



SPATIO-TEMPORAL ANALYSIS OF CHOLERA OUTBREAK IN SOKOTO STATE, NIGERIA (2018-2023)

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Abstract

Cholera is a major public health problem in the world especially in Nigeria. Globally, the annual estimated cases of cholera and the number of deaths associated with cholera are approximately 3-5 million and 100,000–120,000 respectively. Meanwhile, in Sokoto state, in 2014 and 2021 cholera outbreak killed 16 and 23 people respectively across the 23 local government areas of the state. However, despite the efforts to control cholera in Nigeria, the disease continues to occur as a major public health problem. The paper aimed at assessing the spatial distribution of cholera cases in Sokoto State from 2018-2022. The objectives are to examine age and gender distribution of cholera cases in the Sokoto state. The study was conducted in Sokoto state and used the secondary data obtained from the state ministry of health, showing the cases of cholera outbreak in Sokoto state. The results show that the year 2018 recorded the highest cases of cholera disease with 2330 confirmed cases in the state followed by 2022 with 1043 confirmed cases, followed by 2020 with 213 confirmed cases and in 2021 the state recorded if confirmed cases across the twenty 23 local government areas of the state. Similarly, the study revealed that the local government areas that were more affected with cholera outbreak are Sokoto North (743) Tureta (400) Sabon Birni (388), Dange Shuni (263), Bodinga and Illeaha have 248 and 236 cases respectively. The paper recommended the stoppage of open defecation and improved hygiene and sanitation as well as adequate emergency preparedness and response to mitigate the effect of cholera outbreak on the victims.

Keywords: *Cholera Outbreak, Public Health, Spatio-Temporal, Sokoto and Disease.*

Introduction

Cholera is only one of many types of diarrheal disease, but its global importance is underlined by its inclusion in the WHO Communicable Disease Surveillance and Response (CSR) list (WHO, 2002). Globally, the annual estimated cases of cholera and the number of deaths associated with cholera worldwide are approximately 3–5 million and 100,000–120,000 respectively. African countries account for about 25,000 cases with more than 350 deaths. In many endemic countries, children under 5 account for more than half of the global incidence and deaths (UNICEF, 2013, Akpan-idiok & Akpan-idiok, 2010). Cholera remains a persistent health problem in sub-Saharan Africa and worldwide but can be controlled through water hygiene and environmental sanitation. The case fatality ratios remain high at 2–5% against the global declining trend. The disease was largely eliminated from industrialized countries by water and sewage treatment over a century ago but it remains a significant cause of morbidity and mortality in developing countries (WHO 2002, Anthony, Zafar & Gulzar, 2016, Agetue and Obuseh, 2019, Akpan-idiok & Akpan-idiok, 2010 and Stopcholera 2022).



Cholera outbreak is one of the disasters affecting the overall wellbeing of individuals and sometimes leads to comma. Therefore, certain measures need to be taken to ensure that people are safe, before, during and after the outbreak of cholera infectious diseases. These measures depend on the level of emergency preparedness, emergency response which deals with the resources available to control the situation and disaster management dealing with the level of organization and management of available resources to lessen the effect of outbreak on the victims such as humanitarian assistance and the like (Lantagne, and Yates 2018 and Anthony, Agetue and Obuseh, 2019).

Developing countries are disproportionately affected by cholera because of their lack of resources, infrastructure and disaster preparedness systems. In newly affected areas, outbreaks may occur during any season and affect all ages equally. People acquire its infection by consuming contaminated water, seafood, or other foods. Once infected, they excrete the bacteria in stool. Thus, the infection can spread rapidly, particularly in areas where human waste is untreated (Sur, 2000, Qadri, 2004 and Adagbada, Adesida, Nwaokorie, Niemogha, & Coker, 2012). The mainstay of the case management of cholera in Nigeria is treatment of dehydration using Oral Rehydration Therapy (ORS) or IV fluids (Ringer lactate) and electrolytes, although, Oral Rehydration Therapy (ORS) has the advantage of being low-cost and simple, using the technique of decision analysis. Meanwhile, Adagbada, Adesida, Nwaokorie, Niemogha, & Coker, (2012) and Babaniyi, (1991) concluded that community-based control of Diarrhoeal Diseases interventions in Nigeria is problematic to evaluate.

In the last quarter of 2009, it was speculated that more than 260 people died of cholera in four Northern states of Nigeria with over 96 people in Maidugari, Biu, Gwoza, Dikwa and Jere council areas of Bauchi state. Most of the Northern states of Nigeria rely on hand dug wells and contaminated ponds as source of drinking water. Usually, the source of the contamination is other cholera patients when their untreated diarrhoea discharge is allowed to get into water supplies. In Nigeria, since the first appearance of epidemic cholera in 1972, intermittent outbreaks have been occurring. The later part of 2010 was marked with severe outbreak which started from the northern part of Nigeria, spreading to the other parts and involving approximately 3,000 cases and 781 deaths. Sporadic cases have also been reported. In Nigeria, the first series of cholera outbreak was reported between 1970- 1990 (Qadri, 2004). Despite this long experience with cholera outbreak and efforts to control cholera, the disease continues to occur as a major public health problem in many developing countries especially in the area of emergency preparedness, response and management.

Water, sanitation, and hygiene are one part of a cholera control strategy. Household water treatment (HWT) in particular has been shown to improve the microbiological quality of stored water and reduce the disease burden. Water sanitation and hygiene are essential to human health and survival, as well as the development of the community. In Nigeria, more than 65 million people lack safe drinking water (Lantagne, & Yates, 2018). Water sanitation and hygiene practice form an important aspect of Environmental Health in disease prevention and control. Water serves as an important medium through which many illnesses are spread in the human population. The essential role it plays in human survival cannot be over emphasized, especially in the sustenance of life and promotion of health. Thus, it is impossible to separate issues of water and sanitation, including hygiene from life as they impact significantly on our health and general wellbeing. They are also regarded as fundamental human rights by the United Nations (WHO 2005).

Water sanitation and hygiene practice have become global issues and one of the United Nations Millennium Development Goals (MDGs) which is aimed at ensuring environmental sustainability targeted towards reducing by half the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015. It is expected that if the proportion of the population using improved drinking water source and the proportion of the population using improved sanitation



facility increases there will be a reduction in disease transmission and mortality/morbidity rates (UNICEF, 2010).

The extent of the problems of lack of clean and safe drinking water and sanitation facilities (sanitary toilets) worldwide, particularly in developing countries, poses serious public health risks to the citizens. Globally, it is estimated that over 1.1 billion people do not have access to safe water and 2.6 billion are without adequate sanitation. In the developing countries, only 31% of the rural inhabitants have access to improved sanitation. The situation in Nigeria with a population of over 200,000,000.00 million is not different as sanitation coverage is estimated at 41% for urban areas and 26% for rural areas. These levels of coverage were determined based on access to sanitation facilities such as flush toilets; traditional pit toilets and ventilated improved pit (V.I.P) latrines (UNICEF, 2010). According to UNICEF Fact Sheet 6, over 12 million Nigerians have no access to safe water and about 40 million are without improved sanitation. Furthermore, out of an estimated population of over 200 million, nearly 65 million people do not have access to safe water. The statistics clearly shows that more than 100 million people lack improved sanitation facilities such as latrines or toilets, while a larger proportion of the population practice open defecation. Studies also indicate that basic hygiene practice in households, such as hand washing with soap at critical times can equally prevent and reduce diarrheal infection in children by as much as 44% and acute respiratory infections including pneumonia by 25% (Orimoloye, Amadi, Amadi, Azuamah, Nwoke, Zacchaeus & Dozie, 2015).

In Sokoto state, in 2014 cholera outbreak kill sixteen 16 people and 40 others had been hospitalized and in August 4, 2021 the state recorded 23 death of cholera cases across the state's 13 local government areas with 265 confirm cases. By the end of August, 2021 Sokoto is one of the three 3 state that lead the cholera outbreak that kill 653 peoples and infected 27,186 people 2651 suspected cases in Sokoto State (Premium times, 2021, Sun news online, 2021 and Punch online 2021). The State blames the cholera outbreak to poor hygiene, open defecation, and other poor sanitary practice embarked by residence that gets worsen by rainfall. Meanwhile, the Sokoto state government launches a rapid response team in 2021 to curve the cholera outbreak in the state (voice of Nigeria online news 2021).

Recently, National Centres for Disease Control NCDC situation report (2023) reported that in January, 2023 cholera outbreak killed 79 people and 1336 suspected cases across 12 state of the federation and Sokoto state inclusive. It's against this background that this paper assesses the role of water, sanitation and hygiene in the emergency preparedness, response and management of cholera outbreak in Sokoto state Nigeria. It's against this background the paper is assessing the role of water sanitation and hygiene in the management of cholera cases in Sokoto State. The objectives are to examine the cholera prevention, effective preparedness and timely response; analyze the spatial distributions of cholera cases in the state as well as creating awareness on emergency preparedness and response strategy.

Study Area (Sokoto State)

The study area Sokoto State is located in the Northwest geopolitical zone between latitudes 12°00'N and 13°58' and between longitudes 4°08'E and 6°54'E. By its location, it shares boundaries with the Republic of Niger to the North, Kebbi State to the West and Southwest, and Zamfara State to the East (Figure 1). The state covers a total land area of about 32,000km² and has a population of 4,903,095 2017 projection, distributed across 23 local government areas (NPC, 2006). The state faced some changes as a result of creation of Kebbi and Zamfara States in 1991 and 1996 respectively. The state has twenty three (23) local government areas with three senatorial districts

namely Sokoto East, Sokoto North and Sokoto South senatorial districts. However, the state has 120 health districts and 244 political wards (MBEP, 2012). The current health status indices are poor and among the worst in the country as indicated by Multiple Indicator Cluster Survey (MICS) 2007 and Nigeria Demographic and Health Survey (NDHS, 2008) among other studies. Crude Birth Rate is 41.7 per 1000, Infant Mortality Rate is 100 per 1,000 live births, Under Five Mortality Rate is 166/1000 live births and Maternal Mortality Rate 850/100,000. Current use of contraception, any method is 2.1%, with any modern method as 1.9% (NDHS, 2008, SSMOH, 2009). Other maternal health indicators in the State include 13.8% receiving Antenatal care (ANC) from a health professional, 6.8% Percentage of pregnant women whose last live birth was protected against number needed to treats (NNT), Percentage delivered by a health professional is 5.1%; and Percentage delivered in a health facility is 4.4%. In general, malaria, diarrhoea, pneumonia, measles, Human Immuno Deficiency Virus (HIV) and Tuberculosis (TB) still constitute the major burden of prevailing diseases in the general population within the state (SSMOH, 2009).

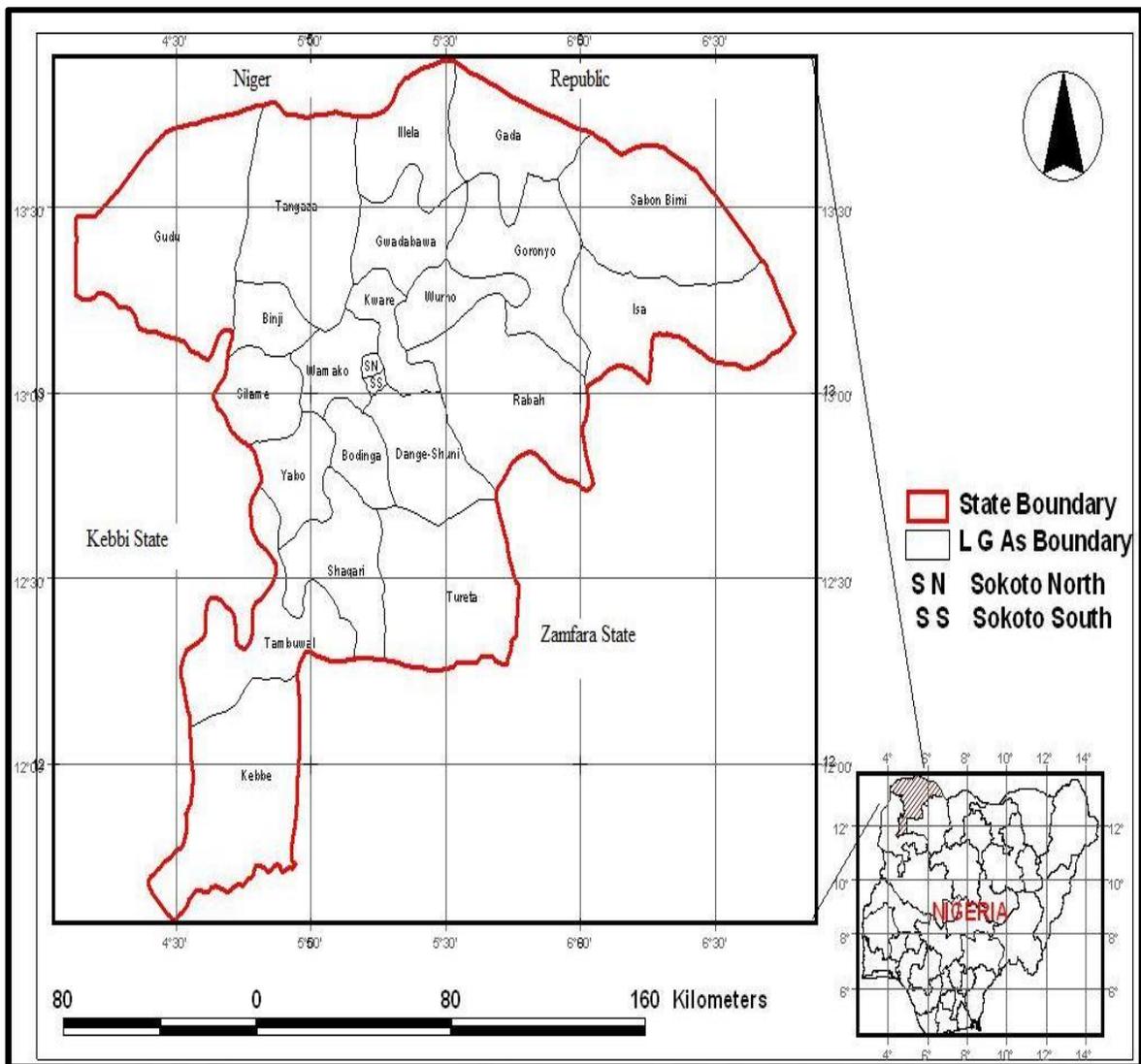


Figure 1: Sokoto State Showing 23 Local Government Area of the State
Source: Department of Geography, Usmanu Danfodiyo University, Sokoto



Materials and Methods

In order to achieve the set objectives for this study, relevant data and information were collected from secondary sources on the incidence of cholera outbreak from State Ministry of Health. Similarly, populations figures were sourced from the National Population Commission and projected to 2017 (NPC, 2006). Geographical coordinates of each local government in the state were also collected from World Health Organization State Divisional Office. The aim was to examine the spatial distribution of confirmed cases of cholera outbreak in the state. The data obtained were analyzed and presented using descriptive statistics. The secondary data collected used in measuring the spatial and temporal distribution of cholera cases in the study area using ArcGIS 10.2.1 Version. Descriptive statistics were used to present frequency distribution, tables, graphs and charts using Microsoft Excel. The reason is that Microsoft Excel is one of the best, comprehensive and flexible statistical and management packages for synthesizing and analyzing data.

Results and Discussions

Spatial Distribution and Prevalence of Cholera Cases in Sokoto State

This section presents the results of cholera outbreak in Sokoto State of 2018, 2020, 2021 and 2022 (Table 1 and Figure 2a to 2d). The results show that the year 2018 recorded the highest cases of cholera disease with 2330 confirmed cases in the state followed by 2022 with 1043 confirmed cases, followed by 2020 with 213 confirmed cases and in 2021 the state recorded if confirmed cases across the twenty 23 local government areas of the state.

In 2018 the state suffered most with the cholera illness in which 73% (17) local government areas (LGAs) were affected. Sabon Birni Local government area was the worst hit with 17% (388) of confirmed cases of cholera outbreak, followed by Tureta local government with 16% (384) of confirmed cases followed by Dange Shuni and Yabo LGAs with the confirmed cases of 11% (261) and 10% (233) cases respectively. Meanwhile, Illela and Rabah LGAs recorded 9.8% (229) and 9.1% (213) confirmed cases respectively.

In the year 2022 recorded the second year with the highest cases of cholera outbreak after 2018. The results show that 48% (11) of the Local Government Areas LGAs, recorded cases of cholera outbreak. In this year Sokoto North LGA was the worst hit and recorded 70% (734) of confirmed cases recorded on that very year, followed by Tambuwal with 11% (110), followed by Isa with 9% (95) and Wurno was the least with 0.1% (1) of confirmed cases of cholera outbreak. In the year 2020 only 3 (13) LGAs were affected namely, Dange Shuni (141), Kebbe (56) and Tureta LGA with 16 confirmed cases of cholera outbreak across the State. This corresponds with the reports issued by NCDC, (2023) which indicated that Sokoto State is one of the states with higher numbers of suspected cholera cases in Nigeria.

Meanwhile, the result of interview indicated that, most of these outbreaks are associated with drinking of contaminated water with traditional pit latrines. Soak a ways, leachate chemicals, and other pollutant resulted from poor hygiene, open defecations and indiscriminate waste disposal among others.

Table 1: Distribution of Cholera Cases in Sokoto State

Local Government Areas (LGAs)	2018 Cholera cases	2020 Cholera cases	2021 Cholera cases	2022 Cholera cases	Total	Population 2017	Ratio per 10,000
Binji	0	0	0	0	0	142,041	0.0
Bodinga	59	141	0	48	248	237,222	10.5
Dange Shuni	261	0	0	2	263	263,107	10.0
Gada	90	0	0	0	90	335,760	2.7
Goronyo	36	0	7	0	43	246,539	1.7
Gudu	0	0	0	0	0	312,893	0.0
Gwadabawa	37	0	0	0	37	129,216	2.9
Illela	229	0	7	0	236	203,524	11.6
Isa	103	0	0	95	198	197,591	10.0
Kebbe	61	56	0	0	117	168,590	6.9
Kware	0	0	0	0	0	181,087	0.0
Rabah	213	0	0	6	219	201,732	10.9
Sabon Birni	388	0	0	0	388	280,760	13.8
Shagari	109	0	0	6	115	211,536	5.4
Silame	0	0	0	22	22	141,162	1.6
Sokoto North	09	0	0	734	743	314,904	23.6
Sokoto South	1	0	0	2	3	263,605	0.1
Tambuwal	78	0	0	110	188	304,200	6.2
Tangaza	0	0	0	0	0	153,977	0.0
Tureta	384	16	0	0	400	92,465	43.3
Wamakko	39	0	0	12	51	242,919	2.1
Wurno	0	0	2	1	3	219,507	0.1
Yabo	233	0	0	5	238	155,542	15.3
Total	2330	213	16	1043	3602	4,999,878	7.2

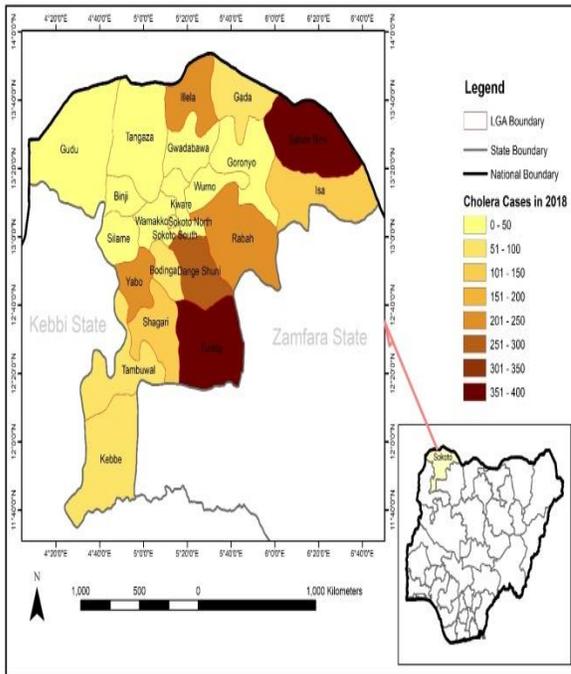


Figure 2a: Distribution of Cholera Cases in 2018

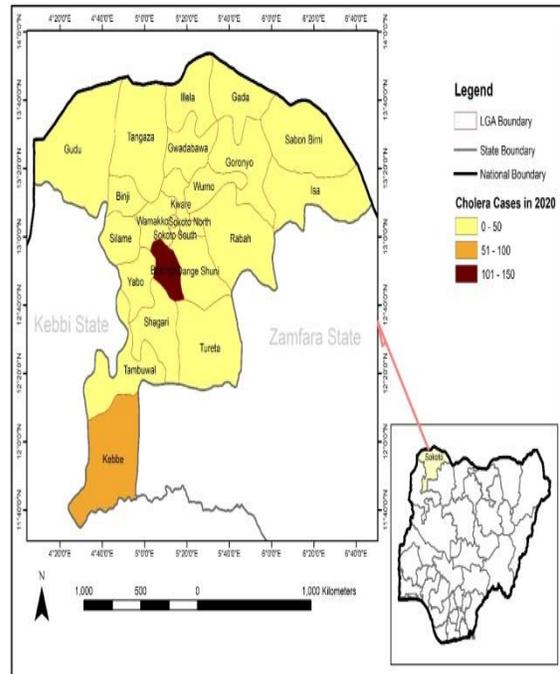


Figure 2a: Distribution of Cholera Cases in 2020

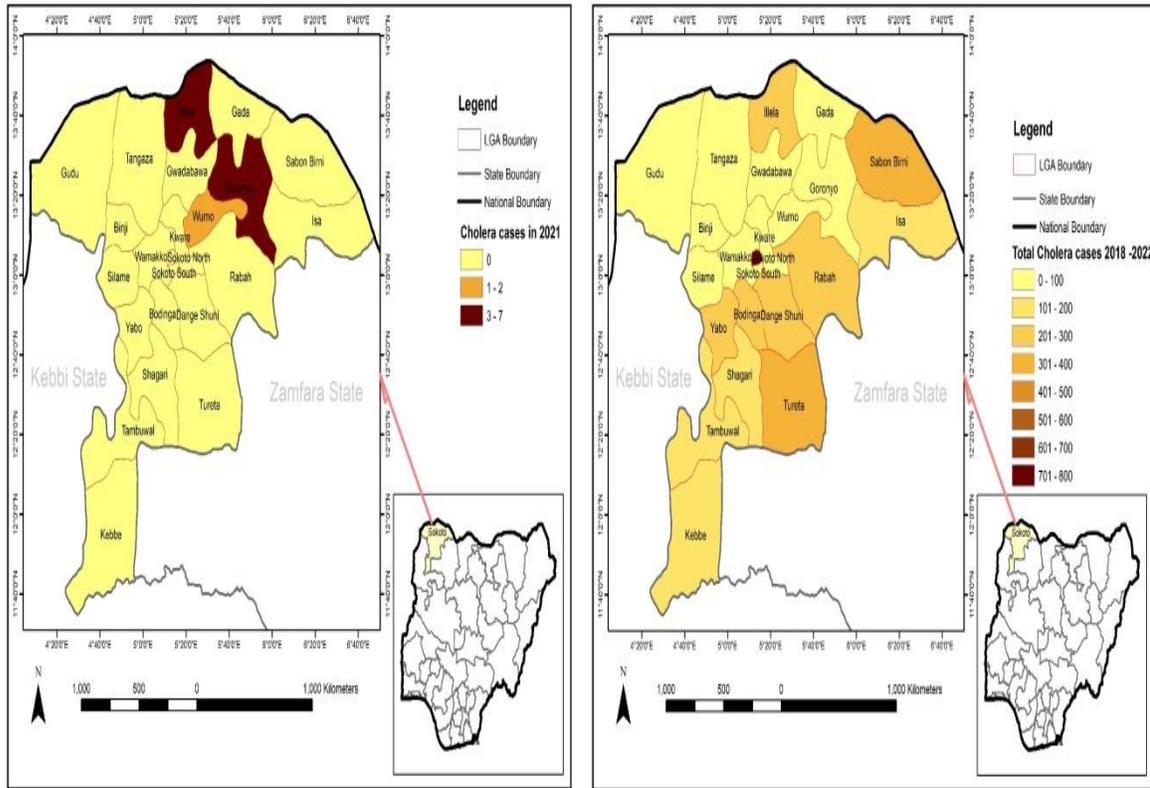


Figure 2c: Distribution of Cholera Cases in 2021

Figure 2d: Distribution of Cholera Cases in 2022

Age Distributions of Cholera Cases in Sokoto State from 2020-2022

The result shows that ages range from 1-10, 11-20 and 21-30 years are age category mostly affected by the cholera illness. While the least ages are within the range of 70-90 years, this is because these age categories are the least of number as only few reaches the age of seventy (70) as indicated by NDHS, (2008), (2013), MIC, (2013) and NPC, (2006).

In 2022, 113 people were affected with cholera diseases with the range of 1-10 years old, followed by 68 people within the range of 11-20 years, followed by 67 people within the range of 21-30 years old and in ages ranging from 60-80 years no cases were recorded in this year 2022. In the year 2020 the highest figure of 69 falls within the range of 1-10 years followed by ages within the range of 11-20 with 30 people within this range continuously as can be see vividly from Figure 3.

The results obtained from interview indicated that the reasons why people at lower age are most affected is that, children usually have lower immune system, can take any form of water good or bad, and can eat food without thorough washing of hands due to the low level of maturity.

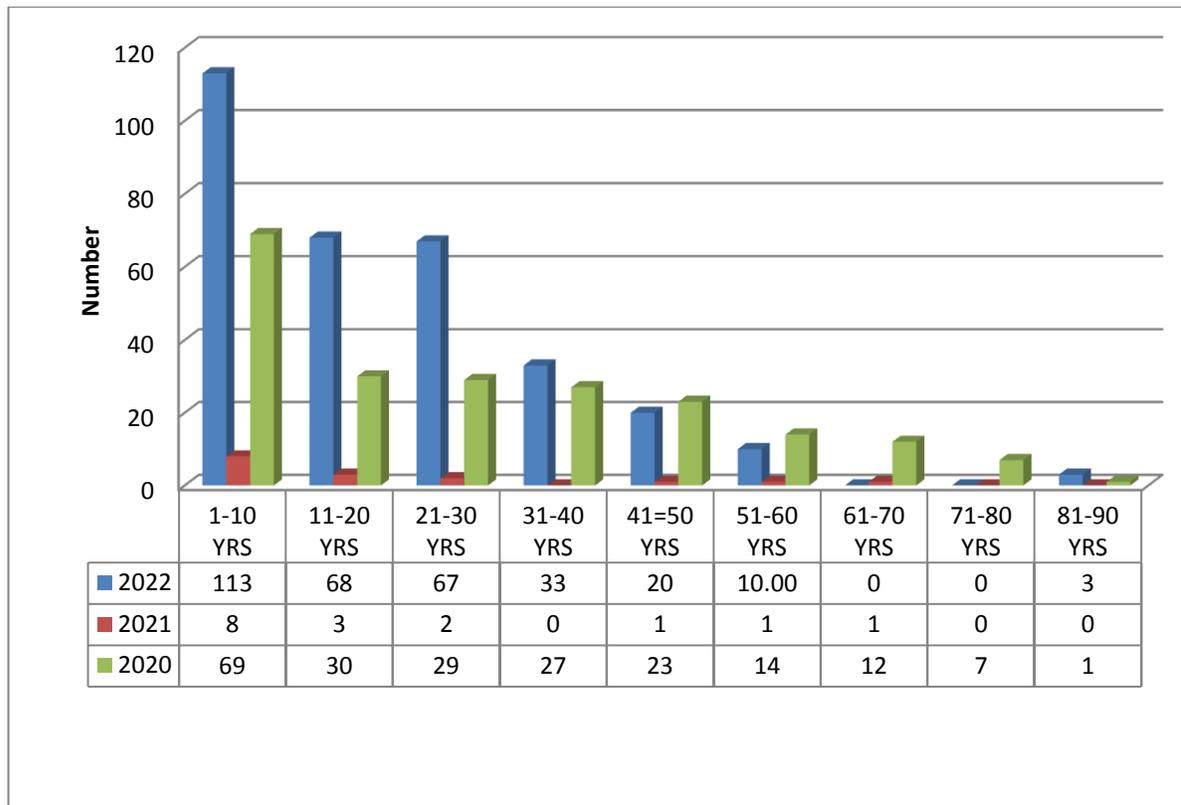


Figure 3: Age Distributions of Cholera Cases in Sokoto State from 2020-2022

Gender Distributions of Cholera Outbreak in Sokoto State from 2018-2023

The results of the analysis explained that females are more affected with the cholera illness than their male counterparts. Figure 4 shows that in 2018, 54% (1284) of females were affected while in 2022, 194 (57%) of females were affected. It’s only in 2023 that the male affected with cholera disease (56%) outnumbered the female (44%).

According to UNICEF (2010), the reasons why females are more prone to cholera disease is females mostly engage in domestic activities, such as taking care of children, sick members of the family, cleaning of latrines, fetching and handling of untreated water, processing and preparations of row food etc. The results of interview indicated that some of the reason for females being more prone to cholera disease are increased number of females, child delivery and breast feeding and other pregnancy related illness that lower the immune system of the women.

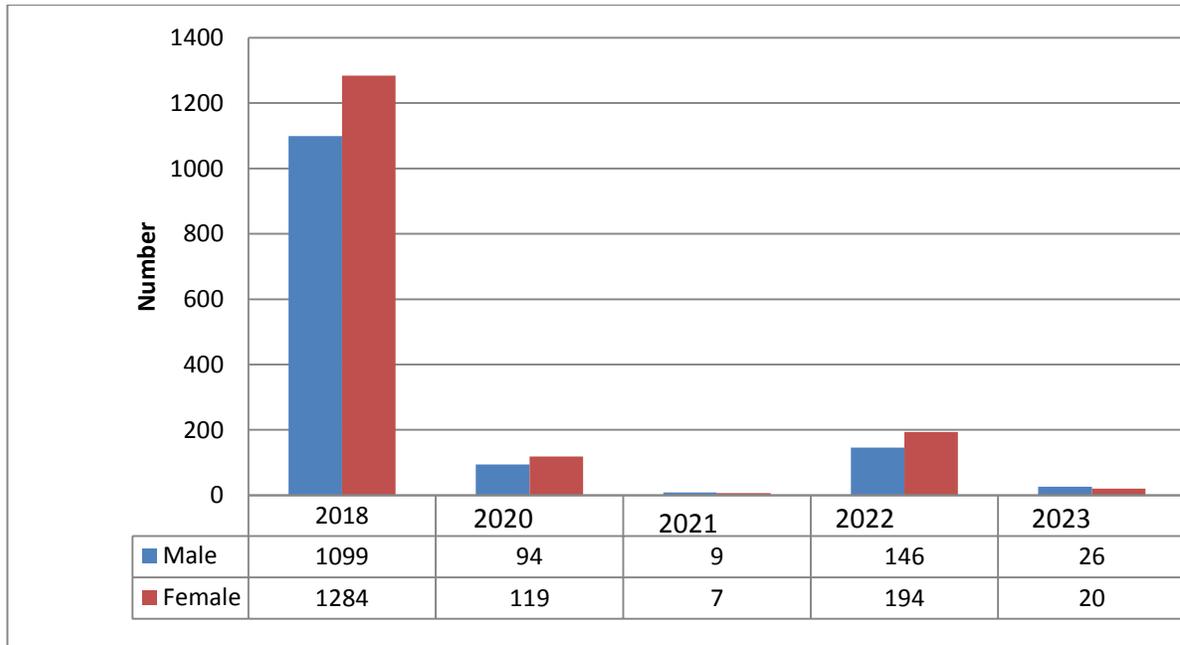


Figure 4: Gender Distributions of Cholera Cases in Sokoto State

Conclusion and Recommendations

Conclusively, it reveals that cholera remains a significant public health concern, because indicates that 2018 recorded the highest number of confirmed cases and followed by 2022. The most affected local government areas within the state include Sokoto North, Tureta, Sabon Birni, Dange Shuni, Bodinga, and Illela. The study also shows that children aged 1-10 years and females were the most affected demographic groups, likely due to lower immunity and domestic exposure to contaminated water and poor sanitation. Similarly, the persistence of cholera outbreaks in Sokoto State is linked to poor sanitation practices, open defecation, inadequate access to clean water and ineffective waste management. The study suggested some recommendations that may prevent and reduce the risk of cholera outbreak in the state. They are as follows:

1. The Sokoto State and its local government, should strengthens the cholera emergency, preparedness and response strategy in the state through efficient sanitation and hygiene prevent the risk of cholera outbreak in the state, provision of quality of drinking water prevent the risk of cholera outbreak in the state, stop page of open defecation prevent the risk of cholera outbreak in the state, provision of good toilet facilities prevent the risk of cholera outbreak in the state good access to quality drinking water prevent the risk of cholera outbreak in the state.
2. Efficient waste management prevents the risk of cholera outbreak in the state.
3. Uses of treated, boiled and filtered water prevent the risk of cholera outbreak in the state.
4. Washing hand with safe water and detergent prevent the risk of cholera outbreak in the state.



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