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Sanitation risk factors contributing to diarrhea in children below five years in Igembe South Sub-County, Meru County, Kenya

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ABSTRACT

Introduction: Lack of safe water, poor hygiene and sanitation accounts for about 90% of the diarrheal diseases in the world. Globally, half a million people lack adequate sanitation, leading to fatalities for over five million people annually. In Kenya, diarrhea still remains one of the top five causes of morbidity and mortality in children below 5 years.

Aims: To identify the household sanitation risk factors contributing to diarrhea in under-five years' children in Igembe South Sub County in Meru County, Kenya.

Study Design: A retrospective and cross sectional study. Place and Duration of the study: Nyambene Sub-County Hospital, Igembe South Sub-County in Meru County, Kenya between December 2022 and March 2023.

Methodology: The sample size was 196 children calculated from a population of 3,332 children who had diarrhea in Igembe South Sub County out of a total of 22412 children who had diarrhea in Meru County for the last one year. Data was analyzed by use of SPSS (2022) and ANOVA.

Results: The study found a strong link (p=0.0034) between diarrhea cases in children under-five and the absence of household latrines, as well as sanitation-related factors. It noted that a significant percentage of households lacked proper latrines, and many caregivers did not practice hand washing after handling child feces.

Conclusion: The study identified access to safe drinking water as a key factor in reducing diarrhea in young children. The study recommends close monitoring of sanitation facilities and ongoing assessments of water source safety by the County Government of Meru and other stakeholders to improve overall hygiene and reduce diarrhea cases in the region.

Introduction

Sanitation is basic and essential for human health. However, lack of sanitation and hygiene is a major public health problem citation. A number of household sanitation factors in the environment are responsible for the occurrence of diarrhea among the under five children. Important factors revolve around sanitation facilities and include, toilet/latrine utilization, availability, and method of child waste disposal (McClelland et al., 2022). It is vital to understand that the influence of environmental factors to household sanitation

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is complex and that they are conditioned by various behaviors which are economic and demographic in nature.

Poor utilization of latrines causes a serious health risk of excreta borne diseases (Busienei, 2019). Owning a latrine has been described as a source of comfort as it prevents one from being exposed to elements such as thorns and dirt. It also provides privacy, especially for women and young girls since it prevents them from exposing their body parts (Busienei, 2019). Therefore, construction of toilets both by individual households and the community as well as the governments is essential for catering for daily sanitation needs and ending the practice of open defecation (OD). The household owning aged or dilapidated latrines most probably preferred to engage in open defecation hence increasing the risk of diarrhea disease. In Ethiopia the availability of latrines could not guarantee proper utilization (Belachew et al., 2018). Belay and Ashenafi (2021) suggest that in many low-income settings, nappies (diapers or clothes) and potties are rarely available for use, making the hygienic collection of young children's feces difficult. If collected, such feces are often disposed of in a manner that does not prevent further exposure to household members or contamination of water sources.

The availability of safe drinking water, which is a key sanitation commodity, has been documented to significantly influence the prevalence of children below five years of age (Turyare et al., 2020). Chege indicates that the dependence of open water source contaminated with fecal materials was found to be a major course of the rising prevalence of childhood diarrhea in Nakuru, Kenya (Chege et al., 2020). Intervention for the prevention and control of diarrhea disease not only include enhanced water quality but also steps to enhance water safety through treatment (Kimani et al., 2019). For example, Kimani *et al.* (2019) revealed that water treatment practices and methods were observed to present a risk for child hood diarrhea.

Washing hands with soap and water removes the bacteria, viruses, and parasites that cause diseases (Malabadi et al., 2021). To be effective, some of the components like water supply, presence of hand washing facilities, presence of soap and water as well as adhering to the right process of hand washing have to function in coordination with each other. Hand washing with soap and water can significantly reduce diarrhea episodes in children under five years old (Solomon *et al.*, 2021). A study done by Cha *et al.* (2021) showed that hand washing programs and facilities in schools and day care centers in high income countries reduced the number of times children had diarrhea (Murphy *et al.*, 1993).

Methodology

This study was conducted in Nyambene Sub County Hospital, located in Maua Town, in Igembe South Sub County, Meru County, Kenya. Population based retrospective study was undertaken in Nyambene Sub County Hospital for children aged under 5 years diagnosed and treated of diarrhea in the facility between December 2022 and March 2023. A cross sectional study design was used whereby these cases were followed up in their homes where household sanitation as well as water and hygiene data were collected through a questionnaire and observations. The study targeted children aged 0-59 months, their mothers and caregivers. Using Fisher formula, (Donner & Eliasziw, 1987), a sample size of 196 was drawn from a target population of 3332 children who had diarrhea in Igembe South Sub County out of 22412 children who had diarrhea in Meru County for the last one year (Ministry of Health, 2020)

Results

Child's Immunization Status and Rota Virus Antigen Administered

The mother and child booklet was reviewed to assess the immunization status and if the child was vaccinated against *Rota virus*. According to the findings, 75.5% (n= 148) of the children were

Immunization status	Frequency	Percent
Partially immunized	148	75.5
Fully Immunized	48	24.5
Total	196	100
***Rota virus* Dose Administered**		
1st dose	124	63.3
2nd dose	37	18.9
Both doses given	24	12.2
None given	11	5.6
Total	**196**	**100**

Table 1: *Child's Immunization Status and Rota Virus Antigen administered*

Latrine availability	Frequency	Percent
Available	138	70.4
Not Available	58	29.6
Total	196	100
Type of Latrine		
Improved	113	57.7
Unimproved	83	42.3
Total	196	100
Description of Latrine's Floor Surface		
Wood	62	31.6
Cement slab	122	62.2
Others	12	6.1
Total	196	100
Cleanliness of Household Latrine		
Presence of stool on the hole	109	55.6
No stool on the hole	87	44.4
Total	196	100

Table 2: *Availability of latrines and latrine characteristics*

partially immunized while only 24.5% (n= 48) of the children were fully immunized with *Rota virus*.

In respect to Rota virus antigen administered, data obtained from the mother child booklet (table 1), indicated that 63.3% (n= 124) of the children had received the first dose of *Rota virus*, 18.9% (n= 37) had received second dose and 12.2% (n= 24) had received both doses. It is worth noting that 5.6% (n= 11) had not received any dose. These results indicate that Rota virus antigen had a high penetration in the Sub County. Only 18.9% of the cases had not received any dose of the antigen. It is worth noting that only 5.6% of the children had not received any dose of Rota virus vaccine. (see table 1)

Availability of latrines and latrine characteristics

Regarding availability of latrines in the household, 70.4% (n = 138) of the households had a latrine and 29.6% (n = 58) had none. For the purpose of this study, latrine were categorized into two, improved and unimproved. Improved latrines refer to sanitation facilities that hygienically separate human waste from human contact. Unimproved latrines refer to sanitation facilities that do not provide separation of human waste from human contact. Results in table 2 indicate that 57.7% (n= 113) of the household latrines were improved while 42.3% (n= 83) were unimproved.

In respect to description of latrine's floor surface, 62.2% (n= 122) of the households had latrines made of cement slab and 31.6% (n= 62) had latrines made of wood floor (Results displayed in table 2). A small proportion of the households 6.1% (n= 12) had their latrines floor made from other materials. For purposes of this study, the concern was presence of stool on the hole. As shown in Table 2, 55.6% (n= 109) of the household latrines observed had stool on the hole while 44.4% (n= 87) of the households' latrines had no stool observed on the hole. (see Table 2).

Variable	Frequency	Percent
Mode of Collection		
Diaper	89	45.4
Clothes	24	12.2
Nappies	49	25
Tissue paper	12	6.1
Leaves	22	11.2
Total	196	100
Disposal Management Practice		
Pit latrine	86	43.9
Burning	14	7.1
Burying	73	37.2
Storing in container and dispose later	12	6.1
Throwing into water bodies	11	5.6
Total	196	100
Caregiver handling		
Mother	89	45.4
Father	11	5.6
Siblings	36	18.4
Caretaker	60	30.6
Total	196	100

Table 3: *Mode of Collection and disposal of child's fecal matter*

Hygiene Practices	Frequency	Percent
Hand washing		
Yes	135	68.9
No	61	31.1
Total	196	100
Visible fecal matter		
Yes	59	30.1
No	137	69.9
Total	196	100
Overflow of latrine/septic tank		
Yes	112	57.1
No	84	42.9
Total	196	100.0

Table 4: *Hygiene Practices around Handling Children fecal matter*

Mode of Collection and disposal of child's fecal matter

The caregivers were asked to state the mode of feces collection for children below age five years. As shown in Table 3, 45.4% (n= 89) of the caregivers utilized diapers, 25.0% (n= 49) nappies, 12.2% (n= 24) utilized clothes, 11.2 %(n=22) while 6.1% (n=12) used tissue papers. In regard to child fecal disposal practices, 43.9% (n= 86) of the caregivers indicated that they utilized pit latrine, 37.2% (n= 73) specified burying and 7.1% (n= 14) stated burning (Table 3). Moreover, 6.1% (n= 12) of the caregivers indicated that they stored child feces in container and disposed later while 5.6% (n= 11) attested that they threw child feces into water bodies. These results signify that majority of the participants adopted hygienic child feces disposal practices. Only a small proportion of the participants specified that they threw child feces into water bodies. However, though the proportion of caregivers who specified risky child feces disposal practices was 6.1% (n=11), the health risk presented was very high. Any contamination of water bodies could potentially affect a huge population. The participants were asked to state the caregiver who usually handles child feces disposal. As shown in Table 3, 45.4% (n= 89) of the caregivers handling child feces disposal were the child's mother, 30.6% (n= 60) were caretakers, 18.4% (n= 36) were siblings and 5.6% (n= 11) were father to the child. See table 3.

Hygiene Practices Related to Handling of Fecal Matter and Latrine Overflow

In respect to hygiene practices around handling children feces, 68.9% (n= 135) of the caregivers reported that they washed their hands after handling child feces while 31.1% (n= 61) attested that they did not

			Diagnosis made	Rota virus antigen
Spearman's rho	Diagnosis made	Correlation Coefficient	1.000	**.650**
		Sig. (2-tailed)	.	.039
		N	196	196
	Rota virus antigen	Correlation Coefficient	**.650**	1.000
		Sig. (2-tailed)	.039	.
		N	196	196

Table 5: *Correlations*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.87[a]	.35	.40	.42074

Predictors: (Constant), Presence of fecal matter in the compound, Water storage facilities, Rota virus antigen, Presence of hand washing facilities, Water source, Distance from water source

Table 6: *Model Summary*

wash their hands. (Table 4). The cleanliness status of the household compound by use of a checklist. Table 4 shows that 69.9% (n= 137) of the household compounds had no visible fecal matter in the compound while 30.1% (n= 59) of the household had fecal matter in the compound. The participants were asked whether their latrine/septic tank has ever experienced overflow. As shown in Table 4, 57.1% (n= 112) of the households had experienced overflow of latrine/septic tank while 42.9% (n= 84) stated that they had not experienced any overflow.

Hypothesis Testing

To test whether there is a relationship between Rota Virus Antigen and diagnosis of diarrhea spearman's correlation coefficient was carried out and the results are presented in table 5 below.

H_o: There is no statistically significant relationship between Rota Virus Antigen and diagnosis of diarrhea.

H_1: There is a statistically significant relationship between *Rota virus* antigen and diagnosis of diarrhea.

The correlation between Rota virus antigen and diagnosis of diarrhea was measured at 95 % level of confidence. From the table 5, the value of computed significance is 0.039, which is less than 0.05. Therefore, we reject the null hypothesis (H_0) and accept the alternative hypothesis (H1) and therefore there is a statistically significant relationship between Rota virus antigen and diagnosis of diarrhea. The exact value of the correlation coefficient was 0.650 therefore there is a moderately strong positive relationship between Rota virus antigen and diagnosis of diarrhea

Regression Analysis

Regression analysis is used to predict the values of a dependent variable given the values of one or more independent variables by calculating a regression equation. If the value of R2 is large, there is a better chance of regression model fitting the observations. R-Squared (R^2 or the coefficient of determination) is a statistical measure in a regression model that determines the proportion of variance in the dependent variable that can be explained by the independent variable. In other words, r-squared shows how well the data fit the regression model (the goodness of fit). Adjusted R-Square is the proportion of variance in the depend-

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1.211	6	.202	1.141	.0034[b]
Residual	33.457	189	.177		
Total	34.668	195			

Table 7: *ANOVA.*
Dependent Variable: Diagnosis made. Predictors: (Constant), Presence of fecal matter in the compound, Water storage facilities, Rota virus antigen, Presence of hand washing facilities, Water source, Distance from water source

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.952	.285		6.857	**.000**
Rota virus antigen	.005	.034	.010	.135	**.008**
Distance from water source	.166	.100	.171	1.658	**.009**
Water source	-.060	.039	-.141	-1.527	**.001**
Water storage facilities	-.114	.063	-.190	-1.805	**.003**
Presence of Hand washing facilities	-.025	.071	-.030	-.356	**.002**
Presence of fecal matter in the compound	-.115	.075	-.126	-1.538	**.006**

Table 8: *Coefficients*
Dependent Variable: Diagnosis made independent variable; distance from the water source, water storage facilities, presence of hand washing facilities, presence of fecal matter in the compound.

ent variable (Diagnosis made) which can be predicted from the independent variables (Presence of fecal matter in the compound, Water storage facilities, Rota virus antigen, Presence of hand washing facilities, Water source, Distance from water source). This value indicates that 40.0% of the variance in diagnosis made can be predicted from the variables (Presence of fecal matter in the compound, Water storage facilities, Rota virus antigen, Presence of hand washing facilities, Water source, Distance from water source).

ANOVA

From the ANOVA table, the F value of 1.141 with (6, 189) degrees of freedom was found to be significant since the p-value was 0.0034 which is less than 0.05. This implies that the independent variables (Presence of fecal matter in the compound, Water storage facilities, Rota virus antigen, Presence of hand washing facilities, Water source, Distance from water source) have a positive significant relationship to the Diagnosis made

Coefficients

Based on the regression analysis, the following hygiene and sanitation related factors were reported to significantly influence the prevalence of diarrhea among children below 5 years; hand washing before preparing the baby's food (p = 0.048) and source of household water (p = 0.042). On the other hand; hand washing after visiting the toilet, hand washing after changing diapers and feces disposal method had no significant influence on the prevalence of diarrhea among children below 5 years

Discussion

Child's Immunization Status and Rota Virus Antigen Administered

From the findings, *Rota virus* antigen had a high penetration in the Sub County. However, most of the cases diagnosed with diarrhea in the Sub County could have been prevented if the children were fully immunized. The results support the finding of Wolde *et al.* (Wolde et al., 2022) who established that partially immunized children were found to be in an increased risk for diarrhea, which was at 30% as compared to fully immunized children whose risk was at 21.83%.

Availability of Latrines and Latrine Characteristics

Studies indicate that basic sanitation is considered the lowest cost technology ensuring hygienic excreta disposal and a clean and healthful environment within the households and neighborhood community Murad *et al*. (Murad et al., 2022). This could be a factor contributing to the high prevalence of diarrhea cases among children aged below five years in Igembe South Sub County. The results reflect the assertion of Godwin *et al.* (2017) who posited that the goal of improved sanitation is to hygienically separate human excreta from human contact and therefore reduce exposure to fecal contamination. Further, a study in Ethiopia revealed that the availability of latrines could not guarantee proper utilization (Belachew et al., 2018). Further, results indicate 31.6% (n=62) of the households' latrines had floor surface made of wood, which is difficult to clean as compared to cement slab. Subsequently, 55.6% (n=109) of the latrines could not be effectively cleaned due to unsuitable floor surface. Hence, this could potentially provide a conducive conditions for pathogens responsible for diarrhea to multiply and thus increase the chances of children below the age of five years being diagnosed with diarrhea. Availability of latrine is not sufficient to hygienically separate human excreta from human contact. The latrine must be put into proper use. Besides, frequent cleaning of the latrine is paramount to ensure that the risks associated with improper latrine use (leading to uncleanliness) are effectively mitigated. These results reflect the finding of Murad *et al.* (2022) who asserted that ownership of a latrine facility does not guarantee health benefits unless the said facility is utilized effectively.

Mode of Collection and Disposal of Child's Fecal Matter

Results from the study indicate that majority of the caregivers utilized unsanitary child waste handling methods. The cumulative caregivers who utilized clothes, leaves and tissue papers was 29.5%. Unhygienic disposal of children feces results to exposure of the household contamination of water sources as well as through fecal oral route contamination. These results concur with those of Baley and Ashenafi who established that in many low-income settings; nappies (diapers or clothes) and potties are rarely available for use, making the hygienic collection of young children's feces difficult (Belay & Ashenafi, 2021). Bitew et al.(Bitew et al., 2017) concluded that unsanitary child waste handling may present a great health risk to children.

In regard to who is responsible for child feces disposal, these results imply that child feces disposal was predominantly a duty of the child's mother, caretaker or sibling. Fathers accounted for only a 20% of the instances. This was in agreement with Maluni (2022) who reported that proper disposal is that which includes burning, burying in a pit or storing in container and disposing in designated site by the mother or caregiver.

Hygiene Practices Related to Handling Fecal Matter

In regard to handling of fecal matter, results suggest that a significant proportion of the caregivers did not observe hygiene practices around handling children feces. Some of the caregivers attested that they did not wash their hands after handling child's feces, an indication, there was

limited information in the Sub County in regard to importance of hand washing. These results are suported by Solomon *et al.* (2021) who established that the effectiveness of hand washing may be reduced by ignorance. Subsequently, the high prevalence of caregivers not washing their hands after handling children feces could be among the factors contributing to high prevalence in diarrhea of children below age five years. It was also in agreement with Moosan & Nair (2015) who established that hand washing with soup and water removes bacteria , viruses and parasites that course diarrhea disease. A significant proportion of the household did not observe hygienic practices in respect to proper child's fecal disposal since 30.1% (n= 59) of the household had fecal matter in the compound. This was in agreement with Maluni (Maluni, 2022) Who reported that proper disposal is that which includes burning, burying in a pit or storing in container and disposing in designated site.

Latrine Overflow

The results revealed that 57.1 % (n=112) of the households had experienced overflow. This is a direct association to childhood diarrhea due to contamination of water bodies. The results agree with Bitew et al.,(Bitew et al., 2017) who indicated that several household, water and hygiene predictors are directly or indirectly associated with diarrheal diseases. These include child age, residential, urban/ rural, drinking water quality, stool disposal site, and sanitation conditions that lead to contamination of water bodies. Similarly, a study by Ashenafi *et al*., (Belay & Ashenafi, 2021) in Wondo Genet district in South Ethiopia indicated that people who experienced a toilet /latrine overflow were 56.7% likely to get bouts of diarrhea. This was due to poor utilization of the latrines by users leading to open defecation as well as contamination of environment and water bodies.

Conclusion

It was concluded that basic sanitation is paramount in ensuring hygienic excreta disposal and a clean and healthful environment within the households, which ultimately curbs cases of diarrhea among children below age five years.

Hence, construction of latrines both by individual households and the community as well as the governments is essential for catering for daily sanitation needs and ending the practice of open defecation.

References

Ashenafi, T., Dadi, A. F., & Gizaw, Z. (2018). *Latrine utilization and associated factors among Kebeles declared open defecation free in Wondo Genet*. *5*(November), 43–51. https://doi.org/10.5897/ISAAB-JHE2018.0050

Belachew, A., Abrha, M. B., & Yemane, D. (2018). *Availability and utilization of sanitation facilities in Enderta district , Tigray , Ethiopia*. *October*. https://doi.org/10.15167/2421-4248/jpmh2018.59.3.826

Belay, S., & Ashenafi, M. (2021). Food safety, Hygiene and Sanitation Status of Micro and Small Food Service Enterprises Managed by Food-Insecure Households: The Case of Lideta Sub-City, Addis Ababa. *Ethiopian Journal of Development Research*, *43*(1), 83–115. http://ejol.aau.edu.et/index.php/EJDR/article/view/4267

Bitew, B. D., Getachew, A., & Azanaw, J. (2023). Diarrhea Prevalence and Associated Factors among Children in Azezo Sub-City, Northwest Ethiopia: A Community-Based Cross-Sectional Study. *American Journal of Tropical Medicine and Hygiene*, *109*(2), 429–435. https://doi.org/10.4269/ajtmh.22-0192

Bitew, B. D., Woldu, W., & Gizaw, Z. (2017). *Childhood diarrheal morbidity and sanitation predictors in a nomadic community*. 1–8. https://doi.org/10.1186/s13052-017-0412-6

Busienei, P. J. (2019). *Latrine Structure , Design , and Conditions , and the Practice of Open Defeca-*

tion in Lodwar Town , Turkana County , Kenya : A Quantitative Methods Research. https://doi.org/10.1177/1178630219887960

Chege, N. M., Ondigo, B. N., Onyambu, F. G., Kattam, A. M., Lagat, N., Irungu, T., & Matey, E. J. (2020). The prevalence of intestinal parasites and associated risk factors in school-going children from informal settlements in Nakuru Town, Kenya. *Malawi Medical Journal*, *32*(2), 80–86. https://doi.org/10.4314/mmj.v32i2.5

Donner, A., & Eliasziw, M. (1987). Sample size requirements for reliability studies. *Statistics in Medicine*, *6*(4), 441–448. https://doi.org/10.1002/SIM.4780060404

Godwin, A., Handsome, O. E., Ayomide, W. A., Enobong, A. E., & Johnson, F. O. (2017). Application of the Henri Fayol Principles of Management in Startup Organizations. *IOSR Journal of Business and Management*, *19*(10), 78–85. https://doi.org/10.9790/487X-1910047885

Kimani, H. M., Akunga, D. N., Anyango, S. O., & Ndwiga, T. (2019). *Diarrhea Risk Factors Associated with Water , Sanitation and Hygiene Among the Under Five in Kasarani , Nairobi County Diarrhea Risk Factors Associated with Water , Sanitation and Hygiene Among the Under Five in Kasarani , Nairobi County*. *January*. https://doi.org/10.11648/j.cajph.20190506.18

Maluni, J. K. (2022). *Disposal of Disposable Child Diapers by Caregivers and Their Environmental Health Implications in Kenya : A Review*. *March*.

McClelland, P. H., Kenney, C. T., Palacardo, F., Roberts, N. L. S., Luhende, N., Chua, J., Huang, J., Patel, P., Sanchez, L. A., Kim, W. J., Kwon, J., Christos, P. J., & Finkel, M. L. (2022). Improved Water and Waste Management Practices Reduce Diarrhea Risk in Children under Age Five in Rural Tanzania: A Community-Based, Cross-Sectional Analysis. *International Journal of Environmental Research and Public Health*, *19*(7), 1–18. https://doi.org/10.3390/ijerph19074218

Ministry of Health, M. C. (2020). *Diarhoea Prevalence in Meru County*.

Moosan, H., & Nair, S. (2015). *Hand washing and public health*. *November*.

Murad, M., Ayele, D. M., Gobena, T., & Weldegebreal, F. (2022). Latrine Utilization and Its Associated Factors Among Community Led Total Sanitation Implemented and Non-Implemented Kebeles of Tullo District, West Hararge, Eastern Ethiopia. *Environmental Health Insights*, *16*. https://doi.org/10.1177/11786302221091737

Solomon, E. T., Gari, S. R., Kloos, H., & Alemu, B. M. (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), 1–11. https://doi.org/10.1186/s41182-021-00315-1

Wolde, D., Tilahun, G. A., Kotiso, K. S., Medhin, G., & Eguale, T. (2022). The Burden of Diarrheal Diseases and Its Associated Factors among Under-Five Children in Welkite Town: A Community Based Cross-Sectional Study. *International Journal of Public Health*, *67*(October), 1–9. https://doi.org/10.3389/ijph.2022.1604960