Open defecation	2.24 (1.32 – 3.82)***
Hand washing facility	
No	1
Yes	0.25 (0.16 – 0.39)****
Wash hand after toilet use	
No	1
Yes	0.58 (0.38 – 0.88)**
Wash hand after helping child to use toilet	
No	1
Yes	0.59 (0.38 – 0.93)**
Wash hand with soap	
No	1
Yes	0.56 (0.37 – 0.85)***
Wash hand before cooking	
No	1
Yes	0.73 (0.44 – 1.21)
Wash hand before eating	
No	1
Yes	0.95 (0.38 – 2.35)
Age of household head	
< 25	1
25-30	0.60 (0.34 – 1.05)*
31-36	0.69 (0.38 – 1.24)
> 36	0.64 (0.34 – 1.21)
Marital status	
Married	1
Single	0.77 (0.33 – 1.79)
Source of income	
Livestock	1
Employment	0.75 (0.45 – 1.25)
Other	0.83 (0.49 – 1.41)
Child's gender	
Male	1
Female	1.29 (0.85 – 1.96)
Child started school	
No	1
Yes	1.08 (0.64 – 1.82)

* ≤ 0.10; ** ≤ 0.05; *** ≤ 0.01; **** ≤ 0.001

Adjusted logistic Regression of the association between hygiene practices and occurrence of diarrhoea

The adjusted models in the association between hygiene practices and the occurrence of diarrhea are presented in Table 4. In model 1, the occurrence of diarrhea among under- five children was highly significant after adjusting for defecation, hand washing equipment and washing hands after toilet use. Here, while practicing open defecation has 1.75(0.95 – 3.22; *P*=≤ 0.10) times more likelihood of experiencing diarrhea, having hand washing equipment and washing hands after toilet use significantly lowers the likelihood of having diarrhea episode 0.21 (0.13 – 0.35; *P*=0.001) and 0.57 (0.34 – 0.96; *P*=0.05). After adjustment of all variable open defecation remained significant and 1.78 (0.94 – 3.37; *P*=≤ 0.10) while hand washing attenuated significally 0.17 (0.10 – 0.30; *P*=0.001).

In addition, the findings showed that age of household head was associated with occurrence of diarrhea with the house hold heads who were between 25-30 years and above 36 years being 0.41 (0.21 – 0.79; p=0.01) and 0.46 (0.22 – 0.94; p=0.05) times less likely to have under-five children experiencing diarrhea episodes. After adjustment of all variables, all age groups remained significant.

Table 4. Adjusted logistic regression of diarrhea occurrence among under-five children in East Pokot sub-county

Variables	AOR(95% CI)	AOR(95% CI)
Defecation		
Latrine	1	1
Open defecation	1.75 (0.95 – 3.22)*	1.78 (0.94 – 3.37)*
Hand washing facility		
No	1	1
Yes	0.21 (0.13 – 0.35)****	0.17 (0.10 – 0.30)****
Wash hand after toilet use		
No	1	1
Yes	0.57 (0.34 – 0.96)**	0.65 (0.38 – 1.12)
Wash hand after helping child to use toilet		
No	1	1
Yes	0.81 (0.46 – 1.43)	0.84 (0.44 – 1.62)
Wash hand with soap		
No	1	1
Yes	0.71 (0.44 – 1.15)	0.69 (0.43 – 1.13)
Wash hand before cooking		
No	1	1
Yes	0.70 (0.38 – 1.30)	0.90 (0.45 – 1.78)
Wash hand before eating		
No	1	1
Yes	1.66 (0.60 – 4.61)	1.94 (0.70 – 5.43)
Age of household head		
< 25	1	1
25-30	0.41 (0.21 – 0.79)***	0.40 (0.20 – 0.78)***
31-36	0.60 (0.31 – 1.18)	0.55 (0.28 – 1.10)*

Variables	AOR(95% CI)	AOR(95% CI)
> 36	0.46 (0.22 – 0.94)**	0.47 (0.23 – 0.98)**
Marital status		
Married		1
Single		0.86 (0.29 – 2.52)
Source of income		
Livestock		1
Employment		0.92 (0.46 – 1.88)
Other		0.64 (0.33 – 1.24)
Child's gender		
Male		1
Female		1.27 (0.79 – 2.06)
Child started school		
No		1
Yes		1.08 (0.59 – 1.96)

* ≤ 0.10; ** ≤ 0.05; *** ≤ 0.01; **** ≤ 0.001

DISCUSSION

Several strategies have been identified to reduce the prevalence of diarrhea among under-five children. Among these strategies are the hygiene practices. However, the actual practices among populations are still elusive. Therefore, this study sought to identify the hygiene practices that are associated with diarrhea among under-five children in the last 2weeks in East Pokot sub-location.

Various socio-demographic characteristics of caregivers were assessed in this study such as Age, marital status, source of income and area of residence (ward). However, only age and ward of residence were found to be statistically significant after adjustment of all variables. Interestingly, majority of the children who had diarrhea in the last two weeks had caregivers who were 25 years and below and from Ripkwo ward. According to this study, caregivers age was an important indicator since caregivers of 25 years and above, were less likely to have a child with diarrhea episode in the last 2 weeks. This finding was consistent with other studies (Magadi, 2004; Tareke et al., 2022) that showed that the older a caregiver gets the more confident they are in handling children, they have more experience as well as knowledge that they can put into practice to enable them prevent diarrhea episodes among the children(Pathela et al., 2006). This study also showed that most children in Ripkwo ward experienced diarrhea episodes. The most probable reason could be because of the frequent movements from one place to another in search of pasture for the livestock, making it difficult to maintain high standards of hygiene. On the other hand, source of income was not significant. This finding contradicts that of other studies on factors associated with diarrhea. From this study, the findings show that the caregivers with a source of income were less likely to have children with diarrhea occurrence even though the findings were not significant. While other studies have insinuated that caregivers with an income could be better placed to care for the children by seeking appropriate care(Alauddin & Haque, 2021; Woldu et al., 2016). Another study did not find any association between source of income and diarrhea occurrence (Godana & Mengistie, 2013). These disparities could be because of the study design as well as the maternal related experiences in child care.

Open defecation has been shown to be a key risk factor for diarrhea. The findings from this study also showed a similar trend- majority of the participants practiced open defecation and the children experienced diarrhea in the last 2weeks. Open defecation still remained significant even after adjustment of all variables where the children were 1.78 times more likely to have an occurrence of diarrhea in the last 2 weeks. This finding was in tandem with a study that was conducted in Kenya using the KDHS data. This study observed that many caregivers often disposed child's faecal matter in an open environment- a practice that most likely increases the risk of contamination that results to diarrhea in children (Mulatya & Ochieng, 2020). Other works also observed that many (5.6 million) Kenyans as well as other populations still practice open defecation (Busienei et al., 2019; Tamilarasan et al., 2022; Water and Sanitation Program, 2012). This means that open defecation is still an issue that needs to be dealt with especially in the Low- and Middle-Income Countries (LMIC). And identifying the reasons why communities still practice open defecation would be important in determining suitable interventions that are community tailored.

Hygiene practices related to hand washing were also evaluated in this study. The findings showed that while having handwashing facility was significant, washing hand after toilet use, washing hands after helping child use the toilet and washing hands with soap only had a significant trend. However, when assessing for an association with diarrhea occurrence, these practices were found to lower the risk of diarrhea occurrence among children before adjusting for confounders. After adjustment, only having hand washing facility remained significant. Hand washing has been shown to be a critical practice in breaking the transmission cycle of infectious agents(Ejemot-Nwadiaro et al., 2021) These findings were similar to those in a randomized control trial conducted in Ethiopia, systematic review, a study in Congo and a study on hand washing facilities in Lao People's Democratic Republic (PDR) . These studies found that hand washing with soap and water lessened the risk of diarrheal occurring among under-five children (Ejemot-Nwadiaro et al., 2021; Ephrem Tefera et al., 2021; Noguchi et al., 2021). Furthermore, other hygiene practices such as washing hands before, during and after handing food could be additional beneficial practices even though they were not significant in this study. The most probable reason why hand washing facility was significant is because it encourages hand washing practice. It is a common practice that toilets are built with hand washing devices that is taps. However, in rural areas having these facilities in different locations within the homesteads can easily encourage proper handwashing practices.

CONCLUSION

Diarrhea still remains a threat among children under five. Areas that still practice open defecation with poor hygiene practices such as handwashing stand a risk of increasing the diarrhea incidences that could possibly result to morbidity and mortality among the under-five.

RECOMMENDATION

This study therefore recommends health education on the detriments of open defecation while encouraging community members and most importantly young caregivers on the benefits of handwashing practices and supporting community members to build latrines for safe disposal of faecal matter. In addition, qualitative study exploring reasons for open defecation and the importance of hand washing equipment should also be considered.

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), e0182783. https://doi.org/10.1371/journal.pone.0182783

Alauddin, S., & Haque, M. E. (2021). Socioeconomic Determinants of Diarrhea among Under-Five Children in Bangladesh: Do Education and Wealth Matter? *Journal of Maternal and Child Health*, *6*(4), Article 4. https://www.researchgate.net/publication/354582278

Baringo County Government, UNICEF, World Vision, & National Drough Management Authority. (2016). *SMART SURVEY FINAL REPORT EAST POKOT SUB COUNTY BARINGO COUNTY*. https://docplayer.net/159577367-Smart-survey-final-report-east-pokot-sub-county-baringo-county-july-2016.html

Boutayeb, A. (2010). The Burden of Communicable and Non-Communicable Diseases in Developing Countries. Handbook of Disease Burdens and Quality of Life Measures. *Nature Public Health Emergency Collection*, 531–546. https://doi.org/10.1007/978-0-387-78665-0_32

Busienei, P., Ogendi, G., & Mokua, M. (2019). Latrine Structure, Design, and Conditions, and the Practice of Open Defecation in Lodwar Town, Turkana County, Kenya: A Quantitative Methods Research. *Environmental Health Insights*, *13*, 1178630219887960. https://doi.org/10.1177/1178630219887960

Cha, S., Lee, J. E., Seo, D. S., Park, B. M., Mansiangi, P., Hwang, J., & Lee, J. (2017). Associations between Household Latrines and the Prevalence of Diarrhea in Idiofa, Democratic Republic of the Congo: A Cross-Sectional Study. *The American Journal of Tropical Medicine and Hygiene*, *97*(2), 460–468. https://doi.org/10.4269/ajtmh.16-0361

Daniel, W. W. (1999). *Biostatistics: A foundation for Analysis for the Health Sciences* (7th ed.). John Wisley & Sons.

Ejemot-Nwadiaro, R., Ehiri, J., Arikpo, D., Meremikwu, M., & Critchley, J. (2021). Hand-washing promotion for preventing diarrhoea. *Cochrane Database of Systematic Reviews*, *1*. https://doi.org/DOI: 10.1002/14651858.CD004265.pub4.

Ephrem Tefera, S., Sirak Robele, G., Helmut, K., & Bezatu Mengistie, A. (2021). Handwashing effect on diarrheal incidence in children under 5 years old in rural eastern Ethiopia: A cluster randomized controlled trial. *Tropical Medicine and Health*, *49*(1), 26. https://doi.org/10.1186/s41182-021-00315-1

Godana, W., & Mengistie, B. (2013). Determinants of acute diarrhoea among children under five years of age in Derashe District, Southern Ethiopia. *Rural and Remote Health*, *13*(3), 2329.

KNBS, & ICF. (2023). *Kenya Demographic and Health Survey 2022. Key Indicators Report*. https://dhsprogram.com/pubs/pdf/PR143/PR143.pdf

Magadi, M. (2004). *Maternal and Child Health among the Urban Poor in Nairobi, Kenya*. https://tspace.library.utoronto.ca/handle/1807/5832

Mulatya, D. M., & Ochieng, C. (2020). Disease burden and risk factors of diarrhoea in children under five years: Evidence from Kenya's demographic health survey 2014. *International Journal of Infectious Diseases*, *93*, 359–366. https://doi.org/10.1016/j.ijid.2020.02.003

Noguchi, Y., Nonaka, D., Kounnavong, S., & Kobayashi, J. (2021). Effects of Hand-Washing Facilities with Water and Soap on Diarrhea Incidence among Children under Five Years in Lao People's Democratic Republic: A Cross-Sectional Study. *International Journal of Environmental Research and Public Health*, *18*(2), 687. https://doi.org/10.3390/ijerph18020687

Ogbo, F. A., Agho, K., Ogeleka, P., Woolfenden, S., Page, A., & Eastwood, J. (2017). Infant feeding practices and diarrhoea in sub-Saharan African countries with high diarrhoea mortality. *PLoS ONE*, *12*(2), e0171792. https://doi.org/10.1371/journal.pone.0171792

Pathela, P., Zahid Hasan, K., Roy, E., Huq, F., Kasem Siddique, A., & Bradley Sack, R. (2006). Diarrheal illness in a cohort of children 0–2 years of age in rural Bangladesh: I. Incidence and risk factors. *Acta Paediatrica*, *95*(4), 430–437. https://doi.org/10.1111/j.1651-2227.2006.tb02257.x

Tamilarasan, M., Maniprabhu, S., Kulothungan, K., George, N., & Dharmaraj, R. B. (2022). The Use of Sanitary Latrines and the Practice of Open-Air Defecation in a Rural Setup in Perambalur District: A Cross-Sectional Study. *Cureus*, *14*(12), e32547. https://doi.org/10.7759/cureus.32547

Tareke, A. A., Enyew, E. B., & Takele, B. A. (2022). Pooled prevalence and associated factors of diarrhea among under-five years children in East Africa: A multilevel logistic regression analysis. *PLOS ONE*, *17*(4), e0264559. https://doi.org/10.1371/journal.pone.0264559

United Nations. (2011). *Countries facing double burden with chronic and infectious diseases* (Global Perspective Human Stories) [UN news].

Water and Sanitation Program, W. (2012). *Economic Impacts of Poor Sanitation in Africa: Kenya*. https://www.zaragoza.es/contenidos/medioambiente/onu/825-eng-v6.pdf

Woldu, W., Bitew, B. D., & Gizaw, Z. (2016). Socioeconomic factors associated with diarrheal diseases among under-five children of the nomadic population in northeast Ethiopia. *Tropical Medicine and Health*, *44*(1), 40. https://doi.org/10.1186/s41182-016-0040-7

World Health Organization. (2011). *World health statistics 2011*. https://apps.who.int/iris/handle/10665/44552

World Health Organization. (2018). *Managing epidemics: Key facts about major deadly diseases*. World Health Organization.

World Health Organization. (2020). *Global Health Estimates 2019: Life expectancy and leading causes of death and disability*. (https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates,

World Health Organization. (2023). *Child mortality and causes of death* (The Global Health Observatory Data).

World Health Organization. (2017). *Diarrhoeal disease*. https://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease