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Epidemiology of Waterborne Diarrhoeal Diseases among Children Aged 6-36 Months Old in Busia - Western Kenya

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***Abstract*—**The purpose of the present study was to evaluate the epidemiology of waterborne diarrhoeal among children aged 6-36 months old in Busia town, western Kenya. The study was carried out between Feb. 2008 and Feb. 2010. Cases of diarrhoea reported in 385 households were linked to household water handling practices. A mother with a child of 6-36 months old was also included in the study. Diarrhoea prevalence among children 6-36 months was 16.7% in Busia town, Bwamani (19.6%) and Mayenje (10.6%) clustered in Mayenje sub-location reported the highest and the lowest prevalence of diarrhoea. There was a positive correlation between the prevalence of diarrhoea in children and the level of the mother's education, 29.9% (n= 100). Diarrhoea cases decreased in range from 35.5% (n =102) to 4.8% (n= 16), corresponding to increase in age from 6-35 months on average. In conclusion, prevalence of diarrhoea in children of 6-36 months old was 16.7% in Busia town. This was higher in children whose mother's age was below 18 years and with low level of education, the rate decreased with increase in age of children. Prevalence of diarrhoea in children aged 6-36months in households was higher in children aged 6-17 and 36 months and whose mothers were less educated and fell between the ages of 18-24 years. The Influence of human activities at the main source of drinking water on the prevalence of diarrhoea in these children was insignificant.

***Keywords*—**Diarrhoea, Children, Mortality, Waterborne disease,

I. Introduction

GASTRO-intestinal water-borne infections are among the most emerging and re-emerging infectious diseases throughout the world. They are infections that affect mainly the stomach and the Gastro-intestinal tract. They are mostly endemic with a worldwide distribution and they have a heterogeneous aetiology. Most water-borne diseases that are caused by organism ranging from microscopic viruses (rotarine) of less than 18mm in diameter to parasites of 10cm in length culminate into diarrhoea and cause approximately 5 million reported deaths annually [1]. Diarrhoea can be recognized by four clinical features, each reflecting the basic underlying pathology and altered physiology. These clinical features are acute watery diarrhoea, acute bloody diarrhoea, persistent diarrhoea and diarrhoea with severe malnutrition of which 50% of worldwide cases of the condition present with watery diarrhoea. Approximately 35% are persistent diarrhoea and 15% dysentery-diarrhoea with blood stains [2].

Diarrhoea is a major cause of death and disease, especially among young children in low-income countries. Dehydration is the major threat, though diarrhoea also reduces the absorption of nutrients, causing poor growth in children, reduced resistance to infection, and potentially long-term gut disorders. Among infectious diseases, diarrhoea ranks as the third leading cause of both mortality and morbidity (after respiratory infections and HIV/AIDS), placing it above tuberculosis and malaria. Young children are especially vulnerable, bearing 68% of the total burden of diarrhoeal disease [3]. Among children less than five years, diarrhoea accounts for 17% of all deaths. Annually, at least 1,500 million episodes of diarrhoea occur in children under the age of five years with an estimated 4 million children deaths due to diarrhoea [4]. WHO [5] indicated that 20-40 litres of water per person per day located within reasonable distance from households is sufficient. Approximately 1.1 billion persons lack access to safe water sources [6] and are among the 2.4 billion who use wood for cooking [7]. Kung'u *et al*, [6] reported that 37% of all cases of diarrhoea in the world occur in sub-Saharan Africa. In Kenya, morbidity patterns over the last 10years rank diarrhoea as the fourth priority disease [8] and it occurs in repeated episodes and leads to growth failure, malnutrition and deaths among children under five years of age [8]. In the year 1990, Central Bureau of Statistics [9] estimated that only 48% Kenyans had access to safe drinking water, but this declined to 45% in 1996. However, there are many parts of Kenya, which have only 25% access to safe water. In 1996, only 40% of the rural population had access to adequate sanitation, and among subsistence farmers and pastoralists, use of unsafe water was prevalent at a rate of 70% [8]. In Busia Kenya, morbidity and mortality due to diarrhoeal diseases affected a total of 2,293 children below five years of age with 9.7% constituting death [10] thus the basis of this study.

In developing countries, only around 40% of the rural populations have access to good quality water [11]. Contaminated water is known to be a major source of

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waterborne illness and in Kenya microbiological tests are rarely done because standard methods are unavailable or unaffordable [7]. In Kenya, the Ministry of Health established National Control of Diarrhoeal Diseases Programme in 1996 placed emphasis on improvement of case management through re-hydration and better feeding than disease prevention at community and household levels [12], despite 50% and 34% of the population lacking access to safe drinking water and without basic sanitation services, respectively [13]. Almost 50% (12.6 million in rural and 3.3 million in urban areas) of the 32 million Kenya's population lack access to safe drinking water and sanitation [13]. The government of Kenya in 1980 set a goal of providing safe and potable water at a source less than one kilometre from homes in high potential (or water rich) and less than five kilometres away in low potential (or water deficient) areas by the year 2000 [12]. Though the target has not been met, provision of safe drinking water still remains a priority item in the government's development agenda. In recent formulation of the National Programme of Action (NPA), the goal of universal access to safe drinking water was emphasised as well as the need to reduce the distance travelled by women and children to fetch water [12].

Diarrhoea is a symptom complex characterized by stools of decreased consistency and increased number. The clinical symptoms and course of the disease vary greatly with the age, nutritional status, and immunocompetence of the patient, and the aetiological agent infecting the intestinal system and interfering with normal adsorption. Most cases resolve within a week, though a small percentage continue for two weeks or more and are characterized as 'persistent' diarrhoea. Dysentery is a diarrhoeal disease defined by the presence of blood in the liquid stools [14]. About 35% of the deaths from diarrhoea in children less than five years old are attributable to acute non-dysenteric diarrhoea, with 45% from persistent diarrhoea and 20% from dysentery [15]. Though epidemic diarrhoea such as cholera and shigellosis (bacillary dysentery) are well-known risks, particularly in emergency settings, their global health significance is small compared to endemic diarrhoea [16]. The immediate threat from diarrhoea is dehydration − a loss of fluids and electrolytes. Thus, the widespread promotion of oral rehydration therapy [ORT] has significantly reduced the case-fatality rate associated with the disease. Such improvements in case management, however, have not reduced morbidity, which is estimated at four billion cases annually [17]. Generally, diarrhoeal infections among children less than five years of age in developing countries are associated with rotavirus often at the time of weaning [20]. The infectious agents associated with diarrhoeal disease are transmitted chiefly through the faecal-oral route [21]. A wide variety of bacterial, viral, and protozoan pathogens excreted in the faeces of humans and animals are known to cause diarrhoea. Among the most important of these are *Escherichia coli*, *Salmonella sp.*, *Shigella sp.*, *Campylobacter jejuni*, *Vibrio cholerae*, rotavirus, norovirus, *Giardia lamblia*, *Cryptosporidium sp.*, *and Entamoeba histolytica*. The importance of individual pathogens varies between settings, seasons, and conditions. While bacterial agents as a group are believed to cause a majority of diarrhoeal disease in developing countries, viral and protozoan agents tend to cause more cases in developed countries [16]. Many of these diarrhoegenic agents are potentially waterborne − transmitted through the ingestion of contaminated water.

Regardless of water quality, wide spread unhygienic water handling and limited access to sanitation facilities perpetuates transmission of diarrhoea [22], [23]. Semenza *et al*, [24] warned that deteriorating water distribution systems posed a significant public health in terms of episodes of diarrhoeal diseases in Uzbekiztan. In Rwanda, water in 43.4% homes had more than 1100 coliform per 100ml due to use of unclean utensil for transport [25]. Pipes as a distribution system served as a source of disease transmission due to leaky pipes and lack of water pressure [24]. Lubys *et al*, [26] reported that despite of increase in access to drinking water in India in the past decade, tremendous adverse impact of unsafe water still continues and that persons in low-income countries do not have access to safe drinking water in predominantly middle class households, a case study in the neighbourhood of Karachi. Among the Nukus in the former Soviet Union, 20% of residents lacked access to piped water [24]-[27]. Almost 24% of Kenyan households draw drinking water from either rivers or streams while the rest have piped water connected to dwellings or on compounds that form a total of 21%, whereas 11% use public tap and 2% use wells, majority of which are covered. Households that fetch drinking water from springs are 13.1% as, 2.1 % and 0.2% use rain and bottled water for drinking, respectively [28].

In Busia Kenya, cases of diarrhoea are ranked third among the top major causes of morbidity among under five years old in-patients and sixth among adult outpatients in the district, according to the Busia district health service work plan [10]. According to El-Gilany and Hammad [29], persistent mobility due to diarrhoea in early childhood may have long term effects on growth and cognitive function resulting from removal of essential body fluids and vital nutrients that lead to dehydration, malnutrition, growth failure and death [4]. Water from source of water may not ensure water quality at the time it is consumed [29], and according to CDC [13], there is need to provide safe water in households using chlorine tablets, boiling and filtration. This study therefore sought to determine the epidemiology of diarrhoeal diseases caused by drinking water contaminated through poor handling, insufficient quality of supply and treatment practices among children aged 6-36 months old in Busia town, western Kenya.

II. Materials and Methods

A. Study sites

This study was carried out in Busia district in western Kenya. The district is bordered by Kakamega district to the east, Teso district to the north, Nyanza province to the southeast and the republic of Uganda to the western side. It lies between latitude 0° and 0° 250' north and longitude 33°54' east. The district covers an area of 1,262 square kilometres [30]. The district is divided into six administrative divisions, namely, Nambale, Butula, Funyula, Matayos, Budalangi and Busia Township [10]. The district total population was 369,209 with density of 327 persons per square kilometre (CBS, 2001) in 81,697 households [30] (Fig. 1). According to DMOH-Busia [10], there were 179 adults and 202 under five children in-patients and 6,594 adults and 2,091 under five children out-patients in a total of 29 health facilities (2 hospitals, 1 sub-district hospital, 6 public health centres and 17 dispensaries) in the district. There were four main types of water sources that supply water to households. They included springs (25%), boreholes (21%), protected wells (17% and 14% households are supplied by water from water treatment works [10].

B. Study population and design

This was a cross-sectional study done between Feb, 2008 and Feb, 2010. All households in the three sub-locations in Busia district were invited to participate in the study. Busia town population consisted of 11,660 males and 12,687 females living in 6,049 households [9]. Primary data was collected and analysed to determine prevalence of diarrheal diseases caused by water contaminated through poor handling practices and treatment households in a recall period of two weeks to elicit more accurate data. Persons responsible for handling water in the household, usually the female head of households or oldest daughter were interviewed about family socioeconomic and demographic characters, hygienic habits and water handling practices. Household mothers were interviewed on water handling, treatment and storage within the study period in retrospect. This study identified cases of diarrhoea reported in households and attempted to link them to household practices that contaminated drinking water through poor handling, treatment and storage in a sample of 385 households. A mother was included in the study if she had a child of 6-36 months of age. The study population targeted was all children 6-36 months of age in the 385 sampled households and who were in the same strata for at least six months. West Isukha sublocation – Khayega location was also considered in the study for data comparison purposes. Majority of the population in west Isukha location is rural. The nearest urban center is Khayega. The population is dominated by peasant farmers who rely on water from rivers, streams, boreholes and springs. Tap water is only found in institutions such as schools and hospitals and in homes of more affluent individuals. Authority by the local administration to collect data was sought to mobilise the community in both cases.

C. Data collection

Because of the difficulty of monitoring water for the presence of all such agents, an indirect approach was adopted where water is examined for indicator bacteria whose presence implies some degree of contamination. While there is controversy over the preferred indicator [31], even those that accept the use of the coliform group use different target indicators (total coliforms, thermotolerant coliforms, *E. coli*) and different methods for assaying the level of indicator present (membrane filtration, multiple tube/most probable number) [32]. In this study it was assumed that the occurrence of cases of diarrhoeal diseases in children 6-36 months old was due to contaminated drinking water, which was the only source of exposure to the infection in households in Busia town, western Kenya. Households in Busia town are found in various strata that have different environmental and social-demographic factors. The strata include: Maduwa, Mauko, Lukonyi, Burumba, Bwamani, Nangwe, Bulanda, Mbale, Siteko A, Siteko B and Mayenje (Table I). The strata were naturally subdivided and not overlap. The sampling technique used for this study thus proportionate stratified sampling.

Values for the variables about the community were established by open questionnaire with open and closed ended questions pre-developed and administered to mothers for two weeks. Water for bacteriological analysis was sampled randomly from household of interviewed mothers and from sources within the study areas while borehole and water treatment works sampling were purposively collected. A total of 8 water samples of 100 millimetres each in labelled and tightly sealed sterile bottles packed in cool box then submitted to Medical laboratory in Vihiga District Hospital the same day for analysis. In the laboratory Colilert test [7] was used to detect levels of total coliform bacteria and *E. coli* simultaneously in water within 24 hours from the time of sampling. Ten millilitres of sampled water was drawn by pipette and added to 1 ml of Pertrifilm in a test tube then corked and inverted repeatedly to allow mixing and incubated at 35°C for up to 24hours to promote bacterial growth. Incubated specimens were examined under light and in darkness using UV (340nm) light for resultant colour. If *E. coli* was present tubes would show fluorescence blue in 10-18 hours, depending on levels of *E. coli* contamination (10 hours with heavy contamination and 18 hours with lesser contamination). Clear resultant colour of test tubes implied no coliforms present and was thus safe for drinking. Yellow colour and fluorescence blue under UV light indicated presence of *E. coli*. For qualitative test on heavy contaminated water (1 or more *E. coli*/ml), the *E. coli* count Pertrifilm was used [7]. Information on the source of drinking water was available for 6,542 residents. These were classified as; water treatment work, protected spring, natural spring, borehole, protected shallow well, unprotected shallow well (Table II & III).

Diarrhoeal diseases in children was measured by prevalence, type and management and theoretically linked with factors that influence water handling and treatment which involved enquiry for residence of children, age, occupation and education of mothers, distance from water sources, method of treating water in households, facilities used to store water, type of water source, mode of water transport, persons responsible in supplying water to households and quality of water from sources of drinking water. In Isukha, majority of the respondents got their water for domestic use i.e. drinking, cooking and washing from the springs and river Isukha. In many schools, there were tanks installed to harvest rainwater.

D.Statistical analysis

Data were entered in Microsoft Excel 2002 (Microsoft Corp.1985—2001) and statistical analysis done using SPSS 10.0 for Windows software (SPSS Inc., 1985 – 2001). Frequency distribution was used to show the distribution of prevalence of cases of diarrhoeal diseases in the study population in relation to characteristics of households. The two-tailed χ^2 test was used to test for differences in proportions between the different subgroups in relation to diarrhoeal diseases, water handling, treatment practices and other demographic characteristics at $P \leq 0.05$.

III. RESULTS

The survey identified a total of 334 children with diarrhoea, of whom 282 were permanent residents and 52 non-permanent resident's children but were within the study area for not less than two weeks during the study. A total of 385 mothers were interviewed. The demographic characteristics considered were on occupation, level of education and age of mothers to children of age 6 months to 3 years in households. Households whose mothers were public health servants constituted 25% of the 385 households sampled for this study. Business mothers represented majority of respondents at 33.2%. Mothers who were farmers constituted 21.3% whereas, 20.3% never had formal occupation. The study included 34.5% mothers who had attained primary level of education and 20.3% mothers with secondary level of education. Mothers with tertiary levels of education were 14% while mothers with no education at all formed 31.2% of the respondents. Mothers interviewed were modal age below 18 years.

Diarrhoea prevalence among children 6-36 months of age was 16.7%. Other sub-locations had higher diarrhoea prevalence (25.2%) while Mayenje had relatively lower prevalence (13.7%). Bwamani and Mayenje clustered in Mayenje sub-location reported the highest and the lowest incidences of diarrhoea prevalence at 19.6% and 10.6%, respectively.

Children whose mothers had no education experienced higher prevalence of diarrhoea, thus 29.9% (n= 100). Children whose mothers had attained primary level of education had a prevalence of 27% (n= 90). There were decrease in ranges of cases of diarrhoea from 35.5% (n =102) to 4.8% (n= 16), which corresponded to increase in age from 6-35 months on average. There was 30.5% (n =102) children in age group 6 to 11 months who had diarrhoea in households. Age group 12 to 17 had 23.7% (n = 79) children with diarrhoea irrespective to level of education of mothers. There were 13.2% (n =44) of children with diarrhoea in age group 6 -11 months in households whose mothers were of no level of education. Cases of diarrhoea reported by description were watery, bloody [or dysentery] and chronic. Watery diarrhoea accounted for 65.3% (n = 218) of the total cases and among whom, female children constituted 42.8% (n = 143) and they were the majority. Bloody diarrhoea accounted for 7.2% (n = 24) in male children and 11.1% (n = 37) in females. Children with chronic diarrhoea were 16.2 % (n = 54) of all the children in households. Overall, there were few children reported with chronic diarrhoea, especially among the males. There were more female children with diarrhoea than males reported with diarrhoea in a ratio of male to female 1:2 children in households of Busia town; this was contrary to findings by Onyango *et al*, [33]. There was no difference in the proportions of children with diarrhoea in relationship with occupation of mothers, i.e. public servants 23.4%, and business 24%, farmers 24.6% and others 28.2%.

Distribution of children reported with diarrhoea by water source and sub-location of residence found that unreported well 18.9% (n=63) and natural spring 14% (n=47) had high children reported with diarrhoeal diseases particularly in Mjini sub-location where some mothers did not know source of their water and reported 2.4% children with diarrhoea. Water source showed $\chi^2 = 6.21$, ($P \leq 0.05$) (Table IV). Mjini sub-location had 17.1% children with diarrhoea whose mothers were below 18 years old. Mothers who were 35 -39 and those ≥ 49 years reported 9% and 8% children with diarrhoea in Mjini and Mayenje sub-locations respectively. Overall, there were 53.8% children with diarrhoea and whose mothers were utmost 24 years old. Majority of children with diarrhoeal diseases were of mothers whose age were utmost 24 ≤ 25 years and resided in Mjini sub-location (Table V). Age of mothers and sub-locations of residence, in Busia town showed $\chi 2 = 55.87$, ($p \leq 0.05$).

There were 2.7% children reported with diarrhoea in households which were less than 500 meters from the water source. Children in households more than 1500 meters away from water source formed 56.6%. Household with pipe scheme as means of transporting water reported 17% children with diarrhoea. Mothers in households supplied with water by pull or pushcarts reported 4% children with diarrhoea. There were 70% of children that experienced diarrhoea from households supplied with drinking water carried on the head or back. Households supplied by water on the bicycle had 9% cases of diarrhoea in children. There were 31.1% children reported with diarrhoea in households that stored drinking water in wide brim vessels. There were 64.4% children with diarrhoea in households that stored drinking water in narrow brim vessels with no cover. 1.5% children diarrhoea cases were reported from households that stored water in narrow brim vessels with cover. Water storage facilities especially with wide brim and without cover was highly associated with occurrence of diarrhoeal diseases in children. Pearson's correlation 0.12 ($P \leq 0.02$). Association between distance of water source from households, type of sources of water and mode of transporting water to households from source had no significance on water handling and treatment practices with diarrhoeal disease in children of 6-36 months old ($P \geq 0.05$).

Activities at main sources of drinking water included bathing and washing, cultivation, watering animals, among others. The study showed that 44% of children 6-36 months old reported with diarrhoea were from households whose water source was also used for washing and bathing. Fetching drinking water from a source where activities such as bathing as were undertaken showed no significant association with diarrhoea in children F= 1.372 ($P \geq 0.05$). Consumption of water contaminated by air and dust during transportation was associated with 28% (n=92) children reported with diarrhoea. Other sources of contamination, which included others like putting fresh leaves in water in transporting vessels, were associated with 53% (n=178) cases of diarrhoea F=14, ($P \leq 0.05$). Contamination of water at source, during transportation, practice of water treatment in households and water drawn from storage facilities had significant influence on diarrhoea diseases in children, F= 17.01 ($P \leq 0.05$).

Methods of domestic water treatment practices included boiling, chemical disinfection by a mixture in fixed doses of iron sulphate and calcium hypochlorite commonly known as "pur" used for slight raw turbid water and sodium hypochlorite commonly known as water guard for cleaning water. Households with no form of domestic drinking water treatment showed 42.2% (n =141) risk of contracting diarrhoea. The differences in cases of diarrhoea in households that treated water for drinking by boiling to those that did not carry any form of water treatment in households was 23%. Other domestic treatment methods which included exposing water in the open broad sunshine, storing undisturbed for hours before use, use of herbs showed 26.3% (n=42) cases of diarrhoea among children 6-36 old. Domestic drinking water treatment highly reduced prevalence of diarrhoea in children, F, 16.5 ($P \leq 0.05$), while persons transporting water to households, contamination of water source and water during transportation showed significant influence on prevalence of diarrhoea in children, F, 3.153, F, 17.01 and F, 14, respectively ($P \geq 0.05$) and similarly to mode water was drawn from storage facilities, F, 9.63 ($P \leq 0.05$) and similarly to mode water was drawn from storage facilities, F, 9.63 ($P \leq 0.05$).

In West Isukha, 50% of the interviewed household respondents boiled water while less than 20% chlorinate their water. Most correspondents preferred boiling water to other water treatment methods because to them method was most effective in killing disease causing germs. Filtering was the least preferred method since the pieces of clothes used to filter the water were believed to be porous to germs. Some did not bother filtering their water may be due to poverty. Chlorinating products were easily available as "stones" on the market or as "Water Guard" (marketed by Population Services International) which could be bought at the counter easily. Some of the products used for water purification were; commercial filters (2.2%), Water Guard (31.6%), chlorine tablets (4.5%), chlorine "stones" (9%), other products (42.6 %) and no product used (10.1%). Part of the other products used for water purification included use of charcoal that is derived from indigenous tress. The most commonly used tree is the teak tree. This was found to be the traditional method for water purification that has been in practice for long in this

TABLE I
HOUSE HOLD SAMPLE SIZE DISTRIBUTION STRATA

Strata		Total No. of HHs	No. of HH sampled
Mjini sub-location			
	Maduma	1305	76
	Mauko	778	46
	Lukonyi	1208	71
	Burumba	1126	66
Mayenje-sub-location			
	Siteko A	197	11
	Siteko B	235	14
	Mayenje	198	12
Other sub-locations		496	29
Total		6542	385

HH (house hold)

TABLE II
THE EXISTING SOURCES FOR DRINKING WATER TO HOUSE HOLDS IN BUSIA TOWN

Water Sources	No. existing
Water treatment work	1
Protected spring	20
Natural spring	65
Borehole	8
Protected shallow well	10
Unprotected shallow well	40

TABLE III
SOURCES OF WATER IN WEST ISUKHA LOCATION; RESPONDENT DATA ON WATER SOURCES FOR DOMESTIC USE

Source	Frequency	Percentage
Tap water	380	35.50%
Borehole	130	12.10%
Rainwater	36	3.40%
Spring/River water	400	37.40%
Other Sources	100	9.30%
TOTAL	1,070	100%

TABLE IV
CASE OF DIARRHOEA BY SUB-LOCATION IN BUSIA TOWN

Water sources	Mjini (n = 99)	Mayenje (n = 83)	Others (n= 52)	Total (n = 334)
Treatment works	13 (3.9%)	5(15)	3(0.9)	21(6.6%)
Shallow well	24(7.2)	10(3)	7(2.1)	41(12.3%)
Bore hole	22(6.6)	9(2.7)	6(1.8)	37(11.1%)
Natural spring	47(14.1)	19(5.7)	13(3.9)	79(23.7%)
Protected spring	22(6.6)	9(2.7)	6(1.8)	37(11.1%)
Unprotected well	63(18.9)	31(9.3)	17(5.1)	111(33.2%)
Do not know	8(2.4)	0	0	8(2.4%)

area. Fine sand, ground charcoal and cotton wool are put in cylindrical container in different layers. The container is cylindrical with both ends open so that water is poured one end and goes through the cylinder to the other end. 42.6% of the correspondents used this method of water purification. The chlorine “stones” are dropped into boreholes and protected springs.

Mothers in households supplied by water from water treatment works reported 1.1% children with diarrhoeal diseases, while majority of the cases of diarrhoea were among children who drunk from unprotected wells. Risk difference in cases of diarrhoea in households that drew water from unprotected wells and shallow wells was 3.6% (n=70). Children in households whose main source of drinking water was borehole showed 1.1% children with diarrhoea, while children whose main source of drinking water was protected spring showed 1.9%. There were 5.8% children in households that fetched drinking water from shallow wells. Effects of domestic drinking water treatment was highly significant in reduction of cases of diarrhoea (p=0.05). Probability of children not having diarrhoea in households that treated drinking water was high, 0.9 (n=1581), compared to those that treated water in their water domestically and reported diarrhoeal disease.

TABLE V
DISTRIBUTION OF CHILDREN WITH DIARRHOEAL DISEASE BY AGE OF MOTHER AND SUB-LOCATION OF RESIDENCE IN BUSIA TOWN

Mothers (age)	Mjini (n = 199)	Mayenje (n = 83)	Others (n = 52)	Total (n= 334)
<18	57 (17.1)	24(7.2)	14(4.2)	95(28.4)
18 -24	51 (15.3)	21 (6.30	13(3.9)	85(25.40
25-29	27(3.3)	11(3.3)	8(2.4)	46(13.8)
30-34	18(5.4)	8(2.4)	5(1.5)	31(9.3)
35-39	7(2.1)	3(0.9)	2(0.6)	12(3.6)
40-44	24(7.2)	10(3)	7(2.1)	41(12.3)
45-49	13(3.9)	5(1.5)	3(0.9)	21(6.3)
50+	2(0.6)	1(0.3)	0	3(0.9)

IV. DISCUSSION

The occurrence of water-borne diseases exhibits seasonal variations. After the start of the rainy season much faecal material is washed into ponds and rivers [34]. These results in heavy contamination of water, hence the high incidences of diarrhoea diseases. In the dry season especially in developing countries where the amount of water available for cleaning purposes decreases, there is always likelihood for increased infection. Prevalence of diarrhoea in the study population established was 16.7% in children of 6-36 months in households in Busia town.

In Mjini sub-solution, there were more children with diarrhoea than in Mayenje sub-location. However other sub-locations situated in rural, reported high prevalence of diarrhoea in children 6-36 months old than the rest of the sub-locations in Busia town. Age of mothers and area of residence had significant difference in influencing prevalence of diarrhoea in children. According to El-Gilany and Hammad [29], frequency of diarrhoea was significantly higher in children who lived in rural areas, whose age was 6-24 months, in high birth order, and of younger mothers who had low education and were non professional or who did go out to work during summer and lived in crowded places where refuse disposal was infrequently done. Majority of children reported with diarrhoea were in age group 6 - 11 months. The types of diarrhoea reported among children 6-36 months old were watery, dysentery and chronic. Children who had watery diarrhoea were more than those who had dysentery diarrhoea and chronic diarrhoea combined.

According to WHO [4], 50% world cases of diarrhoea present with watery diarrhoea and approximately 35% are chronic diarrhoea while 15% form dysenteric diarrhoea of the 1,500 million episodes of diarrhoea in children under the age of 5 years that results in 4 million deaths. Distance between households and main source of drinking water was not significantly associated to cases of children reported with diarrhoea in households. This concurs with findings reported by WHO [22] about a tremendous adverse impact of unsafe water in India despite of increased access and also that regardless of the initial water quality, widespread unhygienic practices during collection and limited access to sanitation facilities perpetuated transmission of diarrhoea. This study found domestic water treatment highly significant in reduction of cases of diarrhoea in children, a probability of children 6-36 months not having diarrhoea in households that treated drinking water was high compared to those that did not treat water. Therefore, there is no clear evidence that water quality interventions are more effective in preventing diarrhoea when combined with any of the additional interventions; hygiene promotion; separate vessel for water treatment or storage, or both; or improvements in sanitation or water supply.

In western Kenya, Makutsa *et al*, [27] reported that more respondent treated water primarily by boiling, but during focused group discussion found that many rarely treated water despite believing that contaminated drinking water was the main cause of diarrhoea in the village. Occupation of mothers had no significant correlation with prevalence of diarrhoeal diseases among children 6-36 months in households in Busia town.

In regard to water quality, protected spring showed moderate general bacteria colony counts and was judged contaminated. All water sources sampled were at least contaminated with coliform bacilli and general bacteria. Natural spring and unprotected wells were highly contaminated with ≥30 colony unit count for coliform bacilli and was implicated in the cause of higher prevalence of diarrhoea in children than water treatment works that had clean and safe water coagulated with alum, retained to sediment and chlorinated. Protected spring and protected well had access to some form of contamination with general bacteria and coliform bacilli and were associated with some diarrhoea in children. Natural spring and unprotected well were highly contaminated with ≥30 colony forming units in each 100ml of raw water and associated with majority cases of diarrhoea. Water treatment works and borehole water showed least colony forming units per volume of raw for coliform bacilli and general bacteria and were associated with few children with diarrhoea. According to Ogutu *et al*, [35] untreated river water was contaminated with *E. coli* than some river water treated with 16ml of chlorine for 20 litres of river water in 100ml of water and achieved free chlorine residual level of more than 0.2mg in 24 hours.

Factors that have impacted negatively on contamination of wells include rainfall, number of households using the well, amount of water extracted daily and the distance of the well from the nearest kitchen; with the last three reflecting domestic activities with poor hygiene around the well. The association with the households using the well has been described in Kenya [36]. Limited access to sanitary latrines in rural areas, indiscriminate defecation in unregulated areas through which the water mains ran, inadequate chlorination of drinking water, poor maintenance of water pipes, parallel sewage and water channels, unhygienic practices such as washing clothes and cleaning utensils in places used for collecting drinking water, communication between taps and gutters, and rainfall during the time of diarrhoea outbreaks may be contributing factors to diarrhoea episodes.

In conclusion prevalence of diarrhoea in children of 6-36 months old was 16.7% in Busia town, higher in children whose mother's age was below 18 years and with low level of education and the rate decreased with increase in age of children. Prevalence of diarrhoea in children of 6-36months old in households was higher in children of 6-17 and 36 months old and whose mothers were 18-24 years, had low education and some clusters. However, influence of activities at main source of drinking water on prevalence of diarrhoea in children 6 - 36 months old was insignificant.

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