

## Spatial and Temporal distribution of Waterborne Diseases in Namanyonyi Sub-County, Mbale District, Uganda

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### Abstract

Waterborne disease is of great concern all over the world. Waterborne diseases represent significant burden of diseases in the globe. Nearly 4% of diseases are attributable to water, sanitation and hygiene, and approximately 2.2 million people die every year due to diarrheal diseases worldwide. The purpose of this study was to investigate the spatial and temporal distribution of waterborne diseases in Namanyonyi Sub County. Retrospective records from Namanyonyi Health Centre III were reviewed to determine the prevalence of waterborne diseases from January to December 2010-2014. Data was analysed with the help of SPSS and Microsoft excel. The results show that Diarrhea is the most prevalent among the waterborne diseases (33.5%) and cholera was the least (3.0%). The more frequent age group (52.6%) was 0-5 years and females (58.1%) are more prone to waterborne diseases in the study area. The ANOVA output indicates that there is significant difference between the different age groups ( $P=0.001$ ). In other hand waterborne diseases were mostly prevalent in rainy season than dry season, showing cases of 1188 and 992 respectively. The study recommends improvement in hygienic conditions, treatment of dug wells and boreholes and adaptation of waste management strategies.

**Keyword:** waterborne diseases, spatial and temporal distribution, prevalence

### Introduction

Waterborne diseases are the most common diseases caused by unsafe drinking water and remain a leading cause of illness and death in the developing world. Waterborne diseases (WBDs) are those diseases which generally arise from contamination of water by human or animal faeces or urine infected by pathogenic viruses or bacteria and are directly transmitted when unsafe water is drunk or used in food preparation (WHO, 2012).

The burden of waterborne diseases is paramount in the globe. About 4% of the global burden of diseases is attributable to water, sanitation and poor hygiene (Mohammad, 2011). The World Health Organization has stated that every year, 4 billion cases of water related diseases cause at least 1.8 million deaths worldwide, making it one of the leading causes of morbidity and mortality. An estimated 99.8% of such deaths occur in developing countries, and 90% are children under the age of five (WHO, 2005; UNICEF, 2008). In addition, 88% of these diseases are attributed to inadequate water supply, poor sanitation and poor hygiene (Lantagne *et al.*, 2006). The poor quality of drinking water has been implicated in the spread of waterborne diseases such as cholera, dysentery, hepatitis A and E, giardiasis, and haemolytic uremic syndrome (Montgomery and Elimelech, 2007).

These diseases are commonly in low-income countries as provision of safe water, sanitation and hygiene is sub-optimal (Rana, 2009). In developing countries, accessibility of safe drinking water is still a problem and people are forced to use available unimproved water sources. These water sources are often microbiologically unsafe and as a result, the most well-known waterborne diseases such as cholera, amoebic dysentery and typhoid are reported from almost all African countries especially in tropical areas of the region (WHO, 2010).

In Uganda, less than 60% of the 26 million people have access to safe water supply or sanitation services (WHO, 2006), over half of the major rivers and associated lakes, wetlands and groundwater or aquifers are contaminated by pollutants implying severe problems for human (UNEP, 2008).

In the study area, many people suffered from a lack of access to safe drinking water from improved sources and to adequate sanitation services. As a result, people are still dependent on unprotected water sources such as rivers, streams, springs and hand dug wells. Since these sources are open, they are highly susceptible to flood and contamination due to disposal of wastewater and solid waste which may results into the prevalence of waterborne diseases in the study area as observed during the field survey (Field survey, 2015).

A preliminary review of medical records conducted at Namanyonyi Health Centre III shows cases of waterborne diseases such as cholera, dysentery, Diarrhea, skin infections, bacterial infections, gastroenteritis etc. This could be a result of utilisation contaminated water and it is in line with the World Health Organisation report (WHO/UNICEF, 2008) that 1.1 billion people lack access to safe drinking water hence leading to a high burden of waterborne infections in African countries including Uganda. The study aims to document information about the spatial and temporal distribution of waterborne diseases in Namanyonyi Sub County, Mbale District, Uganda.

## Materials and Methods

### Study Area

The study was conducted in Namanyonyi Sub County. The sub county is located in Mbale District in the eastern part of Uganda (Figure 3.1). The Subcounty is located in the north of Mbale Municipality where it borders with the northern division between the latitudes  $32^{\circ} 11''$  E to  $34^{\circ} 14''$  E and longitudes  $1^{\circ} 6''$  N to  $1^{\circ} 10''$  N at an elevation of 1143 metres above the sea level.

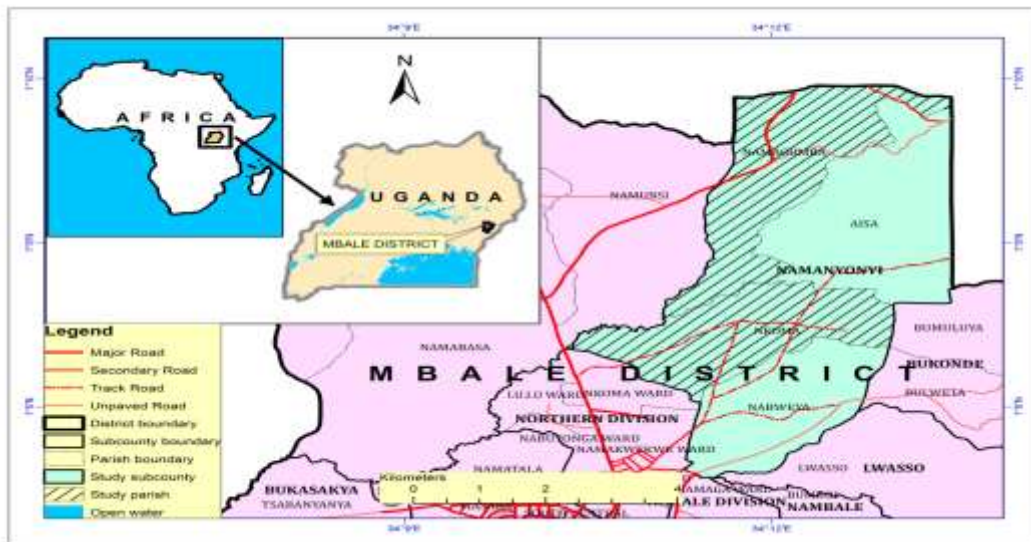


Figure 3.1: Location of Namanyonyi Sub county in Mbale District

### Research Design

A cross-sectional research design was used for this study. This was chosen in order to measure the prevalence of waterborne diseases and exposure status in a population at a particular point of time.

### Data Collection Method

Quantitative data was collected where information regarding the prevalence of waterborne diseases was collected using retrospective medical records from the Namanyonyi Health Centre III which services the study area. Retrospective data from January to December 2010-2014 was collected and the medical records were noted with focus on the patients that had cases of waterborne diseases. All information was gathered using the health centre records that combined the information of the patients such as age, gender, date of consultation, diagnosis and treatments.

### Method of Data Analysis

All statistical analysis was performed using statistical packages SPSS version 20.0. Prior to any statistical analysis, the distribution of waterborne diseases according to villages, gender and age group was determined. ANOVA was conducted to determine if they were statistically different between the selected waterborne diseases. Also an independent t-test was done to test for variations of disease occurrence between genders. A significance level of  $P = 0.05$  was used.

## Results and Discussions

**Table 4.1: Distribution of Waterborne Diseases in the Sub County**

Disease	Frequency	Percent (%)
Skin Infection	578	26.5
Gastroenteritis	533	24.4
Diarrhea	731	33.5
Cholera	65	3.0
Dysentery	177	8.1
Typhoid	96	4.4
<b>Total</b>	<b>2180</b>	<b>100.0</b>

Source: Field survey (2015)

Retrospective clinic records from Namanyonyi Health Centre were reviewed to identify patients with waterborne diseases reported from January to December (2010-2014). Out of which 2180 cases reviewed. Diarrhea had the highest frequency of 733 (33.5%), followed by skin infection 578 (26.5%), gastroenteritis 533 (24.4%), dysentery 177 (8.1%), while typhoid and cholera had the lowest frequency of 96 (4.4%) and 65 (3.0%) from the ten villages (Table 4.1). Findings of this study are agrees with the study by Ejaz *et al* (Ejaz *et al*, 2011) who carried out studies on the major waterborne diseases and estimated that in developing countries (excluding China), there were 875 million cases of Diarrhea and 4.6 million deaths annually. The study was also in line with the World Health Organization (WHO, 2008) report which stated that every year there are 4 billion cases of water of water related diseases which causes at least 1.8 million deaths worldwide.

**Table 4.2: ANOVA Comparisons of Means of Waterborne Diseases**

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	85.744	5	17.149	1.651	.143
Within Groups	22585.949	2174	10.389		
<b>Total</b>	<b>22671.693</b>	<b>2179</b>			

Source: Field survey (2015)

Further statistical analysis shows that there is no significant differences ( $P=0.143$ ) between the means of selected waterborne diseases using ANOVA (Table 4.2).

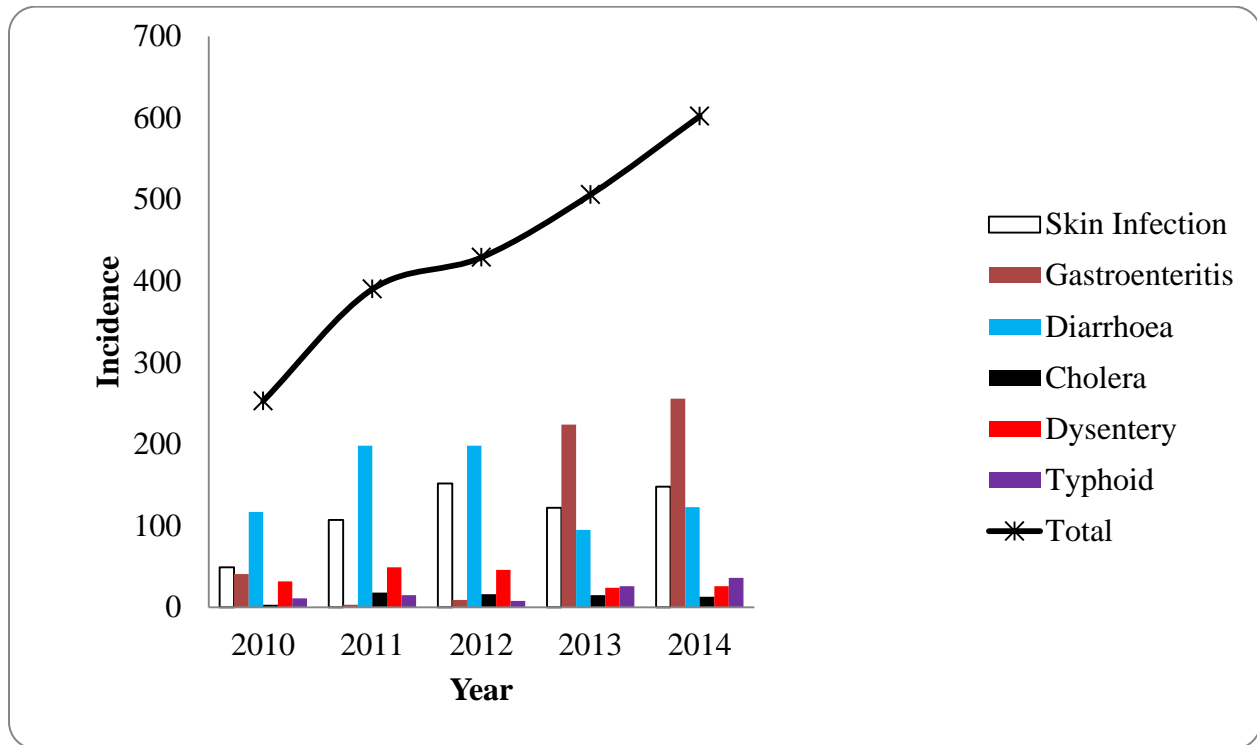
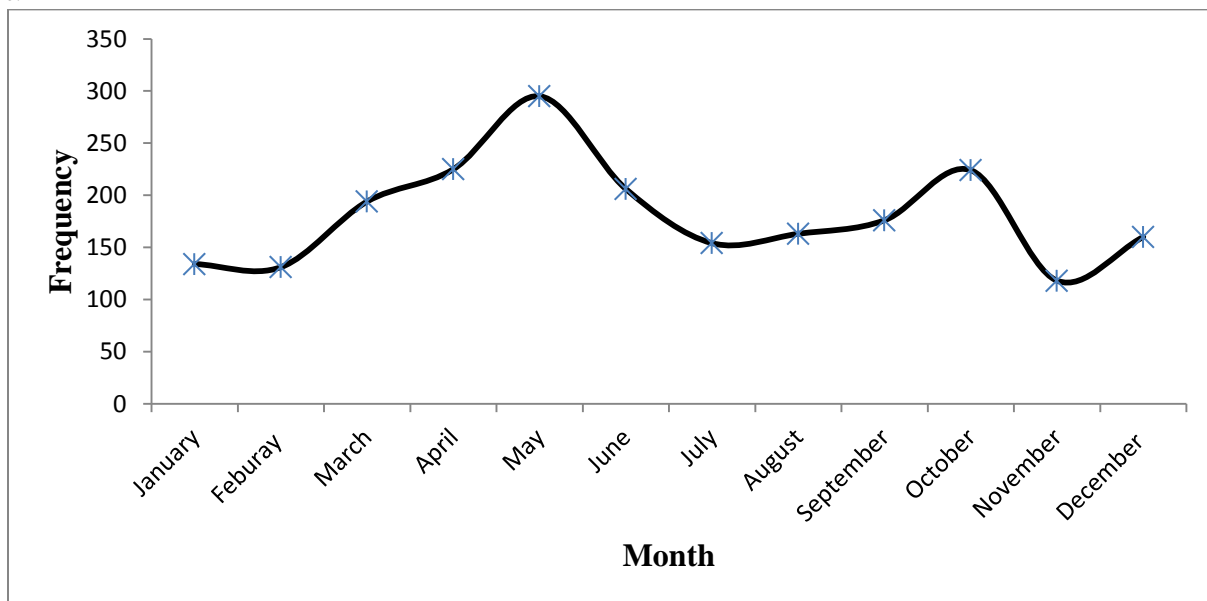


Figure 4.1: Annual Distribution of Waterborne Diseases in Namanyonyi Sub County

The results presented in Figure 4.1 show the temporal variation in the number of cases registered suffering from waterborne related diseases in the sub county between January to December (2010-2014). The figure shows that the cases of waterborne diseases were highest in the year 2014 (602) followed by 2013 (506), 2012 (429), 2011 (390) and 2010 had the least number of cases with (253). The increases in the incidence of waterborne diseases over the years may be due to the increase in population density in the sub county, lack of sanitation, overcrowding and environmental contamination. The finding disagree with the findings of Ocheri *et al* (Ocheri *et al*, 2012) for the profile of water related diseases in Benue State, Nigeria which shows that the cases of water related diseases is declined over the years. This could be due to geographical location, economic status and life style.



**Figure 4.2: Monthly Distributions of Waterborne Diseases**

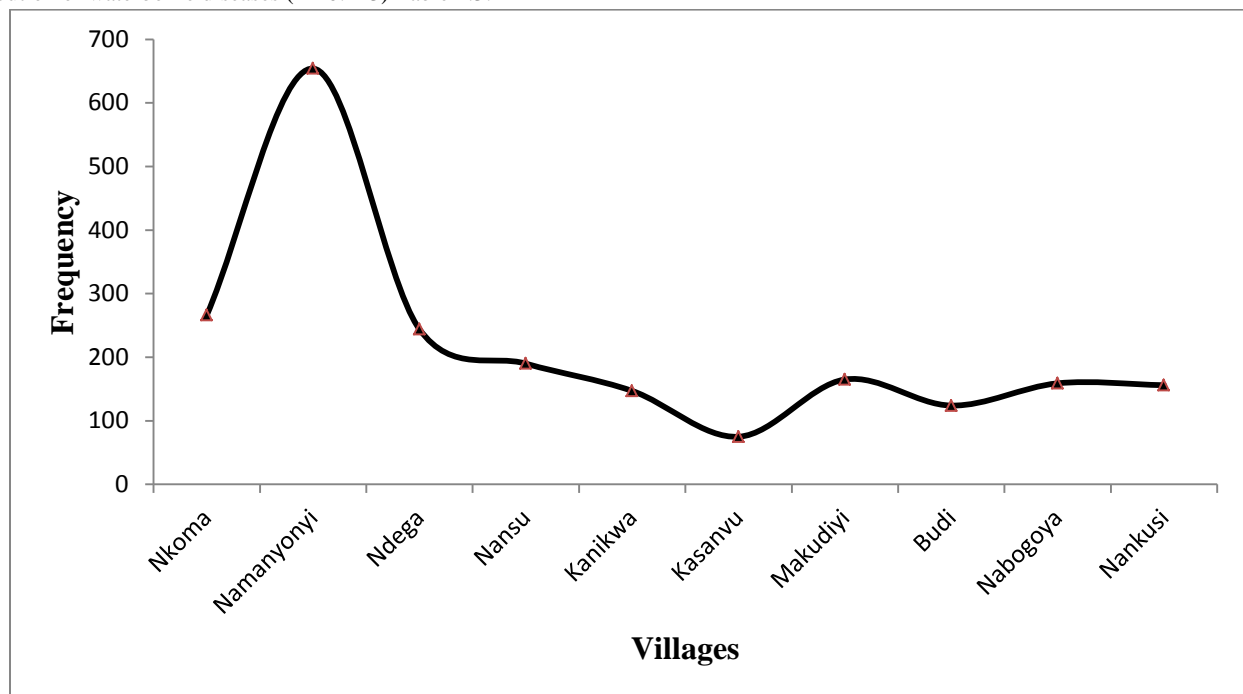
Figure 4.2 shows the monthly distribution of waterborne diseases over the five years. The occurrence of waterborne diseases was highest in the month of May and October and least during February and November. The months that had higher cases of waterborne diseases fall within the raining seasons. This was not supported by the finding of Ejaz *et al* (Ejaz *et al*, 2011) which stated that there is a decrease in incidences of waterborne diseases in Pakistan during the month of July and September which are during the raining seasons.

**Table 4.3: ANOVA Comparisons for the Monthly Variations**

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	85.744	5	17.149	1.651	0.143
Within Groups	22585.949	2174	10.389		
<b>Total</b>	<b>22671.693</b>	<b>2179</b>			

Source: Field survey (2015)

The ANOVA comparisons for the monthly variations of waterborne diseases showed that there is no significant differences between the months in the distribution of waterborne diseases ( $P= 0.143$ ) Table 4.3.

**Figure 4.4 Spatial Distributions of Waterborne Diseases in the Villages**

The village distribution of waterborne diseases is showed in the Figure 4.4. The figure indicates that Namanyonyi Village had the highest cases registered with waterborne diseases (654) compared to other villages. It also observed that Kasanvu village registered the least number of cases of waterborne diseases.

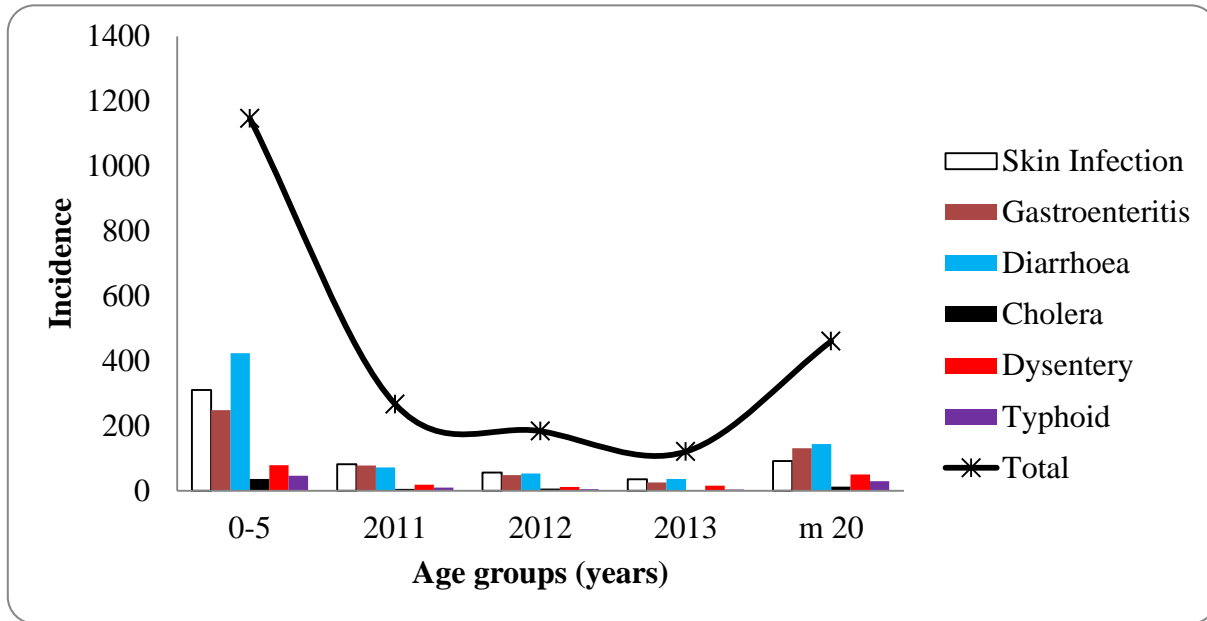


Figure 4.5: Distribution of Waterborne diseases among the Age Groups in Namanyonyi Sub County

6-10      11-15      16-20      ≥21

The distribution of water waterborne diseases as a function of age group is shown in Figure 4.5. Children between the ages of 0-5 were the most vulnerable to waterborne diseases with Diarrhea being the most prevalent among this group, followed by age group greater than 20 in which Diarrhea was also the most prevalent. Skin infections were most common among the 6-10 age groups. It is evident from figure 4.5 that age groups 11-15 and 16-20 were less vulnerable to waterborne diseases. Hence the results indicate that children below the age of five are more likely to be affected by waterborne diseases. The finding agrees with the finding conducted in the rural areas by Raji *et al* (Raji *et al*, 2011) which showed higher prevalence of waterborne diseases in children under age of five years compared to other age groups. Higher occurrence of waterborne diseases among children, especially under five years, may be linked to increased susceptibility of children to infections due to their low immunity. This might also be due to the fact that knowledge on child healthcare is inadequate among the caregivers in rural communities (Adyinka, 2014).

Table 4.4: ANOVA Output of Waterborne Diseases between the Age groups

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	35.891	4	8.973	4.874	0.001
Within Groups	4003.759	2175	1.841		
<b>Total</b>	<b>4039.650</b>	<b>2179</b>			

Source: Field survey (2015)

Statistical analysis using ANOVA show that there is significant differences in the number of infected cases ( $P=0.001$ ) between different age groups (Table 4.4)

Table 4.5: Association between Gender and Waterborne Diseases

Gender	diseases of the patient's						Total
	Skin Infection	Gastro-enteritis	Diarrhea	Cholera	Dysentery	Typhoid	

Male	257	216	316	27	62	35	913
Female	321	317	415	38	115	61	1267
<b>Total</b>	<b>578</b>	<b>533</b>	<b>731</b>	<b>65</b>	<b>177</b>	<b>96</b>	<b>2180</b>

Source: Field survey (2015)

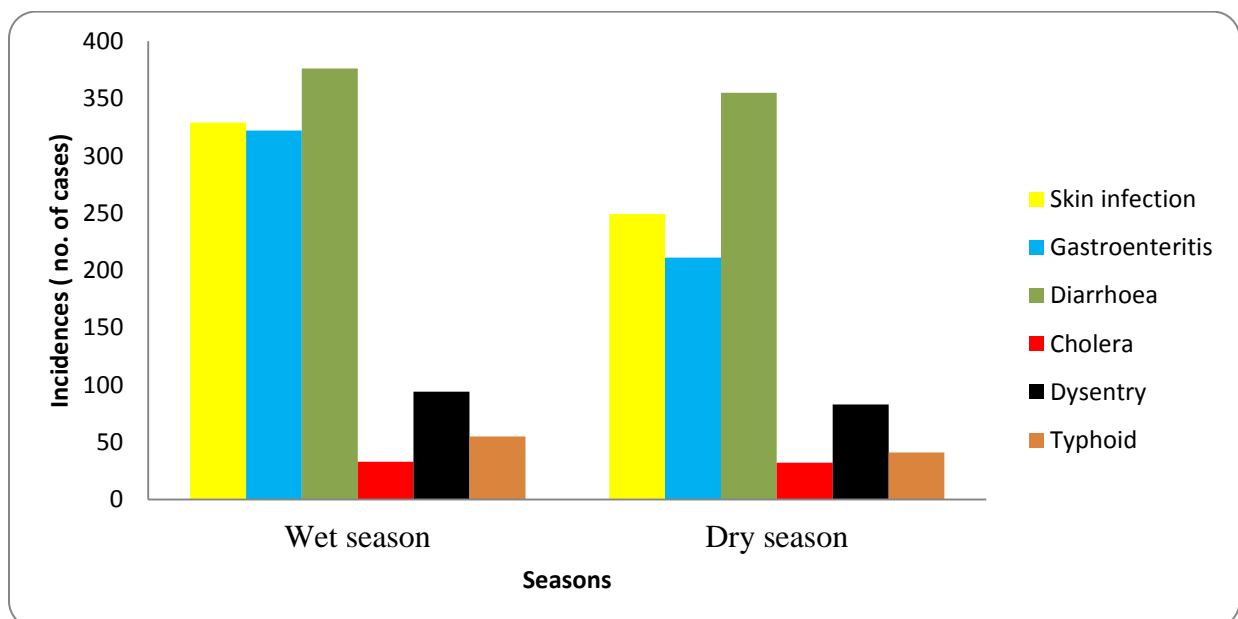
Association between gender and waterborne diseases in the study group showed that females were more prone to waterborne diseases as compared to males (Table 4.5). The data indicated Diarrhea to be the major disease amongst waterborne diseases. Proportion of Diarrhea in male and female was distributed as (316) and (415) respectively, followed by skin infection as a second major waterborne diseases with (257) proportion of males and (321) of females while cholera has the least number of cases in both sexes with 38 in females and 27 in males respectively. The reason for this distribution was hypothesized to be the fact that women's activities involve water usage in many ways, e.g. water collection, cooking, clothes washing and other domestic activities (Sanitation). It can be further reasoned that females mostly stay inside their homes so they are not widely exposed to different types of environmental immunogens and consequently their immunity level is low as compared to males. Hence whenever they are exposed to pathogens or water contaminants of a minute level they become ill as a consequence. These results are supported by a study carried out by Mohammad (2011) on association of socio-economic features, hygienic status, age groups and gender with prevalence of waterborne diseases in Rawalpindi and Islamabad, which shows that female are more prone to waterborne diseases compared to males.

**Table 4.6: Independent Samples t-test for Gender**

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	1.909	0.167	-2.001	2178	0.045	-0.118	0.059	-0.234	-0.002
Equal variances not assumed			-2.018	2021.841	0.044	-0.118	0.059	-0.233	-0.003

Source: Field survey (2015)

The Independent t-test between male and female with waterborne diseases shows that there is no significant difference between the mean ( $P=0.167$ ) this was indicated in the table 4.6.



**Figure 4.6: Relationship between the incidence of the Diseases and Seasons**

The occurrence of water-borne diseases fluctuates with seasons, the information obtained in this context revealed a very clear picture, as shown in Figure 4.6. Water-borne diseases were mostly prevalent in rainy season than dry season, showing cases of 1188 and 992 respectively. This is usually possible due to the surface run-off in wet season that can lead to the contamination of many water sources. This disagrees with the finding of Mohammed *et al* (Mohammed *et al*, 2011) which reported that in the rainy season (July to September), a significantly lower percentage of people in his study area (12%) suffered from water-borne illness. The variation in the prevalence of diseases during different seasons is an important aspect as also reported by Ejaz *et al* (Ejaz *et al*, 2011), who stated that water and sanitation interventions have proven difficult to evaluate because targeted enteric pathogens may be transmitted through multiple routes (that is, contaminated drinking water, contaminated food, person-to-person contact) and because rates of disease show seasonal and secular variation.

**Table 4.7: Independent Samples t-test for the Seasons**

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	0.995	0.319	-1.860	2178	0.063	-0.109	0.059	-0.224	0.006
Equal variances not assumed			-1.864	2125.488	0.062	-0.109	0.058	-0.223	0.006

Source: Field survey (2015)

Table 4.7 shows the independent t- test for the seasons. The t-test for the waterborne diseases between the seasons shows that there was no significant differences between the mean number of waterborne diseases in the two seasons (P=0.319) and wet season has the highest incidence of waterborne diseases.

## Conclusion and recommendations

The results of this study have demonstrated the occurrence of common waterborne disease in some villages of the sub-county. Diarrhea cases ranked highest among the water related diseases recorded, followed by skin infection, gastroenteritis, dysentery, typhoid and cholera. The findings revealed that Diarrhea is most prevalent within the age of 0-5 years and female are found to be more prone to waterborne infections than males. This incidence of waterborne diseases may be as a result of inability to gain access to portable drinking water most especially peoples living in the rural areas of the country. People search for drinking water from all sorts of unsafe water sources, which expose them to all kinds of dangers related to drinking unsafe water. The study recommends improvement in hygienic conditions, treatment of dug wells and boreholes and adaptation of waste management strategies.

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