Water, Sanitation and Hygiene Indicator Levels Eight Years Post Community-Led Total Sanitation Implementation in Kajiado County, Kenya

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Summary

BACKGROUND

The United Nations Sustainable Development Goal (SDG) 3 and 6 aim to improve people's health and wellbeing, as well as expand universal access to safe water and sanitation by 2030. The government of Kenya adopted Community-Led Total Sanitation (CLTS) as an approach to meet these goals. We assessed Water Sanitation and Hygiene (WASH) levels eight years post-CLTS implementation in Kajiado County, inhabited by pastoralists with higher WASH needs in Kenya where two sub-locations were selected.

MATERIALS AND METHODS

Through systematic random sampling, we selected 259 household heads from which we collected quantitative data. We collected qualitative data from 16 focus group discussions (FGDs) with the communities. While we analyzed quantitative data using STATA version 15.1 using logistic regression analyses, QSR NVivo version12 analyzed qualitative data. Household latrine ownership was low at 30%.

RESULTS

Only 9% of these latrines contained a handwashing station, of which 86% were functional with water. Over half (50.8%) of the households practised open defecation. A majority (61.4%) of the households fetched water for household use from improved sources. While only 17.4% of households treated their water before drinking mainly through boiling, our water bacteriological analysis detected widespread contamination. We reported a 45.1% prevalence of diarrhoea cases among under-five-year-old children at the time of the study, predominantly from Namelok sub-location. Independent significant factors increasing the risk of diarrhoea included the use of unimproved water sources (p=0.032) and taking between half to one hour to access a water source (p=0.008). However, significant protective factors included households in Rombo sub-location (p=0.001), household water treatment (p=0.006), and covering water containers (p=0.013).

CONCLUSION

CLTS approach has not helped households achieve high WASH levels in the study area with the potential for sustaining high diarrhoea prevalence. This highlights the need to focus on increased WASH education and promotion through positive cultural contribution while enhancing access to safe and improved water sources.

Keywords: *Water, Sanitation, Hygiene, Community-Led Total Sanitation*

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Introduction

Accessibility to potable water and improved sanitation is considered a human right[1]. These have informed United Nations (UN), General Assembly's decision to include it among its seventeen Sustainable Development Goals through goals number 3 and number 6, which aim at improving people's health and well-being as well as universal access to safe water and sanitation, respectively, by the year 2030.

According to the 2021 Sustainable Development Goal number 6 Progress report by WHO/UNICEF Joint Monitoring Program, 1 in 4 lacked safe drinking water supply in their homes, nearly half the global population lacked safely managed sanitation, and 1/3rd of the people worldwide could not wash their hands with soap and water within their homes[2].

This lack of improved water, sanitation, and hygiene indicator levels among countries contribute to the global disease burden, including under-five-year-old child mortality, diarrhoea, trachoma infection, and helminthic infections[3]. Accessibility to potable drinking water remains a priority for many low and middle-income countries. In rural parts of developing countries- ponds, shallow wells, and rivers are usually regarded by many as aesthetically acceptable for household water use. Water collected from these sources could, however, harbour disease-causing microorganisms [4].

Open defecation is the practice of relieving oneself in the open fields, open spaces, bushes, or water bodies. An area is considered open defecation-free in the absence of defecation sites around its environs. It, therefore, essentially means that all members of that community have access to and are using a latrine/toilet.[5.] The determinants of open defecation in rural areas include cultural attitudes, social habits, the structural status of latrines, economic status, and educational level [6].

According to WHO Sanitation refers to the provision of facilities and services for the safe disposal of human faeces and urine. Poor sanitation is linked to transmission of diseases such as cholera, dysentery, etc. and is estimated to cause 432000 diarrhoeal deaths annually and is also a major factor in several neglected tropical diseases, including intestinal worms, schistosomiasis, malnutrition, and trachoma It also reduces human well-being, social, and economic development due to impacts such as anxiety, risk of sexual assault, and lost educational opportunities[7].

Despite efforts put in place by the GOK Kajiado County household latrine coverage is estimated at 35% with a majority being in urban and peri-urban areas. As part of its plan of action, Kenya implemented a Community-Led Total Sanitation approach in Kajiado County in the year 2013 as part of its open defecation-free rural Kenya campaign road map campaign [8].

Overtime interventions that emphasize community action and behaviour change as elements of sanitation have proven effective in reducing the health burden[9]. A comprehensive progress assessment of these indicator levels has not been done following CLTS implementation in 2013. Here, we assessed water, sanitation, and hygiene indicator levels in Kajiado County eight years post CLTS implementation to document and describe the progress that could inform policy.

Materials and Methods

Study area

Kajiado County has a population of 1.118M and covers an area of 21,902km2. It borders the Republic of Tanzania to the Southwest, Taita Taveta County to the Southeast, Nairobi City to the Northeast, Kiambu County to the North, Narok County to the West, and has five sub-counties.[10] In the year 2018, Kajiado County with other agencies carried out a survey that revealed that 25% of the under-five-year old children suffered from watery diarrhoea, and 1.9% from bloody diarrhoea based on a two-week recall by the caregiver.[11] Rombo and Namelok sub-locations were the study areas. Rombo sub-location has a household population of 2113, and Namelok sub-location has a household population of 1578. The main economic activities in the area are agricultural farming and livestock farming, and small-scale business.[12]

Study design and setting

This study is quasi-experimental with pre-intervention and post-intervention phases. It utilized both quantitative and qualitative data collection methods. However, this is a presentation of the findings at baseline. Namelok sub-location and Rombo sub-location in Kajiado south are purposively selected because CLTS was piloted in Kajiado South by the Ministry of Health in Kajiado County. However, 58.8% of the residents in Kajiado South still practice open defecation majority of those are in the two sub-locations. [13]

Sampling and study population

In Kajiado South, ten villages were selected purposively from the Namelok sub-location and Rombo sub-location. Each sub-location had five villages; are Engumi, Lemongo, Elarai/Noonkotiak, Endonyo/Osoit, and Risa from Namelok sub-location and Rombo sub-location-Lemongo, Esukuta, Empalankai, Ngasakinoi, and Nasipa.

Pilot testing

A pilot study was carried out in the Kuku sub-location to investigate the feasibility of recruiting household heads, procedures of assessment, and workability of the study tools. Kuku sub-location was selected because it shares similar characteristics with the study areas of Namelok sub-location and Rombo sub-location. The results informed the feasibility of the study and helped in identifying modifications in the study design and data collection tools. Further, for qualitative data triangulation method was used to validate quantitative data.

Data collection

The quantitative and qualitative data were collected separately using the concurrent triangulation method. [14] During quantitative data collection, a questionnaire was used to conduct interviews targeting the head of household or spouse. The questionnaire and observation checklist was administered by trained research assistants using Open Data Kit (ODK), a mobile application used for data collection. The application has a system with in-built quality checks to prevent errors. The research assistants used the study tools to collect data on the household's socio-demographic and socio-economic characteristics, water, sanitation, and hygiene status. The research assistants only interviewed the respondents aged 18 years and above, who had resided in the village two weeks before the start of the study and consented to be interviewed. The team tasked with quantitative data collection was ten in number.

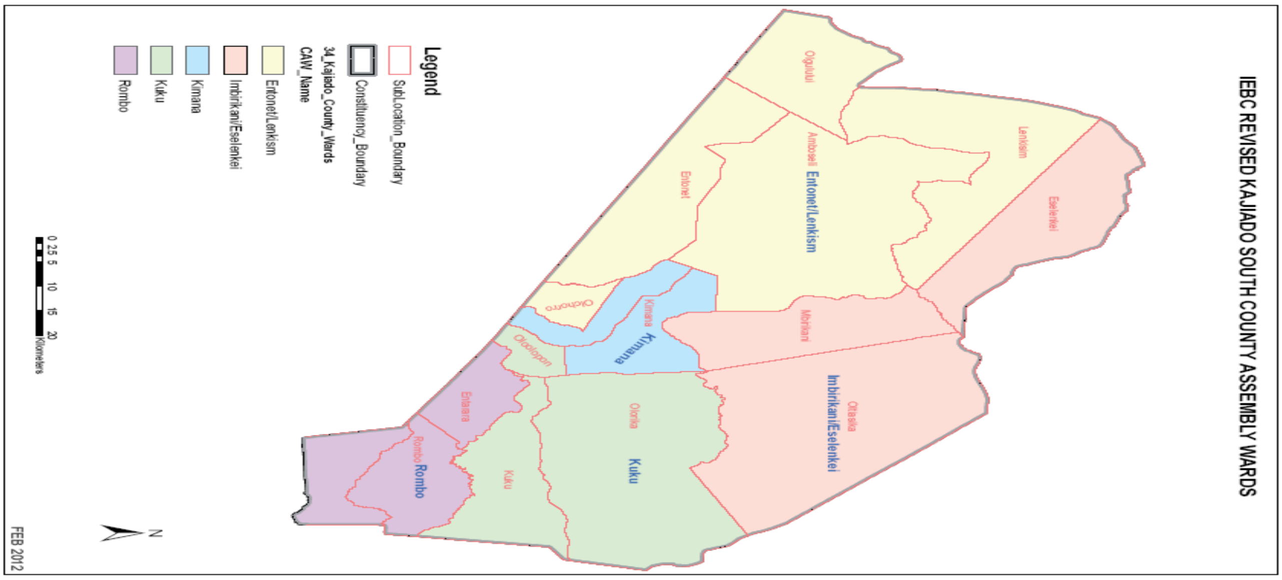

Figure 1:
Map of the Study Area

Each team had a trained research assistant, a community health volunteer (CHV), and a village elder. A supervisor coordinated the teams in the field, ensured that the data was of the quality desired, and ensured transmission to the ODK server.

To get more information qualitative data collection technique was applied to collect data pre-intervention phase through sixteen Focus Group Discussions (FGDs) that had adult male and female single-sex groups. The group discussions provided an insight into the community's perception of safe water, sanitation, and hygiene practices and the incidence of diarrhoea. At the point of saturation, there were no more Focus Group Discussions. The design was iterative. There was a back and forth process, which involved data collection and analysis to inform the selection, therefore, giving early insights and influencing the picking of more participants up to the point where there was no new information coming forth from the discussions. Standard procedures such as; neutrality, probing, allowing the respondents to express themselves without asking leading questions, asking broad questions before specific questions, and varying wordings to avoid repetitiveness were adopted.[15]

The FGDs took between 40 minutes to 1 hour at a quiet and private location. The data collected was moderated by community health assistants assisted by trained research assistants using Maa, the local language. A recorder took notes, and at the same time, audio recordings of the conversations were taking place during the sessions.

The research assistants were trained on both quantitative and qualitative data collection methods for two days before the start of the data collection exercise to enable them to understand the objective of the study, survey protocol, data collection technique, and proper use of the ODK system, voice recorders, and data transcription and translation.

The purposive sampling technique was applied to determine the households chosen for the sampling of water. The water samples were collected from household water storage receptacles and analyzed for Escherichia coli and total coliform bacterial pathogens and their indicators. At the point of collection, safety measures were put in place to avoid contamination. The samples collected were placed under temperatures of 4°C in a cool box and transported for a maximum of 4 hours before laboratory analysis. The use of the membrane filtration technique was adopted as guided by the American Public Health Association (APHA) for bacteriological water analysis. [16]

This involved passing samples through sterile 0.45-µm filters before incubation. The number of cell growth was expressed as colony-forming units per 100 millilitres. For total coliforms and E Coli, the filters were placed onto Chromocult Coliform Agar (Merck) plates and incubated at 37°C for between 18 and 24 hours. Typical colonies appearing pink and dark blue were Total Coliforms, and Escherichia Coli was the blue colonies.

Data management

The hard copies of the qualitative data were stored in lockable and secure cabinets. The recorded data was coded and later transcribed and translated into the English language. To minimize biases - double transcription, translation, and back-translation were conducted. Soft copies of quantitative and qualitative data were stored in computers and password protected with authorized access by the Principal Investigator to ensure quality control.

Statistical analysis

Frequencies means and standard deviations (SD) were calculated for the independent variables. The independent variables are; socio-demographic, socio-economic, and water sanitation and hygiene (WASH) factors. Socio-demographic and socio-economic variables are; age, gender, educational level, marital status, and average monthly expenditure.

Water source factors are; sources of drinking water, time taken to fetch water, whether the water source was improved/ unimproved, whether the water met the needs, and whether the water was made safe for drinking. Sanitation factors are; the presence of a latrine, conditions, the distance from the house, the existence of open defecation sites, and the availability of a handwashing station. Latrine structural conditions; were assessed by the evidence of all the following: roof, walls with no holes, a functional lockable door, and a stable floor slab.[17]

Hygiene factors included whether participants washed their hands after visiting the latrine or after handling children's faeces, and methods of disposing of child faeces. Water quality; was assessed by total coliform counts in 100 ml of untreated water. Total coliform bacteria depicted the type of micro-organisms in the aquatic environment, soil, and vegetation.[18]

The presence of Escherichia coli indicated potential human faecal contamination of the water source. The dependent variable was the incidence of diarrheal cases in children under five years old in the household in the past one week reported by the household head.

Factors associated with diarrheal cases among children under five years old were first analyzed using the chi-square test and bivariable logistic regression analysis and described using chis-square ($\chi 2$) test statistic and odds ratios (OR), respectively. To select minimum adequate variables for multivariable analysis, an inclusion criterion of p-value <0.05 was pre-specified in a sequential (block-wise) variable selection method which selected covariates meeting the set criterion from the bivariable logistic regression analysis. All variables that met the inclusion criteria ($p<0.05$) were further investigated pairwise to avoid collinearity in the multivariable model. None of the variables that met the inclusion criteria had a strong correlation ($r \geq 0.70$). Adjusted OR (aOR) of the most parsimonious model, were obtained by mutually adjusting all minimum generated variables using a multivariable logistic regression model at 95%CI. All the quantitative data cleaning, coding, and general data management procedures, as well as data analysis, were conducted using STATA Version 15.1 (STATA College Station, TX, USA).

Ethical statement

The principal investigator applied for ethical clearance to the Scientific and Ethics Review Unit (SERU) at KEMRI and was cleared through Protocol Number KEMRI/SERU/CPHR/003/3934. During the data collection, a written informed consent form was completed and signed by all study participants. An information sheet was provided to all individuals 18 years and above invited to participate in the study in Maa, Swahili, and English languages. The participants were taken through the written informed consent and agreed to have the questionnaire data captured in ODK and the FGD audio recorded. Alpha-numeric unique numerals were a replacement for participants' names.

Results

Demographics

A total of 259 respondents across ten villages- were interviewed. Out of 259 respondents interviewed, (47.9%) n=124 resided in Namelok sub-location and (52.1%) n=135 resided in Rombo sub-location (Table 1).

Background characteristics of the quantitative arm of the study

The mean age of the heads of households was 32.1 years (SD: 10.8 years, range: 18-72 years). In terms of age categories, most of the respondents (52.1%) n=135 were between the ages of 18 and 30 years, (32.4%) n=84 were between the ages of 31-43 years, (10.8%) n=28 were between the ages of 44-56 years and only (4.6%) n=12 were above 56 years old. The majority of the respondents were female (83.4%), n=216 and the males were (16.6%), n=43. Over half of the respondents, (54.1%) n=140, had no formal education, while (32.4%) n=84 had primary education, (10.8%) n=28 had secondary education, and (2.7%) n=7 had tertiary education. The majority of the participants were married, (90.7%) n=235, while (5.0%) n=13 were single (2.7%) n=7 were widowed, (1.5%) n=4 were divorcees. The average monthly household expenditure was USD. 56.51 (SD: 24.61), with a majority of the households (65.6%) n=170 spending between USD.4.17 and 54.17 monthly (Table 1).

Socio-economic factors were measured using proxy indicators. Latrine ownership was (29.7%) n=76 majority (81.6%) n=62 being ordinary pit latrines, ventilated improved pit (VIP) latrines, and make-shift (made of nylon paper) by (17.1%) n=13 and (1.3%) n=1 of the surveyed households, respectively. Assessment of the latrine structures showed that most (65.8%) n= 50 latrines were made of semi-permanent materials while (30.3%) n=23 of permanent materials and 3 (3.9%) n=3 of temporary materials (such as polyethene/nylon paper). The majority (48.26%) of the households drew their water from boreholes, 26.64% from rivers/streams, 13.3% from a piped water supply, 9.65% from shallow wells, and 2.32% from water pans (Table1).

Background characteristics of the qualitative arm of the study

The single-sex adult male and female FGDs participants were of homogenous characteristics. A majority (58.9%) had no formal education, 24, 6% had attained primary school level of education, 14% had a secondary level of education, and 2.5% had tertiary level of education. The codes used as presented as follows:

- FGD-NAM-CM-F-001-007 stands for Focus Group Discussion-Namelok-Community Member-Female the number assigned during the FGD could be 1-7 as per the number of participants.
- FGD-NAM-CM-M-001-007 stands for Focus Group Discussion-Namelok-Community Member-Male the number assigned during the FGD could be 1-7 as per the number of participants.
- FGD-ROM-CM-F-001-007 stands for Focus Group Discussion-Rombo-Community Member-Female the number assigned during the FGD could be 1-7 as per the number of participants.
- FGD-ROM-CM-M-001-007 stands for Focus Group Discussion-Rombo-Community Member-Male the number assigned during the FGD could be 1-7 as per the number of participants.

Respondents' household water status

More than half of the respondents (46.7%), n=121, reported that a community-based water organization improved their water source in the last 12 months. The majority of the respondents, (81.9%) n=212, used between 20-100liters of water/day, (16.6%) n=43 used between 120-200liters of water/day, and n=4 (1.5%) used more than 200liters/day. The majority of the respondents (83.4%), n=216, reported a sufficient water supply to meet their household needs. (33.2%) n=86, households were paying for their water, with the majority (66.3%) n=57, paying between USD0.008 and USD0.042 per 20-liter container, while (25.6%) n=22, paying USD0.083. Only a proportion of the respondents, (17.4%) n=45, made their water safe for drinking at home mostly predominantly boiling n=20 (44.4%), chlorination n=14 (31.1%), filtering (17.8%) n=8, or by some unspecified methods (6.7%) n=3. At the time of the study, (78.9%) n=202 had water storage containers. The containers were mostly clean (53.5%), n=108, and had covering caps (83.7%) n=169. In (46.5%) n=94 of the households, the water storage containers had dirt marks or stains (Table 2).

The bacteriological quality results from the 27 households sampled all tested positive for coliforms. For the most probable number (MPN) of coliforms, 3.7%, n=1 water sample from Rombo sub-location had 41 MPN of coliform counts while the remaining had an MPN of >1800 coliform counts, the presence of Escherichia coli was detected in (7.4%) n=2 of water samples. The findings reveal higher contamination of household water in the two sub-locations.

Respondents' household sanitation status

Among the 259 respondents, only (29.7%), n=76 owned latrines of which (81.6%) n=62 latrines were ordinary pit latrines, (17.1%) n=13 ventilated improved pit (VIP) latrines and (1.3%) n=1 were make-shift (made of nylon paper) latrines. Of these latrine facilities, 13 (17.1%) were categorized as improved sanitation facilities defined as those designed to hygienically separate excreta from human contact and included: flush/pour-flush to a piped sewer system, septic tanks or pit latrines; VIPs, composting toilets, or pit latrines with slabs (WHO-UNICEF, 2017). 93 % (n=71) of the latrines were in good structural condition, while 7% (n=5) were in poor structural condition. Further, the majority were made of semi-permanent materials 50 (65.8%) while 23 (30.3%) of permanent materials and 3 (3.9%) of temporary materials (such as polyethene/nylon paper). The average distance of the house to the latrines was 17.0 meters (SD: 22.3, range: 3-150 meters) majority were currently in use (97.4%) n=74. The type of flooring material of most of the latrines was cement (59.2%), n=45, mud (35.5%), n=27, and timber (5.3%) n=4. Only (9.2%) n=7 latrines had leaky tins/tippy taps present. (85.7%) n=6 had water in them. A refuse storage receptacle was available in (43.4%) n=111 households visited, and only (20.7%) n=23 covered. Indiscriminate solid waste disposal in (59.4%0 n=152 households visited. At the time of the study, most of the respondents (68.7%) n=178 washed their hands after visiting the latrine or after handling children's faeces with both water and soap (76.9%) n=137 or with water only (23.0%) n=41. The majority of the respondents disposed of children's faeces in open fields, 171 (66.0%), with the remaining respondents in the latrine (33.6%) n=87. Defecation sites were in (50.8%) n=130 household environs (Table 3).

Prevalence of diarrheal cases in children under five years old

n=115 children; 45.1% (95% CI: 39.4-51.6) under five years old reported having had diarrhoea in the past seven days before the study. The highest proportion of diarrheal cases were in Namelok sub-location, n=62 children; 51.7% (95%CI: 43.5-61.4) followed by Rombo sub-location, 53 children; 39.3% (95%CI: 31.8-48.4) (Table 2). According to the villages, the highest cases Lemongo-Namelok village, with n=23 children; 92.0% (95%CI: 81.9-103.3), followed by Empalankai village in Rombo with n=17 cases; 62.9% (95%CI: 47.1-84.1) and Ngasakinoi in Rombo 16 cases; 61.5% (45.4-83.4). Lowest cases were recorded in Lemongo-Rombo village, n=4 cases; 14.8% (95%CI: 5.9-36.6), followed by Nasipa village in Rombo, n=6 cases; 22.2% (95%CI: 10.9-45.0) and Elarai village in Namelok, n=6 cases; 23.1% (95%CI: 11.4-46.6). Figure 2 shows the prevalence of diarrhoea cases among under-five-year-old children per village.

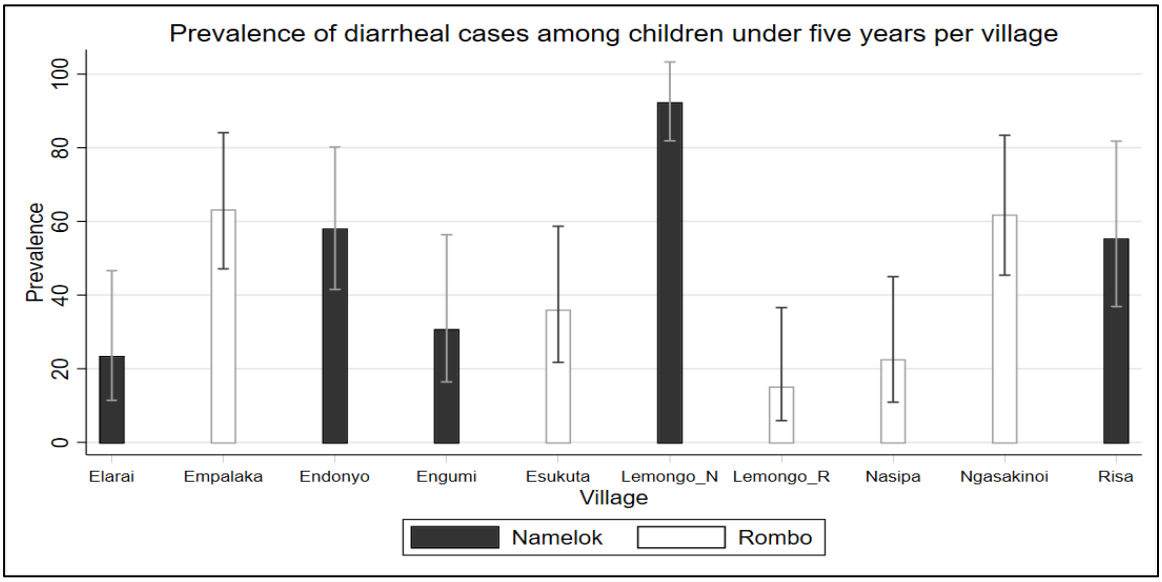

Figure 2:
Prevalence of Diarrhoea among Children under the Age of Five Years

Univariable analysis of risk factors associated with diarrheal cases

Socio-demographic, socio-economic, and WASH factors were analyzed in a univariable model for their association with diarrheal cases and several factors revealed a significant association (p<0.05).

Among the socio-demographic and socio-economic factors, children from households whose household heads were widowed(er) had a significant risk of diarrhoea (OR=13.5, p=0.035). While children from the Rombo sub-location (OR=0.60, p=0.047) and those from households with a monthly expenditure of above Ksh. 12,500 (OR=0.16, p=0.003) had a significantly lower risk of diarrhoea (Table 1).

Participants in the FGDs with females stated that under-five –years old diarrhoea is more in children from widowed homes.

"We have seen children from widowed homes suffering from diarrhoea" (FGD-NAM-CM-F-003)

"Even during house visits, we have observed that children from widowed homes suffer more from diarrhoea when compared to other children" (FGD-NAM-CM-F-002)

Analysis of the factors related to water source indicated that children from households with unimproved water sources (OR=2.27, p=0.001) and those that took between 30 minutes and one hour to arrive at their water source (OR=1.97, p=0.014) all had a significantly higher risk of diarrhoea.

Table 1:
Socio-demographic factors of the households associated with the occurrence of diarrheal cases among children under five years old in Kajiado County, Kenya

Variables	**No. of people sampled n (%)**	**Risk factors associated with diarrhoeal cases (n=115) [OR, p-value]**
Overall (N)	259 (100.0)	115 (72.3)
Sub-location		
Namelok	124 (47.9%)	Reference
Rombo	135 (52.1%)	0.60, p=0.047*
Gender		
Male	43 (16.6%)	Reference
Female	216 (83.4%)	0.74, p=0.395
Marital status		
Single	13 (5.0%)	Reference
Married	235 (90.7%)	2.25, p=0.487
Divorced	4 (1.5%)	1.81, p=0.335
Widower	7 (2.7%)	13.5, p=0.035*
Age group		
18-30 years	135 (52.1%)	Reference
31-43 years	84 (32.4%)	1.056, p=0.847
44-56 years	28 (10.8%)	0.86, p=0.723
Above 56 years	12 (4.6%)	1.87, p=0.347
Education level		
None	140 (54.1%)	Reference
Primary	84 (32.4%)	0.62, p=0.093
Secondary	28 (10.8%)	0.73, p=0.449
Tertiary	7 (2.7%)	0.16, p=0.096
Monthly expenditure (USD)		
4.17-29.17	60	Reference
29.18-54.17	110	0.69, p=0.257
54.18-79.17	31	0.99, p= 0.988
79.18-104.17	34	0.45, p=0.080
>USD104.17	24	0.16, p=0.003*

***Indicates a statistically significant association (p-value <0.05)**

However, children from households that had improved their water sources in the last 12 months (OR=0.53, p=0.014), those with water storage receptacles (OR=0.27, p<0.001), water storage receptacles with a lid (OR=0.46, p=0.047), those from households that made water safe for drinking (OR=0.25, p=0.001), and those who paid for their household water (OR=0.42, p=0.002) all had a significantly lower risk of diarrhoea (Table 2).

Table 2:
Household Water Factors associated with the Occurrence of Diarrheal Cases among Children

Variables	No. of people sampled n (%)	Risk factors associated with the diarrhoeal case (n=115) [OR, p-value]
Overall (N)	259 (100.0)	115 (72.3)
Type of water source		
Improved	159 (61.4%)	Reference
Unimproved	100 (38.6%)	2.27, p=0.001*
Water source improved in last 12 months		
Yes	121 (46.7%)	0.53, 0.014*
No	138 (53.3%)	Reference
Time taken to arrive at the water source		
Less than 30 minutes	130 (50.2%)	Reference
30 minutes – 1 hour	95 (36.7%)	1.97, p=0.014*
Over 1 hour	34 (13.1%)	1.28, p=0.524*
Number of water containers used per day		
1-5	212 (81.9%)	Reference
6-10	43 (16.6%)	0.82, p=0.568
>10	4 (1.5%)	-
Water meets the household need		
Yes	216 (83.4%)	1.17, p=0.640
No	43 (16.6%)	Reference
Do you pay for the water		
Yes	86 (33.2%)	0.42, p=0.002*
No	173 (66.8%)	
Cost per 20-litrecontainer (USD)		
0.008-0.04	57 (66.3%)	Reference
0.05-0.08	7 (8.1%)	0.36, p=0.362
>0.08	22 (25.6%)	
Those who made water safe for drinking		
Yes	45 (17.4%)	0.25, p=0.001*
No	214 (82.6%)	Reference
Method of making water safe		
Boiling	20 (44.4%)	Reference
Filtering	8 (17.8%)	0.53, p=0.605
Chlorination	14 (31.1%)	0.63, p=0.620
Others	3 (6.7%)	7.50, p=0.466

***Indicates a statistically significant (p-value< 0.05)**

According to the findings of the FGD, the respondents agreed that the water from the region was not safe. Water sources mentioned are; furrows, flowing water, spring water, swampy water used for irrigation, and stagnant water in the households. In addition to these, the causes of unsafe water were animal waste, human activities, chemicals, and water bacteria. The following are a few responses;

"The same water we are using is the same for farming you might go to the river and fetch water that is not safe since it has chemicals, others bathed there while others do their cleaning like washing their clothes there." (FGD-ROM-CM-F-006)

"If I may add to this matter, water is not clean even though the springs are fenced, wild animals have tampered with it. You can find an elephant drinking water from there. People wash clothes at the same time and use that water at home." (FGD-NAM-CM-M-002)

"Honestly speaking, the water that is from the river is clean, the one from the ground is very salty, it is the one used here, and sometimes it affects people." (FGD-NAM-CM-M-001)

"Another issue with that water, it is not accessible for some people, you find that someone can walk up to 3 kilometres to get water, so if a woman goes fetch a jerry can of water, she doesn't know if it's the children who will use to bath because it is far." (FGD-ROM-CM-M-003)

"Cholera affected us for example I lost my mother to cholera. Lately, it has gone down as doctors are putting effort. Before it affected this area so badly and it took many lives but now the rate and effects of cholera are minimal. Dysentery, amoeba and typhoid are still present due to the problem of water." (FGD-ROM-CM-M-002)

"And a while ago before the water was brought to school, children commonly suffered from running stomachs but now it is so safe at school, the only problem is at home and we are glad they are safer. We hope that they would soon be even better." (FGD-NAM-CM-F-005)

"Another one is an amoeba. It disturbed us. You know this amoeba is caused by the water we get from waterholes that are not good for consumption." (FGD-NAM-CM-F-005)

"There are people that cannot access water." (FGD-ROM-CM-F-002)

From the analysis, sanitation and hygiene factors that showed a significant risk of diarrhoea included; latrines made of a mud floor finish (OR=3.41, p=0.019), disposal of faeces in the open field (OR=1.84, p=0.027), and use of water only to wash hands after handling child's faeces (OR=2.87, p=0.004). However, factors that showed significantly reduced risk included; latrines located between 10 and 30metres from the house (OR=0.29, p=0.022) and washing of hands after visiting the toilet/latrine or after handling children's faeces (OR=0.34, p<0.001) (Table 3 and Table 4).

"The main challenge we have is latrines because you find that sometimes some people will go for long calls in the bush, and sometimes the bad smell reaches here, so that is the biggest challenge that should be looked at." (FGD-NAM-CM-F-004)

"The only latrines we have are from schools like this one at the centre. Even the churches have no latrines people depend on the bushes." (FGD-NAM-CM-M-007)

"To add on that, the higher percentage of people with latrines are those living close to the centres, but those at the remote places still is a challenge, but it is improving. The most important thing is the water, if it could be available throughout, it would be of great help. But at the moment it can take 2 weeks without water." (FGD-NAM-CM-F-002)

"Maasai people are used to using the forest as the toilet, another thing you may even find is that person can even have a toilet but still use cattle shade as the toilet, you will find in this scenario that it is easy to spread diseases." (FGD-NAM-CM-M-007)

“Those are our men that say they can’t share a latrine with their children. They dig toilets for their children and not them.” (FGD-ROM-CM-F-004)

“In this community of Nasipa, there are old men but they use the latrines freely because they know the benefits. Therefore, education is important for these people to understand.” (FGD-ROM-CM-M-001)

"Poverty. Some of the families cannot afford to have a latrine. You can dig a hole, that is not a problem, but putting the walls are a major problem; so poverty level is very high". (FGD-ROM-CM-F-004)

“We have known the importance of latrines but lack the resources to construct one.” (FGD-ROM-CM-F-007)

Table 3:
Household Hygiene and Sanitation Factors associated with the Occurrence of Diarrheal Cases among Children

Variables	Number of people sampled n (%)	Risk factors associated with diarrhoeal cases (n=115) [OR, p-value]
Overall (N)	259 (100.0)	115 (72.3)
Washed hands after visiting the latrine after handling children's faeces		
Yes	178 (68.7%)	0.34, p=0.001*
No	81 (31.3%)	Reference
What do you use to wash your hands		
Water and soap	137 (76.9%)	Reference
Water only	41 (23.0%)	2.87, p=0.004*
Methods of disposing of children's faeces		
In the latrine	87 (33.6%)	
In the open field	171 (66.0%)	Reference
Burning it with the litter	1 (0.4%)	1.84, p=0.027*
Presence of latrine/toilet		
Yes	76 (26.7%)	0.63, p=0.105
No	180 (70.3%)	Reference
Latrine/toilet type		
Improved	63 (82.9%)	0.58, p=0.450
Unimproved	13 (17.1%)	Reference
Latrine in good structural condition		
Yes	71 (93.4%)	Reference
No	5 (6.6%)	1.12, p=0.905
Kind of building material used		
Permanent	23 (30.3%)	Reference
Semi-permanent	50 (65.8%)	3.26, p=0.060
Polythene/nylon	3 (3.9%)	2.00, p=0.607
Kind of floor finish material used		
Cemented	45 (59.2%)	Reference
Mud	27 (35.5%)	3.41, p=0.019*
Wood	4 (5.3)	
Availability of aperture cover		
Yes	40 (52.6%)	1.66, p=0.022*
No	30 (47.7%)	Reference
Length in meters latrine is located from house		
<10 m	31 (40.8%)	Reference
Between 10m and 30 m	35 (46.1%)	0.29, p=0.022*
Between 50 and 150 meters	10 (13.2%)	0.70, p=0.676

Multivariable analysis of risk factors associated with diarrheal cases

From the multivariable analysis, factors that were significantly associated with increased risk of diarrhoea were; the use of unimproved water sources (aOR=2.28, p=0.032) and a period of between 30 minutes and one hour to arrive at the water source (aOR=2.85, p=0.008). On the other hand, factors that were significantly associated with a lower risk of diarrhoea were; households in the Rombo sub-location (aOR=0.25, p=0.001), making water safe for drinking (aOR=0.26, p=0.006) and using water storage covered with a lid (aOR=0.31, p=0.013) (Table 5).

Table 4:
Household Hygiene and Sanitation Factors Associated with the Occurrence of Diarrhoeal Cases among Children

Variables	No. of people sampled n (%)	Risk factors associated with diarrhoeal cases (n=115) [OR, p-value]
Overall (N)	259 (100.0)	115 (72.3)
Existence of a leaky tin/tippy tap next to the latrine		
Yes	7 (9.2%)	0.25, p=0.211
No	69 (90.8%)	Reference
If Yes, water is present in it		
Yes	6 (85.7%)	-
No	1 (14.3%)	
Existence of a walkway covered with grass		
Yes	28 (36.8%)	0.97, p=0.950
No	48 (63.2%)	Reference
Signs of latrine usage		
Yes	74 (97.4%)	-
No	2 (2.6%)	Reference
Existence of open defecation sites		
Yes	130 (50.8)	1.59, p=0.070
No	126 (49.2%)	Reference
Availability of refuse receptacle		
Yes	111 (43.4%)	0.87, p=0.576
No	145 (56.5%)	Reference
Refuse receptacle covered		
Yes	23 (20.7%)	0.97, p=0.946
No	88 (79.3%)	Reference
Scattered solid waste in compound		
Yes	152 (59.4%)	0.63, p=0.074
No	104 (40.6%)	Reference
Water storage receptacle		
Yes	202 (78.9%)	0.27, p=0.001*
No	54 (21.1%)	Reference
Is it free from dirt marks or stains?		
Yes	108 (53.5%)	1.51, p=0.168
No	94 (46.5%)	Reference
Water storage receptacle covered		
Yes	169 (83.7%)	0.46, p=0.047*
No	33 (16.3%)	Reference

***Indicates a statistically significant association (p-value < 0.05)**
- Indicates insufficient/no observations

Discussion

Community approaches to total sanitation interventions to improve community WASH status, and subsequent reduction of diarrhoeal cases have been in existence for decades. The government of Kenya, through the MOH, has adopted CLTS as an approach to improve community WASH status and its subsequent impact on childhood diarrhoeal disease burden. This study aimed at assessing CLTS's impact on WASH status in rural parts of Kajiado County, Kenya, while relating them to the potential effect on childhood diarrhoea.

Results reveal that a majority of households did not own latrines, practised open defecation, and used water from unimproved sources. Bacteriological laboratory test results show that all water samples collected were contaminated with coliform, consequently, nearly half of the children under five years old had suffered from diarrhoeal diseases within seven days before the household visit.

These results are a starting point toward improving water, sanitation, and hygiene practices and inform future policy planning to meet SDG-3 and SDG-6 by the year 2030.

The study findings reveal that a majority of households did not own latrines. These results are similar to a study done in Ethiopia that reported only 1/3rd of selected 'woderas' had toilets/latrines[19], and the KDHS report,2014 reveals that rural Kenya accounts for only 1/3rd available.[20] Most of the households owned toilet/latrines that were functional but with un-cemented floors. The physical state of the toilets/latrines made it hard to maintain clean. The state of the toilets/latrines exposed the users to bacterial and parasitic infections. There was an association between latrine ownership and monthly expenses, which compares well with a study carried out in Tanzania that established households with a monthly income of Tsh.50, 000 were more likely to own an improved latrine.[21]

Table 5:
Multivariable Analysis of the Risk Factors associated with Diarrhoeal Cases among Children Under-Five Years

Variables	Adjusted Odds Ratio (aOR)	p-value	95%CI
Sub-location			
Namelok	Reference		
Rombo	0.25	0.001*	0.11-0.56
The water source improved in the last 12 months			
Yes	Reference		
No	1.15	0.706	0.55-2.40
Type of water source			
Improved	Reference		
Unimproved	2.28	0.032*	1.07-4.86
Time taken to arrive at water source			
Less than 30 minutes	Reference		
30 minutes – 1 hour	2.85	0.008*	1.32-6.17
Over 1 hour	2.05	0.212	0.66-6.31
Those who made water safe for drinking			
Yes	0.26	0.006*	0.10-0.68
No	Reference		
Does the water storage have a cap?			
Yes	0.31	0.013*	0.12-0.78
No	Reference		

Significant factors with p-value <0.05

Reasons cited for lack of latrine ownership in similar studies are consistent with these findings, including men who cannot share toilets with children and accessibility to vast free space.[22]

Reducing open defecation also requires access to and use of improved sanitation facilities, which prevent human faeces from re-entering the environment.[23] In this study, a majority of households practised open defecation. They relieved themselves in surrounding bushes and even along the seasonal river beds. A significant majority of respondents disposed of their children's faeces in the compound or bushes at the back of their houses. Unsafe disposal of children's faeces is a combination of two factors; the first is the misconception of the faeces being mild and not dangerous, and the second is the state of the physical structure of toilets/latrines that makes them potentially dangerous and difficult to clean if soiled by children. Access to a sanitation facility is not the same as the adoption of good sanitary and hygiene practices. The faecal matter contaminates environments and water bodies and exposes whole communities to risks of contracting sanitation-related diseases/illnesses. The respondents cited the lack of resources as the reason behind open defecation behaviour. Similar claims have also been put forward in other studies conducted. [24, 25]

Most of the respondents reported washing their hands with water and soap at critical times- soap was not available for a significant number and, therefore, not commonly used in handwashing. A comparative study in Ghana revealed that 42.2% of mothers whose children suffered from diarrhoea did not wash their hands with soap after handling their children's faeces or relieving themselves.[26] Even though recent epidemiological evidence reveals that in the absence of a toilet/latrine number of cases of diarrhoea can be reduced by between 30% to 48% with handwashing at critical times.[27]

A systematic review study found that only 19% of the global population used soap and water at critical times.[28] The practice of washing hands at critical times is known to reduce rates of diarrhoea and the associated global disease burden.[29]

In the study, most of the households relied on unimproved water sources. The majority of the respondents obtained their water from shallow wells, streams, and seasonal rivers. Due to their unprotected nature, these sources are easily prone to contamination and hence unfit for drinking.[30, 31] These findings are comparable to a study done in Isiolo County, which showed that most households relied on unprotected water sources.[32]Although the quantity of water was not problematic in these study areas, the respondents reported that the quality of the water was of concern, which is consistent with statistics of limited access and poor water quality in parts of Kajiado County.[33] Indeed, the water sampled was not free from contamination, even though most respondents did not practice household water treatment.

Dependence on unimproved water sources can present significant health challenges; research shows an association between the occurrence of diarrhoea and consumption of untreated water. Furthermore, diseases associated with poor water, sanitation, and hygiene can compound existing undernutrition. It is of particular concern for these respondents, as they often experience a disproportionately high level of diarrhoea.[34]

Monitoring household water quality is essential in ensuring the safety of users.[35] Water pollution results in the spread of water-related infectious diseases such as dysentery, cholera, diarrhoea, and bacterial, fungal, viral, and parasitic infection.[36] Water classified as potable water must meet certain physical, chemical, and microbiological standards. These standards are to ensure that the water is safe for drinking. It is water-free from disease-producing microorganisms and chemical substances deleterious to health.[37] Water is a good solvent that picks up impurities easily; therefore, conforming to microbiological standards is of interest because of its capacity to easily spread infectious diseases within a large population. [38.] Most coliforms are present in large numbers among intestinal flora of humans and animals hence found in their faecal wastes. As a result, coliforms detected in higher concentrations than pathogenic microbes are an index of the potential presence of entero-pathogens in water environments, [39] their presence in household drinking water is considered harmful to human health.

Three bacteriological tests were done to determine the microbiological quality of the household water samples-presumptive, confirmatory, and completed. The Most Probable Number (MPN) of coliform counts in the water sample was ≥1800/ 100 ml. These were in most of the 27 water samples. The coliform count was exceedingly high as the WHO Guidelines for drinking water safety is zero coliforms per 100 ml of water, [40] further biomedical tests for some selected colonies showed the presence of Escherichia coli. These can be associated with the high open defecation as a consequence of low latrine coverage.

Studies have revealed the impacts of latrine coverage on microorganisms in the environment and water source contamination. For instance, a study conducted in Ethiopia showed that cases of diarrhoea were higher in households that did not own latrines.[41]

The evidence presented points to poor WASH conditions having a detrimental effect on under-five-year-old child health due to exposure to enteric pathogens. Achieving the optimal potential of safe WASH practices to reduce childhood diarrhoea requires a sustainable effort to meet universal access to these services as contemplated under the Sustainable Development Goals. It may also require new or modified CATS approaches that go beyond the traditional interventions to address this low WASH status.

Finally, if safe WASH practices are not adopted, childhood diarrhoeal cases and mortality will rise in these communities under study.

Limitations

These study findings are from a pastoral community in Kajiado south, the results from these data might not translate to non-pastoral communities. However, these findings can be used by future researchers to study different communities given the evidence to be deduced.

Conclusion

Even though the quantity of water available from these communities was sufficient, quality challenges were observed with findings revealing a significant number of household water samples as contaminated. Open defecation was rampant due to a lack of toilets/latrines. Adequate handwashing at critical times was uncommon because of the lack of handwashing stations and soap. Therefore, in the context of Community-led Total Sanitation, this places the community at the bottom of the sanitation ladder [42]. It is, therefore, important that the Kenya government needs to prioritize water, sanitation, and hygiene improvement efforts in these communities as the populations are well below national and international service provision targets. We suggest that water, sanitation, and hygiene promotion initiatives should focus on understanding cultural practices, behaviours, and norms within communities before implementing interventions. Initiatives that are locally relevant will help bridge the existing gaps.

Author contributions

James Otieno Okumu: conceptualized and study design; developed data collection tools, supervised data collection, data analysis and interpretation, and manuscript drafting.

Dr John Gachohi: Conceptualizing and design and implementation; data analysis and manuscript review.

Dr Violet Wanjihia: Design, data collection, and drafting of the manuscript.

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