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Household Environmental Health Risk factors influencing Children under five years diarrhoea Morbidity in Homabay County, Kenya

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Abstract: *Globally, more than 5 million children die every year from diseases linked to the environmental conditions. The objective of this study was to explore environmental risk factors influencing diarrhoea morbidity of children under five. A community based cross sectional study was conducted to explore incidence and environmental risk factors associated with children under five. Focus Group Discussions (FGDs) and Key Informants interview (KII) and observational check list were employed as data collection instruments. Microbial water quality was conducted to check on presence of faecal coli forms. Residual chlorine levels were also assessed through laboratory analysis. A sample size of 384 households was used with 10% to account for non response was incorporated. Statistical Package for Social Sciences (SPSS) was used for the analysis of quantitative data. Qualitative data from both questionnaire and Key Informants interview guide were triangulated. Water collection from the water points was reported to be mainly done by the female children under 15 years 124 (39.5%) while male children under 15 years were reported to go for water by 23 (7.0%) of the respondents. The respondents reported cleaning their toilets in varied periods. Ninety one (46.4%) clean their toilets on a weekly basis, 60(30.7%) clean on a daily basis, while 18 (9.2%) did not clean their toilets. There was a statistical significance between children diarrhoea incidences and faeces disposal practices (r_S = 0. 018, p = .01). Efforts should be made by the county governments to ensure that the communities within the study area adopt current best practices as pertains to sanitation, water storage and Point of Use Treatment. Mechanisms should be put in place to sensitize the local communities to put up and utilize latrines correctly to deter occurrences of faecal coli forms in water as it happens in the event of Open defecation.*

Keywords*; Children under five, Diarrhoea, faecal coli forms, Risk factors, Water treatment*

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I. Introduction

Poor sanitation and hygiene are responsible for 7% of deaths especially in developing countries [1]. Globally, more than 5 million children die every year from diseases linked to the environmental conditions in which they live, learn and play. A number of studies indicate that most diseases are contracted in the house and the immediate surroundings [2],[3],[4]. Over 40% of the global burden of disease attributed to environmental risk factors fall on children below the age of 5years who account for 10% of the world's population [5]. This children experience high rates of diarrhoea mortality and are more vulnerable to smaller doses of pathogens than other members of the household due to their under developed immune systems [6]. Globally the burden of disease and mortality rates could be reduced by about 9.1% and 6.3% if only rapid success is attained in facilitating access to water, sanitation and hygiene facilities [7]. Unsafe drinking water is a major cause of diarrhoeal diseases and death in children under five years in most developing countries [4]. The source of drinking water greatly influences the health outcomes of both the mother and child [5].

A research conducted in the Republic of Congo showed that children from households that obtain water from protected sources were less likely to have cases of diarrhoea compared to those who get it from unprotected sources [8]. Approximately 2.7 billion people in the world live without proper sanitation and of these about 2 billion live in rural areas of developing countries [5]. Exposure to human waste increases the risk of diarrhoeal morbidity among children and adults [9]. Defecation in open places facilitates the transmission of diarrhoeal pathogens and also exposes individuals to high risk of intestinal parasitic infections [2],[3],[4]. A study conducted in Indonesia by [10] found out that families that did not have improved latrines had higher odds both of a child with a history of diarrhoea in the previous 7 days. The findings concurred with another

study conducted by [3] in Mozambique that showed an association between lack of latrine and child mortality in Mozambique. Another study conducted by [11] in South Asia showed that young children were allowed to defecate in the yard or land surrounding the household. A qualitative study conducted in a dense settlement in Peru revealed several determinants of disposal of human faecal matter behavior which increased diarrhoeal morbidity including age, efforts required by the disposal method and availability of toilets or latrines [12].

In developing countries, many households still do not have access to piped water hence they rely on springs and dug wells [5] . These households are at a higher risk of being exposed to bacterial contamination especially during floods and typhoons [5],[4]. According to [5] local governments of many developing nations often weakly enforce the building codes that enable households with flush toilets on the surface but still allow unsanitary septic tanks underneath. The greatest reduction of diarrhoea is associated with pit latrines and flush toilets. Refuse disposal is a key factor that influences diarrhoeal morbidity among children below 5 years [12]. Open dumpsite approach in solid waste disposal is the most primitive stage of solid waste management practiced in many parts of the world [13]. In most developing countries solid waste disposal sites are mostly on the outskirts of urban areas and were sources of contamination to children below five years due to the incubation and proliferation of flies, rodents and mosquitoes [1]. This opinion is shared by [14] in their research that aimed at establishing the relationship between garbage disposal and diarrhoeal morbidity.

In their study, [9] argue that environmental hygiene especially in the cooking area is the most important determinant of diarrhoea; their findings show that diarrhoea was high among children from families who cooked and slept in the same room. Another research by [15] concurred with earlier studies that the morbidity of diarrhoea among the children under 5 years was significantly influenced by the location of the cooking area in the household. These findings were attributed to the children easily accessing the cooking area and eating food from the pot with dirty hands or picking left over foods from the ground hence increasing chances of getting diarrhoea [16],[17]. Despite diarrhoea's causes being multi factorial, most of the diarrhoea causing organisms are transmitted through the faecal-oral route [18]. This is main transmission mechanism for the infectious diarrhoeal agents such as parasites, bacteria and viruses. Fecal-oral transmission occurs as a result of poor sanitary disposal of human faeces leading to contamination of water sources and the ground [18].

Human right to water and sanitation acknowledged that clean water and sanitation are essential to realization of human right [19]. Consequently Article 43 (1) of the Kenya constitution provides that people have a right to clean and safe water in adequate quantities and a right to reasonable standards of sanitation [20]. According to the social pillar of Vision 2030, only 48% of households use improved water sources and 22% use improved sanitation within the county thus, increasing health risks and mortality rate of children below five years [21]. This is contrary to the Sustainable Development Goal 3 (SDG 3) which targets to reduce the neonatal mortality to lower than 12 per 1000 live births and at least as low as 25 per 1000 live births for children below the age of 5 years by the year 2030 [22]. In order to ensure that SDG 3 is achieved, there is need to ensure that 90% of households have access to adequate water and sanitation. Sendai frame work provides that management of risks should be done in an integrated and inclusive manner [23].

Diarrhoeal causative agents can be transmitted through four transmission routes which include; Human-to-human transmission via the environment, human-to-human transmission where the agents multiply in the environment, human-to-animal-to-human and the animal-to-human through the environment [24]. Infectious diarrhoea caused by the faecal-oral transmission is usually spread when a susceptible individual ingests pathogens in food or water that is contaminated with the excreta from an infected individual. A Study by [25] identified the major routes of transmission for the diarrhoeal disease causing agent and produced the 'f' diagram which has been applied until today [26]. A research by [27] that investigated the impact of school based safe water and hygiene program concluded that places where the faecal contamination is high is in the domestic environment.

II. Methods

The study was carried out in Homa Bay County located at 0.52^0 South latitude, 34.45^0 East longitudes and it is elevated 1166 meters above the sea level. Homa Bay County has an estimated population of 1,038,858 persons consisting of 498,472 males and 540,386 females [28]. The study employed a community cross sectional study design and utilized multi stage random sampling. Homabay County was selected via purposive sampling, simple random sampling for the Sub-counties, the divisions which entailed Sub-county Lambwe, East Karachuonyo, Kochia and Nyarongi. Sub locations in each division were alphabetically listed and one picked randomly from each division. Two villages were randomly picked from each sub-location all totaling eight. Selection of subjects was done purposively by use of the rule of the left direction where every subsequent household was jumped before getting to the other. The research assistant interviewed mothers/care takers of children under five years of age after making them understand objectives of the study and getting express authorization for interviews until the required sample sizes from the villages was attained. The results of the study had a 5% level statistical significance and a confidence level of 95%. The Z value at 95% confidence is 1.96. When the study population is 10, 000 and above, a sample size of 384 is adequate. This was arrived at

using the following formula: $n = Z^2pq/ d^2$, to account for non response, an additional of 10% of the sample was considered hence the study used a sample size of 423. Primary data comprised quantitative and qualitative data and it was collected using structured questionnaires targeting caregivers selected for supplementing information gathered through Focus Group Discussions (FGDs) Water samples were collected from all households at point of use. Additional qualitative data was collected from key informants entailing Public Health officers, facility in-charges, Community Health Extension Workers and Pharmacists. Observation checklists were also utilized at household levels. Semi-structured interview guides were used to collect information from key informants from the sampled health care facilities. The instrument contained open-ended and closed-ended questions. A pilot study was conducted to establish Validity and Reliability of instruments.

Water quality analysis

Water samples were taken at the point of use directly from the container used for drinking from sampled household. The samples were collected at the end of the interview, placed in an icebox cooler and transported for laboratory analysis on residual chlorine level and presence or absence of faecal coli forms. Chlorine levels in water were detected using DPD complex tablets. Bacterial contamination in the water samples was detected by presence or absence of faecal coli forms using Filter Membrane Technique. The number of coli forms colonies was then counted after incubation for 24 hours at the temperature of 35.5 ± 0.5ºC to give the approximate number of *E.coli* in one hundred milliliters (100ml) of water. Water samples of 100mls were collected in sterile polypropylene sample containers with leak proof lids and filtered through a 47mm, 0.45µm pore size cellulose ester membrane filter that retains the bacteria that is present in the water sample. The filter was then placed on the absorbent pad which was saturated with 2-3ml of MI broth and the plate incubated at 35^0C for up to 24 hours. The bacterial colonies that grew on the plate were inspected for the presence of blue colour that occurred as a result of the breakdown of IBDG by *E.coli* enzyme β-glucuronidase and fluorescence under long wave ultraviolet light (366nm) from the breakdown of MUGal by the TC enzyme β-galactosidase. The study was conducted between November 2015 and March 2016.

III. Results and discussions

A total of 315 (82%) respondents were interviewed. Majority 126 (40.1%) were aged between 25-35 years and 155 (63.3%) of the household heads had attained primary level of education. Majority of the women with children under five years 213 (73.4%) had attained primary level of education while 24 (70.6%) of the guardians had also attained primary level of education. Hundred and thirty four (42.7%) of the respondents were farmers. Majority 278 (88.5%) were residing in the rural areas and 264 (83.8%) were protestants among the 315 respondents, majority 272 (86.3%) reported having mobile phones, 229 (72.7%) had a radio while only 27 (8.6%) reported having motorcycles. Findings of the study showed that, most respondents, 254 (81.2%) had their floors made of earth, sand and dung. Only 54 (17.3%) were observed to be made of cement. Firewood was the most commonly used source of fuel 272 (86.6%) while 41 (13.1%) acknowledged using Charcoal.

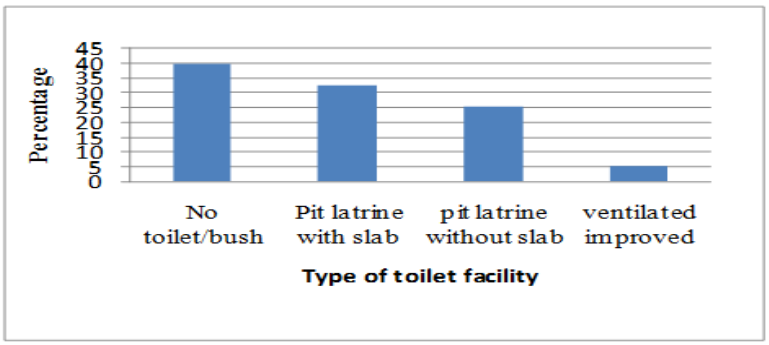

Fig 1: Distribution of respondents with regard to kind of toilet facility in the households

The study area had different toilet facilities adopted by the households. More than two thirds 116 (36.9%) had no toilet hence they resorted to Open defecation. On the other hand, 102 (32.5%) had Pit latrines with slabs, 80 (25.5%) had open pit latrines without slaps as illustrated in fig 1. The socio-cultural inclinations were also found to have influenced the type of toilet facilities in use. The practice of having cultural persuasions holding as a determinant in the use of the latrines even after the construction equally came out as an aspect that could have motivated the type of latrines in use [11]. Further investigations sought to determine the relationship between the type of toilet used and the frequency of cleaning**.** There was a positive correlation with a statistical significance between the type of toilet used and the frequency for cleaning the facilities ($r_s = 0.752$, $p = .01$).

Water handling practices

The respondents reported using different containers to fetch water from the source. A total of 152 (48.4%) respondents reported using wide mouthed pails as the most commonly used to get water from the source, 82 (26.1%) reported using wide mouth pails with lids and only 3 (1%) reported using narrow mouthed clay pots as shown in Fig 2. The clay pots were observed to be less common in the contemporary society and were then categorized as jerricans that have replaced the traditional narrow mouthed clay pot. This was only aligned to fetching water from the source and not storage.

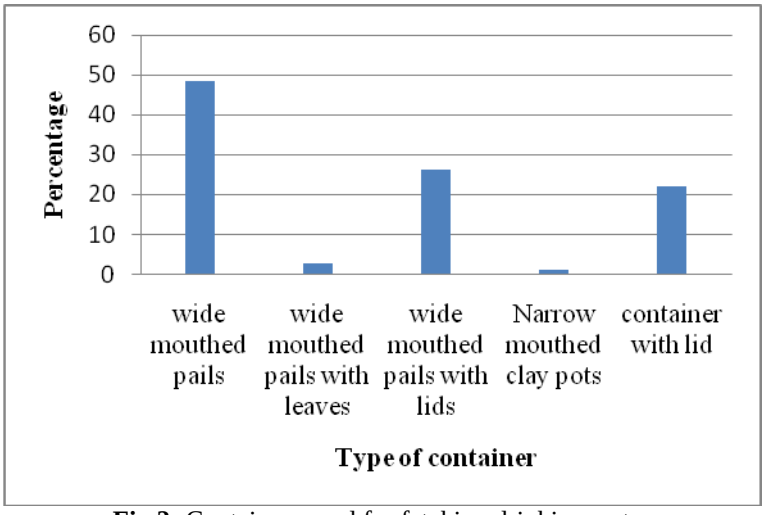

Fig 2: Containers used for fetching drinking water

Another study by [29] in Kenya concurred with this findings that there was an association between storage of drinking water and diarrhoeal incidences among children under five years. The study established that 62.7% of the mothers who stored their drinking water in buckets reported episodes of diarrhoea. In addition, the study found that children usually scooped water for drinking directly from the buckets using any cup or bowl thereby increasing the risk of diarrhoeal morbidity [30],[31],[28].

Distance to water sources and type of person collecting water

1 show the distance covered to the water source and the kind of container used for fetching drinking water. The study revealed that in the event of distances which required short periods of time, preference for wide mouthed pails was evident. Longer distances required the use of covered containers with lids. A study by [32] concurs with these findings indicating that the nature of containers used in the transportation and storage of drinking water was a great determinant of the quality of drinking water in the household hence influencing the prevalence of diarrhoea among children below five years.

Table 1. Comparison of distance to water source and containers used for fetching drinking water

		What containers do you use for fetching drinking water?					Total
		Wide-mouthed pails	Wide mouth pails with leaves	Wide mouth pails with lids	Narrow mouthed clay pots	Containers with lid	
How long does it take to go there, get water and come back?	0-1hr	148	8	79	3	62	300
	2-3hrs	4	0	3	0	6	13
	4 and above hrs	0	0	0	0	2	2
Total		**152**	**8**	**82**	**3**	**70**	**315**

Water collection was reported to be mainly done by the female children under 15 years 124 (39.5%) while male children under 15 years were reported to go for water by 23 (7.0%) of the respondents. This finding concurs with the results obtained by [33] which also indicated that young girls and women in the population were largely involved with the fetching of water for the family.

There was a significant relationship between the person fetching water and the distance to the water source, χ^2 (12.004, N=315) = 11.865, $p<0.000$ at $\alpha = 0.02$. This was an indication that the ability of the respondents with regards to the capacity to undertake menial work was a factor which affected the distance to

the water sources [34]. The statistical findings were in tandem with some of the FGD discussions where the participants from the four areas of the study demonstrated that the distances to water sources were shorter during rainy seasons but during dry seasons the distances were slightly longer. The variation was based on the fact that there were sources that dried up during dry seasons forcing the households to look for water from distant water sources. The study findings concurred with past research findings by [35] which indicated that distance to and from the source of drinking water is an important determinant of diarrhoea among children.

Sources of drinking water

Regarding the main source of drinking water, a larger percentage 124 (39.5%) of the respondents recorded using water from borehole, while 65 (20.7%) used water from rivers/springs. Only 33 (10.5%) got their drinking water from the piped system. The information was essential to the study as it showed how water sources influenced diarrhoea among children under five years of age. According to a study by [36] the source of water for domestic use had a positive association with the incidences of diarrhoea among children below five years. The study found out that the distance and time period taken to get water from the source to the household were as follows. The response were as evidenced in Table 1 and almost all 300 (95.5%) respondents reported taking between 0-1 hour in getting water from the source while only 1 (0.3%) said he took more than 4 hours to get water from the source. On the other hand, more than half of the respondents 202 (64.3%) reported covering a distance less than 250 meters to get to the water source and back while 5 (1.6%) cover more than a kilometer to and from the water source. Research has shown that the time taken by a household member to collect water from the source for domestic use is associated with the occurrence of diarrhoea in children below five years [15]. The study found out there was a positive correlation between distance to water source and number of diarrhoea cases. Table 1 also shows the distribution of respondents in relation to the time and distance covered to access drinking water for the household.

Comparison of the person collecting water and the distance from the house to the water source was established, in the event of long distances, adult women and men majority who were vendors had the responsibility of fetching the water. Similar to the conclusion drawn by [36] there was need to ensure training and capacity building on the women members of the community as a measure of enhancing their water handling and hygiene knowledge to assure the households of access to good quality water. The study further sought to confirm the relationship between the respondents' occupations and the sources of water supply. This was with an aim of relating the occupations to economic disposition and the ability to influence the water supply sources. There was no significant relationship between the respondents occupation and the source of water that they relied on for household consumption, χ^2 (55.820, N=315) = 57.984, $p<0.000$ at $\alpha = 0.01$. The study also sought to assess the presence of residual chlorine in water in order to establish effectiveness of point of use water treatment. Evidence of residual chorine in the water samples was confirmed from 20.6% of the households. Further analysis was done to relate the presence of residual chlorine to the main sources of water and the distance of collection and handling. This was with a view of determining the extent to which the factors affected the water treatment practices used. The means analysis for the households with presence of residual chlorine in the water samples showed that the greatest motivating factor for the treatment method was awareness of risk levels of the source of water. Treatment of the water by way of chlorination was greatly influenced by the actual source of water that the families relied on [8],[30].

Methods of water treatment

The study further sought to establish the pertinent factors of water handling that predisposed the occurrence of faecal coli-forms in water for domestic use. The parameters that were evaluated entailed; containers used for storage, treatment method used and perceptions about water contamination spreading diarrhoea. The means analysis for the households with presence of residual chlorine in the water samples showed that the water sources that the households relied on were the greatest contributing factor to the treatment mode. This is because the highest mean difference was denoted in the attribute of the mode of treatment that the water was subjected to before ferrying home. The study examined various parameters that predisposed various individuals to diarrhoeal diseases such as containers used for collection and storage of water, water treatment method used as well as the water handling at the source. The study established that households that used drinking water which was drawn from unprotected source recorded high faecal coliform levels. Various studies conducted to determine the relationship between the water source and the incidences of diarrhoea among children below five years indicate that water quality greatly depends on whether the source is protected or unprotected and therefore significantly affect the incidences of diarrhoea among children [36]. The study further sought to establish the levels of faecal coli forms contamination in the water samples in the community. The results were as shown in fig 3.

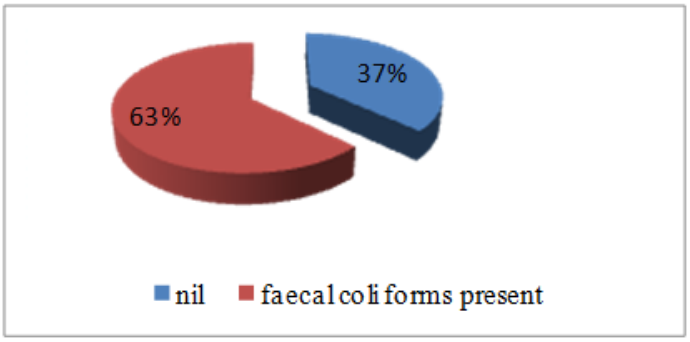

Fig 3: Presence of faecal coli forms

The majority of water samples collected (64%) from the households had evidence of microbial contamination by the precence of faecal coli-forms. The study revealed that greatest motivating factor for the choice of the water treatment method was the effectiveness of the methods used. However, a study by [37] which aimed at determining the factors that influenced water treatment behavior in Chad for the prevention of cholera contradicts this finding when it established that more than half of the respondents interviewed (55%) could not state even a single water treatment method. Interestingly, among the respondents who confirmed to know at least one method of water treatment, almost all of them (95%) mentioned chlorine in either liquid, powder or tablet form. These findings concurred with the results obtained from this study indicating that majority of the respondents 122 (38.9%) used chlorination for treating water with all of them asserting that their choice for chlorine is based on its effectiveness as opposed to the cost. Only 4 (13%) indicated that the choice of their water treatment method depended on its cost [36].

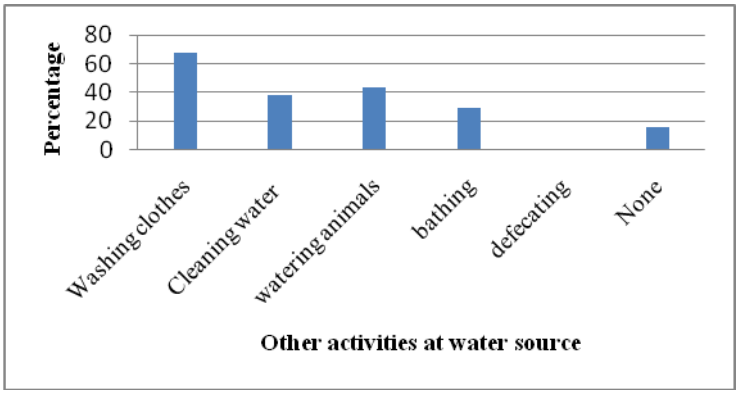

Fig 4: Other Activities taking place at the water source

Activities at the water source

Fig 4 reveals that 214 (67.9%) of the respondents indicated that washing of clothes is also done around the source of water while 138 (43.9%) reported watering of animals as another common practice at the source of water. The study established that only 2 (0.6%) reported defecating practice at the water source. The findings confirmed the results obtained in another study by [35] which indicated that activities undertaken at the source of water for domestic use and their effects as pertains to the contamination are great determinants predisposing the community members to the occurrence of diarrhoea. Further analysis was carried out to find out the relationship between the activities undertaken at the water source and the incidences of diarrhoea in the children under five. There was a significant relationship between other activities taking place at water source and the incidences of diarrhoea in children under five, χ^2 (4. 368, N=315) = 3.827, p<0.000 at α = 0.05. However, a study by [38] contradicted these findings when it identified that there was no statistically significant relationship between river water quality and diarrhoea incidences across the study area (p > 0.05). The study found out that the failure to practice water treatment before using the water for domestic purposes was a statistically significant predictor of diarrhoea incidences among the children below five years in the area of study (*p=0.028*).

However, the results obtained in this study contradicted the findings of other previous studies that established that point-of-use treatment of drinking water with chlorine had significant effects on the incidences of diarrhoea among the children below five years. For instance, a systematic review and meta-analysis conducted by [39] indicated that the intervention of water treatment using chlorine products at the point of use in the households reduced the risks of diarrhoea among the children below five years (pooled relative risk: 0.71,

0.58-0.87). Similarly, it significantly reduced the risk of stored water contamination with Escherichia coli (pooled relative risk: 0.20, 0.13-0.30). As indicated by [40] the period of water storage had a significant effect on diarrhoeal incidences in the household. In regard to the period taken to replace water in the storage container, a total of 214 (67.9%) of the respondents stated that they replace water in the storage containers after every two days while 138 (43.8%) reported to replace the water after a period of more than three days. Only (121) 38.4% of the respondents indicated that they replace water in storage containers every day. This indicated that majority of the household took more than two days to replace water in the storage containers hence, predisposing their children to diarrhoea [2].The findings identified with another study by [29] in Kenya who opined that there was an association between storage of drinking water and diarrhoea cases among children under five years. The study established that most mothers stored their water in buckets which were usually not covered or lacked fitting covers and thus exposure to dust and other pollutants. More than half (62.7%) of the mothers who stored their drinking water in buckets reported episodes of diarrhoea [30],[29].

Water contamination at the source, collection, transportation and storage was the main predictor of household children under five diarrhoeal incidences. This was a pertinent environmental hazard that greatly affected the households exposing them to the risks of diarrhoea cases. The economic status occasioning earthen floors with predisposed households to higher contamination levels leading to increased diarrhoea incidences. The toilet facilities in place were equally predisposing factors leading to increased incidences of diarrhoea attributed to propensity to use the bushes at the advent of having no toilets to access in the households. This ultimately occasioned night soil contamination and fecal traces in the sources of water accessed by the households. The disposition of the economic situations also determined the frequency of cleaning the toilets and in the event of latrines with no slab the toilets were not cleaned as they ought to. This occasioned great risks of contamination in the households and predisposed them to increased diarrhoea incidences. Water collection handling and storage was a household behavior practice which predisposed the occurrence of diarrhoea. This was attributed to the failure to have clean sources owing to fecal contamination at the point of collection and failure to empty storage containers and clean them regularly. Situation of poor sanitary practices which entailed defecation in the bush predisposed the occurrence of night soil and contamination of open water points like boreholes, wells and rivers.

Volume of water used per day and number people in household

Over three quarters 237 (75.7%) of the respondents reported fetching enough water for use at home on a daily basis. In this regard the relationship between the volume of water fetched per day and the presence of fecal matter was investigated using correlation coefficient. The findings had a relationship which had no statistical significance (r_S = -0.045, p = .01). The statistical findings led to the conclusion that the volume of water used in a day did not affect the presence of faecal coli-forms. The statistical findings can thus be deduced to show that regardless of the volumes of water consumed in the households, the contamination at the source determined the presence or absence of faecal coli-forms. Similarly, the study went further to relate the incidences of diarrhoea in children under five years and the numbers of persons living in the households. The findings had a correlation which had statistical significance between the incidences of diarrhoea in children under five years and the numbers of persons living in the households (r_S = 0. 014, p = 0.01). The findings were an indication that the numbers of persons living in the households affected the incidences of diarrhoea. This was mainly attributed to the handling of the water and the volumes involved owing to the populations in the households. These findings were in agreement with another research by [41] which argued that children belonging to families with more than six household members had 2.3 times higher risk of suffering from diarrhoea (95% CI =1.03-4.48) compared to the families that fewer than six members. These statistical findings pointed out to the possibility of some household members not exercising the requisite caution when fetching water due to the need to just meet the immediate needs thus getting it from unsanitary quarters. This poses a risk of developing diarrhoeal diseases to the entire household especially the children below five years who are most vulnerable.

The statistical findings identified with the results of a survey conducted by [28] which showed that the mean Kenyan household size is 4.2 persons. The findings from the survey indicated that there was an association between the household size and the prevalence of diarrhoeal diseases. Household size was found to be significant determinant of the number of meals for children less than 5 years during food shortage. It was also established that households with more family members recorded a higher number of diarrhoeal cases compared to households with fewer members. This indicated that the higher the household size the more family resources were divided among many hence the adequacy of the meals and proper nutrients were limited [42].

Breast feeding of children

Majority of the respondents 285 (91.1%) indicated that they started breast feeding their children within 24 hours after delivery while 19 (6.1%) said that they started after 24 hours. Only 9(2.9%) of the respondents did not respond to the question. The high number of respondents starting to breast feed their babies within 24 hours after delivery is attributed to the fact that the healthcare providers are educating their clients on the importance of breast milk in the body of their newborns as suggested by [43]. A third of the respondents (33.0%) reported breast feeding for a period of 12-17 months, 27.2% reported breast feeding for a period of after 18 months, 15.45% reported still breast feeding their children, 16.3% mentioned breast feeding their children for 6-11 months while the remaining 8.0% reported to have breast fed their children for only 0-5 months. The practice of breast feeding of last children was critical to understand the manner in which care and immunity of the children under five years was considered. In a number of FGDs, and the reports from the KIIs, precisely the CHEWs revealed that breast feeding of the children was hindered due to a number of factors such as, women's desire to maintain their figure, economic activities and poverty.

The study findings identified with the position taken by [44] who pointed out that in developing countries only 40-50% of infants less than two months and 25-31% of infants 2-5 months are exclusively breastfed and the proportion of infants 6-11 months of age receiving any breast milk is significantly low. In a system review on the benefits of breastfeeding on diarrhoea and pneumonia mortality conducted by [1] found out that breastfeeding protects against diarrhoea and respiratory infection in children under five years. It was emphasized on the other review conducted by [45] on the effect on the child health and growth of exclusive breastfeeding for 6 months which showed that morbidity from gastro-intestinal diseases was lower among infants who were exclusively breastfed for 6 months in comparison to infants exclusively breastfed for at least 3-4 months. The findings concurred with a study carried out by [46] who found out that lack of exclusive breastfeeding among infants 0-5 months of age and no breastfeeding among children 6-23 months of age are associated with increased diarrhoea morbidity and mortality in most developing countries. In addition, a research conducted by [47] in Chittagong, Bangladesh showed that breast feeding reduces exposure to contaminated fluids and foods, and contributes to ensuring adequate nutrition and thus guarantees non-specific immunity.

Food hygiene

Food hygiene plays a big role in causing diarrhoea and malnutrition among children in low socioeconomic communities [40]. Poor food hygiene especially in food preparation and feeding practices which increased the risk of diarrhoeal diseases, up to 70% of this diseases were caused by water and food contaminated with pathogens. Contamination of food can be related to the storage of food at room temperature for a long time and in the rainy seasons [47]. A cohort study in Turkey revealed that children whose houses did not have kitchens were more likely to suffer from diarrhoeal diseases compared to those who had [48]. A similar study in Nigeria showed that children who lived in houses with private kitchens had lower incidences of diarrhoea diseases than those children who did not have [49]. These findings were attributed to the fact that children living in houses that have no separate kitchen were more likely to access food leftovers as well as the one that drops on the floor which predisposes them to diarrhoea. Analysis was done to relate the study findings to the occurrence of diarrhoea attributed to the hand washing practices. Which reflected that majority of the respondents (81.3%) washed their hands before meals while 75.3% recorded washing hands after using the toilet. Only 37.7% of the respondents indicated that they washed their hands after cleaning the child who has defecated while 25.9% and 22.2% reported cleaning their hands before preparing food and before breast feeding the baby respectively. It was interesting to note that only 12% of the respondents reported washing their hands in all occasions. In addition, 89.6% of the respondents reported washing their hands with soap and water, 13% mentioned washing their hands sometimes with water alone and 7.6% reported washing hands always with water alone. Only 1.6% indicated that they did not wash their hands with soap and water while 0.3% did not give a response to the question.

Almost two thirds 88.2% of the respondents did not have a place for washing hands and the remaining 11.8% had a place for washing hands. The study findings confirmed the position of [50] whose research aimed at promoting hand washing intervention in Peru with an attempt to improve child healthcare. The study showed that a 42% - 47% reduction in diarrhoea can occur when the culture of hand washing with soap and water is introduced and sustained in the community [28] established that in the year 2012, 38,800 children lost their lives to diarrhoea and pneumonia in Kenya alone. In spite of many attempts by various organizations to promote hand washing through modern communication channels in Kenya, the practice has not been fully embraced. The findings of this study concurred with a study by [51] which indicated that poor maternal hand washing practices were positively associated with diarrhoeal morbidity among the children below five years. The research found out that children whose caregivers had poor hand washing practice were 2 times at high risk of developing diarrhoea compared to those whose caregivers had good hand washing practice (APR=2.33 {95% CI: 1.80, 4.15}). The study concluded that there was need for mothers being the main caregivers for their children to wash

their hands properly before feeding children to minimize the occurrence of hygiene related diseases. Many past studies have emphasized on the essence of proper hand washing before feeding children especially those below five years to prevent diarrhoea and other related diseases [52]. The study also sought to find out the hygiene practice of disposal of children faeces. The responses were as shown in figure 5.

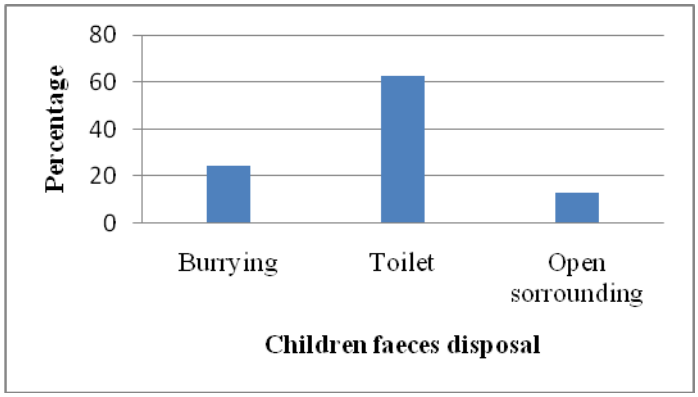

Figure 5: Disposal of Children Faeces

Disposal of children's faeces

More than half of the respondents 196 (62.4%) reported to be putting the child's faeces in the toilet, 77 (24.5%) reported burying of the child's feaces while the remaining 41(13.1%) reported throwing the faeces away in open surroundings. The practices were reflective of the situation whereby the disposal of faeces by the households was a factor which pre-disposed them to the risk of contracting diarrhoea from the exposure [11]. An analysis of the care offered to the children after defecation and the methods used showed that a total of 90.4% of the respondents reported cleaning the child right away after defecating while the other 9.6% reported cleaning the child after sometime. Further evaluation of the practices carried out in the cleaning process showed that 36% reported cleaning the babies with water, 30.2% reported using leaves while 28.4% mentioned using tissue paper. The remaining 5% and 0.4% mentioned using cloth and dragging the baby on the ground respectively. Analysis of the facilities used for defecating in the households showed that the highest number of respondents 210 (66.8%) reported using the latrine only as a defecating facility in the homes, the use of the bush was reported by 101(31.9%) of the respondents and the remaining 4(1.3%) reported using the neighbors' toilet for defecating as illustrated in Figure 6. The findings indicated that availability of a toilet facility in a household is an important factor in reducing the risk of diarrhoea among the children below five years. The results were in agreement with the findings of a study by [53] which found out that there was a significant association between the availability of toilet facility and the diarrhoeal morbidity at the household level. In the multivariate model which included two demographic variables and the toilet facility, the toilet facility retained its negative significant effect. Similarly, it was also found out that the presence and correct use of the toilet facility reduced the risk of diarrhoea by 26%.

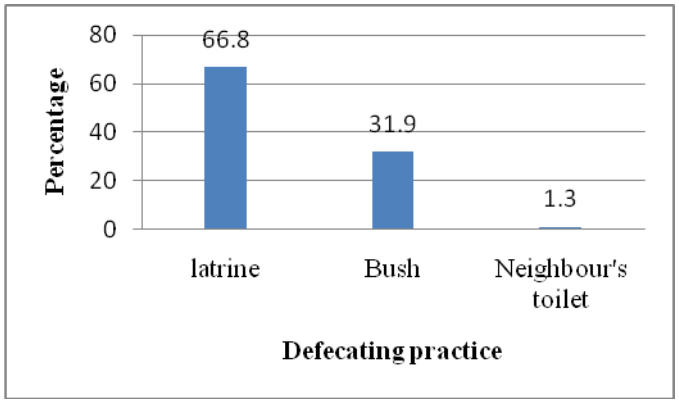

Fig 6: Facilities used for Defecating in the Household

Type of toilet facility used in the house

The study went further to relate the toilet facilities used in the households and the occurrence of diarrhoea incidences. A Pearson product correlation on the type of toilet facility and incidences of diarrhoea in children under five was done. The findings reflected a correlation which did not have statistical significance

between the type of toilet facility and incidences of diarrhoea in children under five (r_S = -0.074, p = .01). Thus showed that regardless of the toilet facilities in use, the incidences of diarrhoea could be predisposed and attributed to other factors other than the type of toilet facility available. Further analysis revealed that there was positive significant statistical relationship between the care given to children after defecating and the incidences of diarrhoea in the household, χ^2 (2.783, N=315) = 2.318, p<0.000 at α = 0.75. The statistical findings confirmed that the practices used in the handling of the children after defecation had a direct bearing on the exposure to the inherent risks of diarrhoea in the children less than five years of age. A Pearson product correlation test on the relationship between the incidences of diarrhoea in children under five years and the faeces disposal practices was done. The correlation had statistical significance (r_S = 0. 018, p = 0.01). These findings were found to be consistent with those of other studies globally. For instance, a study by [54] that sought to find out the association of safe disposal of child faeces and the reported diarrhoea cases in Indonesia indicated that that the unsafe disposal of child feces at the household level is strongly associated with an increased number of diarrhoea cases (OR: 1.46; 95% CI: 1.18-1.82, p = 0.001). Similarly, a meta-analysis that examined 10 observational studies across several countries noted that risky child feces disposal behaviors such as open defecation and stool disposal in the open surrounding were associated with 23% increase in diarrhoea morbidity (RR: 1.23, 95% CI: 1.15-1.32). On the other hand, the analysis found out that safe disposal or handling of child feces through latrines, potties and toilets were borderline protective and therefore they reduce the morbidity of diarrhoea among the children below five years (RR: 0.93, 95% CI: 0.86-1.00).

Regarding to the washing of hands after defecating, 61 (19.5%) indicated that they washed their hands with water only as a way for caring for hands after defecating. A significant majority 244 (78%) reported washing hands with water and soap and only 8 (2.6%) reported never washing hands. The findings showed that quite a good number of respondents were aware of the role of hand washing in reducing diarrhoea and other hygiene related diseases. The study findings were in tandem with [55] who pointed out that diarrhoeal disease was mostly spread by person to person contact, ingestion of food and water contaminated by fecal matter or direct contact with infected faeces. Studies by [1],[55] showed that over 70% of diarrhoea cases were attributed to ingestion of contaminated food and water. The most important risk factors were behaviors that encouraged human contact with fecal matter which included improper disposal of human waste and lack of hand washing after handling faeces and before handling food [33]. In many low income countries, households lacked facilities for proper disposal of human waste and even where available they were not adopted for the use of children [56]. This led to open defecation and hence increased the risk of handling excreta by mothers, care givers and even children themselves. Evidence showed that children's faeces contained higher concentration of pathogens than those of adults due to their increased interaction with contaminated materials in their environment [53].

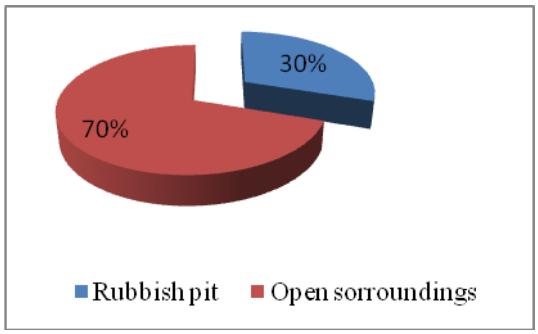

Fig 7: Disposal of Waste Food and Water

Figure 7 shows that 218 (69.9%) of the respondents reported disposing waste food and water in the open surrounding while 94 (30.1%) reported disposing the waste food and water in the rubbish pit. A study by [51] defined proper waste food disposal as the best way of disposing refuses and food left overs which included burying in a pit, storing in a container and disposing of waste only in designated places while the disposal of waste food and water in open ground was considered unimproved-disposal method. It is evident from the data obtained from this study that majority of the respondents used unimproved waste disposal as opposed to proper waste disposal hence may be a contributing factor to the increased diarrhoeal incidents as established by [34]. However, it is interesting to note that [51] found out that only 39 (33.9%) of those who practiced improper waste disposal had suffered from diarrhoea while an overwhelming majority 76 (66.1%) had not had diarrhoea. Following these results they did not find the ground to positively associate the unimproved waste disposal with the occurrence of diarrhoeal diseases since there was no statistical significance in the value obtained (CPR 1.14: 95% CI, 0.85-1.53 p< 0.05).

IV. Conclusions

The study conducted highlights that Water contamination at the source, collection, transportation and storage was the main predictor of household children under five diarrhoeal incidences. Lack and low utilization of toilet facilities and indiscriminate disposal of children faeces in place were equally predisposing factors leading to increased incidences of diarrhoea attributed to open defection. Poor water collection handling, treatment at point of use and storage predisposed children the occurrence of diarrhoea. This was attributed to fecal contamination at the point of collection and failure to empty storage containers and cleans them regularly. Proper Hand washing after all the five critical moments was not carried out correctly and consistently thus accelerating the risk of increased diarrhoea morbidity in the households. Households which were big in size had the practice of fetching a lot of water and ran the risk of failing to observe the requisite sanitary practices. The practice of complementary feeding children was often started from when they are six months also occasioned reduced immunity owing to lack of adequate nourishment from the breast milk. This predisposed the kids to higher incidences of diarrhoea from reduced immunity and contamination in the food preparation stage.

Conflict of Interest: The authors declare that there is no conflict of interests.

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