

Prevalence and Causes of Cholera Among Children in Ekiti State, Nigeria

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Abstract

This study investigated the prevalence and causes of cholera among children in Ekiti state. Cholera epidemic is a pandemic disease that is responsible for much illness. Cholera seems to remain a major public health issue and it seems that inadequate knowledge of parents to make adequate provision for clean water, clean environment and decent toilets contributed to its high prevalence among children in Ekiti State. The research design used for this study was descriptive survey, the sample size of (300) respondents were used for the study. While Simple random sampling technique was used for the study. The researcher used questionnaire for the study. The instrument used for the study was 26 items structured questionnaire and split half method was employed to ascertain the reliability of the instrument of the instrument in which the coefficient of 0.91 was obtained at 0.05 level of significance. In the research work four hypotheses were formulated from the purpose of the study. The four hypotheses were rejected. The study showed that poor sanitation can lead to the outbreak of cholera among children; eating of contaminated food and drinking of contaminated water can lead to the outbreak of cholera among children. It was recommended that there is need for proper awareness of people living in Ekiti on the prevalence of cholera outbreak in the community and necessary factors that may lead to the outbreak. Parents and guidance should educate their children toward hygienic habit and proper ways of keeping the surrounding clean to avoid the spread of the diseases

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Introduction

Cholera epidemic is a recurrent disease in developing countries like Nigeria, with poor environmental sanitation and inadequate supply of potable water. It is a natural disease of epidemic proportion caused by a comma-shaped, rod like, motile, Gram negative bacterium called *Vibrio cholera*, with the characteristic acute watery diarrhoea, vomiting, muscle cramps and severe dehydration (Sack, 2017). Cholera disease is among the leading causes of morbidity and mortality in young children in developing countries. Each year, an estimated 2.5 billion cases of cholera occur among children under five years of age and estimates suggest that overall incidence has remained relatively stable over the past two decades. Africa account for over half the cases of childhood cholera which is ranked as the fourth leading cause of mortality among under five children in Nigeria (WHO, 2016).

Nigeria recorded its first Cholera epidemic near a Village in Lagos State, South-West Region of Nigeria on the 26th December 1970, with 22, 931 suspected cases and a cumulative fatality of 2,945 deaths. Till date, the year 1991 has the highest fatality of 7,654 deaths and 59,478 suspected cases. Between 1st January and 31st December 2017, a total of 4,221 suspected Cholera cases and 107 deaths were reported in twenty (20) States in Nigeria.

Cholera is a bacterial infection of the intestine caused by certain strains of *Vibrio cholerae* (*V. cholerae*). The bacteria can be found in food or water, so people can get infected after oral ingestion. When *V. cholerae* is ingested it produces enterotoxins (toxins that act in the gastrointestinal tract) whose actions on the mucosal epithelium are responsible for the characteristic symptoms of cholera, namely: acute watery diarrhoea and vomiting (Lee, 2016).

Cholera may occur as sudden progressive outbreak after a natural disaster such as a cyclone, flood, and an earthquake. The disruption of the water distribution system and an inadequate hygiene situation or inadequate sanitation system after a natural disaster may cause cholera outbreaks as the disease is transmitted mainly through contaminated water (Watson, Gayer, & Connolly, 2017). Diarrheal diseases constitute a major global public health problem, and affect indigenous populations and travelers.

Every single day, Nigeria loses about 2,300 under- five year olds and this makes the country the second largest contributor to the under-five mortality rate in the world (WHO, 2016). The incidence of cholera diseases varies greatly with the seasons and a child's age. The youngest children are most vulnerable with incidence been highest in the first two years of life though declines as the child grow older. The infection is endemic and outbreaks are not unusual in Nigeria. In view of the vulnerability to Cholera disease, data generated from Water Aid Nigeria in its 2018 report, indicated that, about 33% (60 million) of the country's population are living without adequate access to clean water; 67% (over 120 million) do not have decent toilets and 26% (about 47 million people) practice open defecation. Thus, an increase in the prevalence of cholera in Nigeria cannot be overemphasised

Greater risks occur in over-populated communities and refugee camps, with poor sanitation, unsafe drinking water, increased person-to-person transmission because incubation period is very short, thus rapidly increase the

number of cases. Treatment is straight forward (basically rehydration), and if applied correctly and promptly, case fatality rate is less than 1% and in untreated cases, case fatality rate may reach 30-50% (Adenoja, 2015). The main reservoir for cholera is water, which is a non-living reservoir. *V. cholera* is part of the normal flora in brackish water (water with a salt level between fresh water and seawater), and is seen in algal blooms (WHO, 2014). People and animals (specifically shellfish) are also reservoirs for cholera. Humans are the only animal in which *V. cholera* grows. It lives in the small intestine of humans. *V. cholera* exists in a "viable but not culturable state" in shellfish, algae, and plankton (Finkelstein, 2016).

The Prevalence of Cholera in Nigeria

Between February and June 1, 2018, Cholera outbreaks occurred in nine States in Nigeria with five (5) Northern States recording death cases. A cumulative total of 3,039 suspected cases were recorded in Adamawa, Yobe 5, Borno and Bauchi States 6 and 50 cholera related deaths 7. The figures of death could be more, as States continue to record isolated cases. States with recorded fatalities include; Borno State, 3 deaths; Yobe State, 15 deaths; Kano State, 4 deaths; Adamawa State, 16 deaths; Bauchi State, 12 deaths. Other States with suspected cases include; Ekiti, Ebonyi Kaduna and Zamfara States.

The World Health Organisation (WHO), however, linked the outbreak in Borno State to areas where vaccination was not conducted while the practices of open defecation increased susceptibility to contracting Cholera. Other affected States reportedly traced the outbreak of the disease to water contamination. In the case of Adamawa State, 90% of residents in the affected Mubi LGA's- the second most populous town in the State rely on water supply from vendors who source water from boreholes meant for irrigation along River Yedzaram.

Poor Sanitation as a Cause of Cholera among Children

Cholera is more common where there is poor sanitation. Odumayo (2017) opined that cholera bacteria enter the body through the mouth, often in food or water that has been contaminated with human waste, due to poor sanitation and hygiene. They can also enter by eating seafood that is raw or not completely cooked, in particular shellfish native to estuary environments, such as oysters or crabs. Poorly cleaned vegetables irrigated by contaminated water sources are another common source of infection.

Non-improved sanitation for urban areas is recorded at 6.6% whilst some facilities though improved are shared amongst households (48.5%) hence both non-improved and shared facilities are classified as unhygienic as they do not effectively separate human waste from human contact (Odumayo, 2017). The rural situation is worse as only 30.8% constitute toilets. A combination of factors therefore led to cholera disease outbreak as the urban areas were affected most compared to rural settings yet urban areas have high coverage. Flush toilets require availability of water which was often cut therefore leading to unhygienic conditions or resorting to open defecation.

Contaminated Water as a Cause of Cholera among Children

Contaminated water sources such as rivers, shallow wells and other unprotected water sources have high chances of faecal contamination. This is so especially in the rainy season when there is runoff and faeces get into water sources. The faeces are as a result of open defecation by humans due to inadequate sanitation. Leaking sewage pipes have also led to faecal contamination of water sources. Surface water, which seeps into porous ground and into shallow wells become contaminated with faecal waste because of leaking sewerage pipes (PHR 2008). Piped water had become unreliable in many suburbs that people resorted to unimproved sources such as shallow wells. For instance as reported by city of Harare (2008), challenges in procurement of chemicals and power outages resulted in erratic water supplies to residents who dug shallow unprotected wells which resulted in an explosive cholera epidemic. In the high density suburb of Budiro in Harare which was the epicentre of cholera, people dug shallow wells as a way of coping with water shortages (Chipare 2010). The citing of the shallow wells could have contributed to cross contamination where the wells were dug in close proximity to sewer systems.

Contaminated Food as a Cause of Cholera among Children

Food can be a source of cholera infection as well as water which gets contaminated at point of use by hands that are soiled with human faeces. Food can be contaminated during or after preparation. The Zimbabwe cholera control guidelines by MoHCW and WHO (2009) indicated fish/seafood, fruits and vegetables particularly taken from contaminated water and eaten raw or insufficiently cooked as a source of cholera infection. Fruits and vegetables grown at or near ground level, irrigated with water containing human waste, or "freshened" with contaminated water, and eaten raw are also sources of cholera infection

The survival and growth of *V. cholerae* in foods depend on the physico-chemical properties of the particular foodstuff that has been contaminated. Food characteristics, which enhance the growth of *V. cholerae*, are low temperature, high-organic content, neutral or alkaline pH, high-moisture content, and absence of other competing micro-organisms in the food (Odumayo, 2017). *V. cholerae* are very sensitive to heat, and are rapidly killed when exposed to temperature of 100°C. Drying and exposure to sunlight is also an effective means of killing *V. cholerae*

(WHO, 2009). Domestic freezing is usually ineffective in sterilizing foods, and the organisms can survive for a long period in a frozen state.

Fruits and vegetables: In many countries, the practice of fertilizing gardens with untreated night soil and the habit of consuming uncooked vegetables have often resulted in cholera outbreaks. Vegetables may be contaminated during washing with polluted water. This can also occur when contaminated water is injected into fruits, such as water melons, to preserve their weight and taste. The pH of a specific fruit is an important factor that influences contamination by *V. cholerae*. Sour fruits, such as lemons and oranges, with lower pH do not support the growth of *V. cholerae*, and, thus, do not pose risk of cholera transmission. Fruit pulp and concentrate preserved in cans are also less likely to be contaminated if they have an acidic pH. Spices, including raw onions and garlic, can support the survival of *V. cholerae* for 2 to 3 days at ambient temperature.

Seafoods: The importance of fish and shellfish as a vehicle of transmission of cholera has been recognized by early observers. Fishes are likely to be contaminated by *V. cholerae* when the surrounding water is contaminated by sewage or other environmental sources of *V. cholerae* O1. It has been shown that *V. cholera* can survive in seawater in association with zooplankton (copepods). Zooplankton secrete a self-protective coat of chitin that can be dissolved by chitinase, an enzyme produced by *V. cholerae* O1. Seafoods, including molluscs, crustaceans, crabs, and oysters, feed on plankton and can become infected with *V. cholerae*. Once infected, particularly clams and oysters can harbor *V. cholerae* for weeks, even if refrigerated. In crabs, the organisms can rapidly multiply at ambient temperature, and boiling for less than 10 minutes or steaming for less than 30 minutes does not completely kill *V. cholerae*.

Dairy products: *V. cholerae* O1 can survive for more than two weeks in different dairy products, including milk, milk products, soft deserts, and cakes. Addition of sugar and eggs enhances bacterial survival. Although *V. cholerae* is killed by pasteurization of milk, the organisms can persist in raw milk as long as four weeks, even if refrigerated.

Poultry and meat: Contamination of meat of animal origin occurs exogenously during processing, cooking, storage, or consumption. It has been shown that *V. cholerae* can live and grow on cooked chicken, an increase in numbers of *V. cholerae* from 10³ to 10⁶ within 16 hours has been demonstrated. An early observation by Seligmann indicates that consumption of improperly cooked horsemeat was incriminated in small outbreak of cholera. The meat had been prepared by an infected butcher who succumbed to cholera the next day. There are many other types of food that may be contaminated with *V. cholerae*. *V. cholerae* can survive on cooked rice, potatoes, eggs, and pasta for up to 5 days, and can also survive in spices, including pepper and cinnamon, for up to several days.

Statement of the Problem

Cholera seems to remain a major public health issue and it seems that inadequate knowledge of parents to make adequate provision for clean water, clean environment and decent toilets contributed to its high prevalence among children in Nigeria, especially in Ekiti State. The researcher observed that many of the victims face a lot health challenges such as extreme diarrhea, nausea, vomiting and dehydration. The infected children may lose as much as liter of fluid an hour, nausea and vomiting may last for several hours at a time and dehydration causes electrolyte imbalance which can lead to muscle spasms and shock. Hence, victims suffer a life-long disability, reduction in life expectancy and majority of affected individuals hardly survive to adulthood.

The high morbidity and mortality associated with cholera produce grief and permanent anxiety to the family, pain, frustration and a poor quality of life to the patient, serious financial stress to the family and a large drain on the national health expenditure. In order to reduce high morbidity and mortality associated with this disease, there is need to intensify effort towards educating the general populace on the prevalence, causes, symptoms and preventable measure to this epidemic. Children with cholera disease are frequently absent from school. These absences may be the result of a painful episode, hospitalization, outpatient visits and procedures or other illnesses. Frequent absences from school may result in incomplete class work and incomplete development of social skills. Students can feel disenfranchised from classroom activities and classmates. However, the importance of curbing this problem and to ensure that children live healthily in Ekiti State is the major focus of this study.

Purpose of the Study

The general purpose of this study was to investigate the prevalence and causes of cholera among children in Ekiti state. The specific objectives of the study were to:

1. to find out the extent of cholera outbreak among children in Ekiti State, Nigeria.
2. examine poor sanitation as a factor responsible for the outbreak of cholera disease among children in Ekiti State, Nigeria.
3. examine water contamination as a factor responsible for the outbreak of cholera disease among children in Ekiti State, Nigeria.
4. examine food contamination as a factor responsible for the outbreak of cholera disease among children

in Ekiti State, Nigeria.

Research questions

The study attempted to answer the following research questions:

1. what is the extent of cholera outbreak among children in Ekiti State?
2. is there any effect of poor sanitation as a cause for cholera outbreak among children in Ekiti State?
3. is there any effect of water contamination as a cause for cholera outbreak among children in Ekiti State?
4. is there any effect of food contamination as a cause for cholera outbreak among children in Ekiti State?

Hypotheses

The following hypotheses were formulated for the study.

1. there is no significant extent of cholera outbreak among children in Ekiti State.
2. there is no significant effect of poor sanitation as a cause of cholera outbreak among children in Ekiti State.
3. there is no significant effect of water contamination as a cause of cholera outbreak among children in Ekiti State.
4. there is no significant effect of food contamination as a cause of cholera outbreak among children in Ekiti State.

Significance of the Study

The contribution of the study could be important to policy makers, government and non-governmental agencies, curriculum planners, students, parents, teachers/counsellors and researchers. The study could contribute to an in-depth understanding of prevalence and causes of cholera in the study area.

The findings of this study therefore could help policy makers and stakeholders who are involved in the provision of health services to children to provide relative measures for preventing this disease. This could enable them to design and adopt more appropriate policies and intervention strategies that would enhance the general wellbeing of children in the society.

The result of the study could bring to fore the health information needs on how to prevent cholera outbreak to government and non-governmental agencies in Ekiti State, Nigeria. This is expected to provoke government and non-governmental agencies to make concerted efforts toward meeting these needs. The outcome of this study may be a basis for reviewing and improving the quality of existing National Health Information Policy, National Health Management Information System etc.

The outcome of this study could help curriculum planners to include a well-structured health education in the curriculum. The outcome of the study could help students to get appropriate and detailed information needed to avoid this menace. The study could help parents to understand better how to disseminate health education to their children. Teachers and counsellors could gain tremendously from the outcome of this research work. It could help them to know the type of information and services they need to pass across to children. Lastly, this study could contribute to knowledge and literature on prevalence and causes of cholera which could be of immense benefit to researchers in the field of health in Nigeria.

Methodology

The research design used for this study was survey design of descriptive research. This type of design is considered to be suitable for this study, because it allowed a wide coverage within a limited time and it also allowed the researcher to know the recent condition going on, not just on historical record. The population for the study included all pupils in public primary schools in Ekiti State. Fifteen public primary schools were selected from the three senatorial districts in the state. The sample size of three hundred (300) pupils was used for this study. A simple random sampling technique was used to select five (5) public primary schools from each of the senatorial district. Thereafter 20 pupils were randomly selected from each of the selected primary schools. The selection cut across boys and girls from primary 5 and primary 6 classes. The instrument for the study was self-designed questionnaire. The questionnaire was titled: Prevalence and Causes of Cholera (PCC). The questionnaire has two sections, A and B. Section A of PCC comprises the subjects' bio-data. Section B contains 26 items that gives a measure of the prevalence, causes and preventive measures of Cholera in the study area. Yes/No questionnaire items was provided to elicit responses from the participants. The responses was scored: 'Yes (2)' or 'No (1)'. The scores obtained by each respondent were used to analyze the data. Data analysis was conducted using chi-square (X^2) for the hypotheses at 0.05 level of significance.

Results and Discussion

Hypothesis 1: There is no significant extent of cholera outbreak among children in Ekiti State.

Table 1: Chi- square analysis of data on the extent of cholera outbreak among children

S/N	Items	No	Yes	X ² -cal	X ² -tab	df
1	Have you been a victim of cholera?	288	12	3.42	6.84	4
2	Have you ever seen child/children who has/have been a victim of cholera?	253	47	4.40		
3	Is there any outbreak of cholera in your local government?	103	197	10.45*		
4	Is the outbreak in your local government more than one time?	118	182	13.65*		
5	Does the outbreak of cholera in your local government lead to any death	180	20	2.61		
Criterion X²				6.91	6.84	4

P<0.05; *S- Significant

The result presented in Table 1 revealed the extent of cholera outbreak among children in Ekiti state. It was revealed in the table that only 12 out of 300 pupils sampled for the study indicated that they have been a victim of cholera while 47 out of 300 respondents indicated that they have seen children who have been a victim of cholera. In the table, 197 out of 300 pupils indicated that there was outbreak of cholera and 182 of the pupils indicated that the outbreak was more than one time. However, only 20 out of 300 respondents indicated that the outbreak led to death. The criterion Chi-square (x²) calculated was slightly greater than Chi-square (x²) table which indicated that there was cholera outbreak among children in Ekiti state. However, the extent of outbreak was low and insignificant.

Hypothesis 2: There is no significant effect of poor sanitation as a cause of cholera outbreak among in Ekiti State.

Table 2: Chi- square analysis of data on poor sanitation as factor responsible for the outbreak of cholera disease

S/N	Items	No	Yes	X ² -cal	X ² -tab	df
1	Do you keep refuse around the classroom?	175	125	8.33*	12.62	5
2	Do you keep refuse around the home?	116	184	15.41*		
3	Do you eat in an untidy environment?	204	96	38.88*		
4	Do you excrete anywhere in the school premises?	170	30	10.45*		
5	Do you observe regular sanitation around the school?	165	35	20.28*		
6	Do you observe regular sanitation around the home?	213	87	52.92*		
Criterion X²				24.38*	12.62	5

P<0.05; *S- Significant

The table above displays that x²-cal= 8.33, 15.41, 38.88, 10.45, 20.28 and 52.92 for items No 1,2,3,4,5 and 6 respectively were greater than x²-tab = 12.62 showing that at p< 0.05 and df = 5 (i.e. x²- cal > x²- tab) in all cases. Therefore, the null hypothesis was rejected and the result was significant. This implies that there is a significant effect of poor sanitation as a cause for cholera outbreak among children in Ekiti State. This means that keeping refuse around the classroom, keeping refuse around the home, eating in an untidy environment, excreting anywhere in the school premises lead to cholera outbreak among children.

Hypothesis 3: There is no significant effect of water contamination as a cause of cholera outbreak among children in Ekiti State.

Table 3: Chi- square analysis of data on water contamination as factor responsible for the outbreak of cholera disease.

S/N	Items	No	Yes	X ² -cal	X ² -tab	df
1	Are you care free when it comes to drinking of water?	177	123	9.27*	6.84	4
2	Do you drink water from the stream?	217	83	59.85*		
3	Do you drink untreated water?	288	12	253.92*		
4	Do you drink uncovered water?	273	27	201.72*		
5	Do you drink water from unknown source?	273	27	201.72*		
Criterion X²				181.62	6.84	4

P<0.05; *S- Significant

Table 3 above displays that x²-cal= 9.27, 59.85, 253.92, 201.72 and 201.72 for items No 1,2,3,4 and 5 respectively were greater than x²-tab = 3.84 showing that at p< 0.05 and df = 4 (i.e. x²- cal > x²- tab) in all cases. Therefore, the null hypothesis was rejected and the result was significant. This shows that there is a significant effect of water contamination as a cause for cholera outbreak among children in Ekiti State. This means that primary school pupils are care free when it comes to drinking of water, they drink water from the stream, they

drink untreated water, they drink uncovered water and drink water from unknown source, thus leading to outbreak of cholera among primary school pupils.

Hypothesis 4: There is no significant effect of food contamination as a cause of cholera outbreak among children in Ekiti State.

Table 4: Chi- square analysis of data on food contamination as factor responsible for the outbreak of cholera disease

S/N	Items	No	Yes	X ² -cal	X ² -tab	df
1	Do you eat food that has stayed for a long time?	272	28	198.45*	6.84	4
2	Do you eat uncovered food?	213	87	52.92*		
3	Do you eat food in untidy and unclean environment?	222	78	69.12*		
4	Do you eat food with an unwashed hand?	216	84	58.08*		
5	Do you eat food that has dropped on the ground?	211	89	49.61*		
Criterion X²				85.64	6.84	4

P<0.05; *S- Significant

The table above displays that x^2 -cal= 198.45, 52.92, 69.12, 58.08 and 49.61 for items No 1,2,3,4 and 5 respectively were greater than x^2 -tab = 3.84 showing that at $p < 0.05$ and $df = 4$ (i.e. x^2 - cal > x^2 - tab) in all cases. Therefore, the null hypothesis was rejected and the result was significant. This shows that there is a significant effect of food contamination as a cause for cholera outbreak among children in Ekiti State. This means that eating food that has stayed for a long time, eating uncovered food, eating food in untidy and unclean environment, eating food with an unwashed hand and eating food that has dropped on the ground lead to the outbreak of cholera among primary school pupils.

Discussion of Results

The finding of the study in hypothesis 1 revealed that there was cholera outbreak among children in Ekiti state. However, the extent of outbreak was low and insignificant. Although, children have been victims of cholera and they have seen children who have been victims of cholera due to the outbreak of cholera that had occurred in Ekiti, however, outbreak had no significance influence on children in the state. This finding is in line with Odimayo (2017) that cholera outbreak was suspected in Ekiti State around February, 2018 but quick intervention from the state government curb the menace. The report from WHO (2016) indicated that 22,740 cases of cholera had been reported across the country but 2942 lives were lost which is equivalent to 7.7%. This is an indication that the prevalence is low and insignificant in Nigeria and Ekiti in particular.

It was also revealed in hypothesis 2 of the study that there was a significant effect of poor sanitation as a cause of cholera outbreak among children in Ekiti State. This means that keeping refuse around the classroom, keeping refuse around the home, eating in an untidy environment, excreting anywhere in the school premises lead to cholera outbreak among children. The study corroborated with Odimayo (2017) that Cholera bacteria enter the body through the mouth often in food or water that has been contaminated with human waste due to poor sanitation and hygiene.

The finding of the study in hypothesis 3 was that there was a significant effect of water contamination as a cause for cholera outbreak among children in Ekiti State. This means that primary school pupils are care free when it comes to drinking of water, they drink water from the stream, they drink untreated water, they drink uncovered water and drink water from unknown source, thus leading to outbreak of cholera among primary school pupils. The finding is in line with Harare (2008) that contaminated water such as river, shallow well and other unprotected water sources have high chances of contamination which lead to the spread of cholera.

It was equally revealed in the study in hypothesis 4 that there was a significant effect of food contamination as a cause for cholera outbreak among children in Ekiti State. This means that eating food that has stayed for a long time, eating uncovered food, eating food in untidy and unclean environment, eating food with an unwashed hand and eating food that has dropped on the ground lead to the outbreak of cholera among primary school pupils. The study corroborated with the report of WHO (2009) that foods from contaminated water are source of cholera infection.

Conclusions

It was observed that there was outbreak of cholera among primary school pupils in Ekiti State and that poor sanitation, drinking of contaminated water and eating of contaminated foods were strong factors responsible for the outbreak among children in Ekiti State.

Recommendations

Based on the above conclusions from the research work, the following recommendations are hereby made.

1. There is need for proper awareness of people living in Ekiti on the prevalence of cholera outbreak in the community and necessary factors that may lead to the outbreak.

2. Parents and guidance should educate their children toward hygienic habit and proper ways of keeping the surrounding clean to avoid the spread of the diseases
3. Pupils should be informed by their teachers that contaminated water is a factor leading to the spread of the disease. Hence, there is need for teachers to advice pupils to drinking clean and treated water.
4. The parents and guidance of the school children should endeavor to provide nutritious food for their children and educate their children not to beg for food from friends in the school.

References

- Adenoja, J. (2015). *Research Methods for Graduate Business and Social Science Students*. London: SAGE Publications Ltd.
- Chipare, J.M. (2010). River blindness in Nangodi, Northern Nigeria: a hypothesis of cyclical advance and retreat. *Geographical Review* 56, 398-416.
- Finkelstein, L. (2016). *Epidemiology*. 3rd Edition. Johns Hopkins University. Philadelphia: Saunders.
- Harare, R.A. (2008). *Introduction to social network Methods*. Department of Sociology, University of California at Riverside. Riverside, California.
- Lee, J. (2016). *Nursing Research: Methods and Critical Appraisal for Evidence-based Practice*. St Louis: Mosby.
- Odimayo, V. (2017). Determining Sample Size for research activities. *Educational psychology Measurement*, 607-610. USA: University of Minnesota.
- Sack, J. (2017). Diarrheal disease risk in Matlab, Bangladesh. *Social Science & Medicine*, 49(4), 519-530.
- WHO, (2009). Cholera in 1991. *Weekly Epidemiological*; 67-253-60.
- WHO, (2014). WHO report on global surveillance of epidemic-prone infectious diseases. Cholera, Geneva. 4: 39-43.
- WHO, (2015). Cholera Fact Sheet, http://www.who.int/nf/fs/en/fact_107.html Retrieved 13/01/2015.
- WHO, (2016). *Cholera and the Global Task Force on cholera control*. Geneva: Switzerland.