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ASSESSING THE IMPACT OF SEASONAL VARIATIONS ON CHOLERA OUTBREAK IN BIDA METROPOLIS, NIGERIA

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ABSTRACT

Cholera remains a significant public health concern in Nigeria, with Bida metropolis experiencing recurrent outbreaks. This study evaluates the trend of cholera cases in Bida Metropolis, Niger State, from 2000 to 2020, using retrospective data from two hospitals. The study is limited to retrospective cholera cases reported at Umaru Sanda Ndayako General Hospital and the Federal Medical Centre Bida. Data on cases, deaths and vaccination coverage were collected through primary and secondary sources. Data collected were analysed using trend analysis, standardised coefficient of Skewness (Z1) and Kurtosis (Z2) statistic. The results showed that a significant increase in trend in cholera cases was observed from 2000-2020 with an average annual incidence which revealed that year 2007 ranked the highest with 231 cases of cholera, followed by the 2014 with 198 cases and the least was observed in the 2013 with 26 cases. The study concludes that a significant increase in cholera cases was observed, with peaks in 2007 and 2014. Statistical trend analysis was applied to assess seasonality and distribution patterns. The study highlights the critical need for improved environmental sanitation and public health interventions, particularly during the dry season. It recommends strict enforcement of waste disposal regulations to mitigate future outbreaks.

KEY WORDS Environment; rainfall, infectious, wet season, incidences

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1. INTRODUCTION

Cholera, a diarrheal disease caused by Vibrio cholera remains a significant public health concern globally, particularly in developing countries like Nigeria (Osunla and Okoh, 2018). Cholera remains a global threat to public health and an indicator of inequity and lack of social development (WHO, 2016). Unhygienic practices like indiscriminate dumping of refuse and open defecation are prevalent in many areas in Nigeria and thus the likelihood of meeting tainted water through drinking, cooking, using utensils or eating vegetables washed with contaminated water is high. Most of the time, the infection is moderate or symptomless, but it can also occasionally be severe and life-threatening (Bashar and Soundappan, 2022).

According to WHO (2015), Lagos in Nigeria recorded the first-ever cases of cholera with a figure of 22,931 and 2,945 deaths. Subsequently, four northern states in the late 1970s witnessed about 260 deaths from the pandemic, mainly affecting Maiduguri, Jere, Gwoza, Biu, and Dikwa local government councils. According to Abdulsalam (2014), between 1991 and June 2017, Nigeria saw a significant increase in cholera-related fatalities, with the pandemics of 1991 and 2010 recording the highest numbers of cases and fatalities to date

According to Kalaiselvan (2010), eighty-three per cent of deaths in children under age five are caused by infectious, neonatal and cholera. The overall child mortality declined significantly in the 1990s into the 2000s, but environmental risk factors still kill at least 3 million children under age 5 every year. Such young children make up approximately 10% of the world's population and comprise more than 40% % of the populace suffering from health problems related to the environment (WHO, 2016).

It is estimated that about 2.86 million (1.3 m - 4.0 m) cholera cases occur annually in endemic countries with 95,000 (21,000 - 143,000) deaths per year (WHO, 2016). Cholera is endemic in several developing countries in Asia, Africa, and Latin America (Yanda *et al*., 2018). Limited access to clean water, poor sanitation practices, and the disruption of public health systems continue to have a considerable negative impact on morbidity and mortality in nations with dense populations (Yanda *et al*., 2018).

Cholera is a significant public health challenge in developing countries, including Nigeria. Recurrent outbreaks in Bida Metropolis necessitate an understanding of cholera trends to inform preventive strategies. This study assesses cholera incidence in Bida from 2000 to 2020, addressing a gap in localized epidemiological data.

2. MATERIALS AND METHOD

2.1. The Study Area

Bida in Niger State, Nigeria, resides in the heart of Northern Nigeria (Figure 1). It is in the Niger Valley within latitudes 09° 09' 9'' North of theequator and longitudes 05° 56' 64" East of the Greenwich meridian. Bida has an area coverageof 1,698 km2 (Daramola, 2013; Ishaya and Musa, 2023).

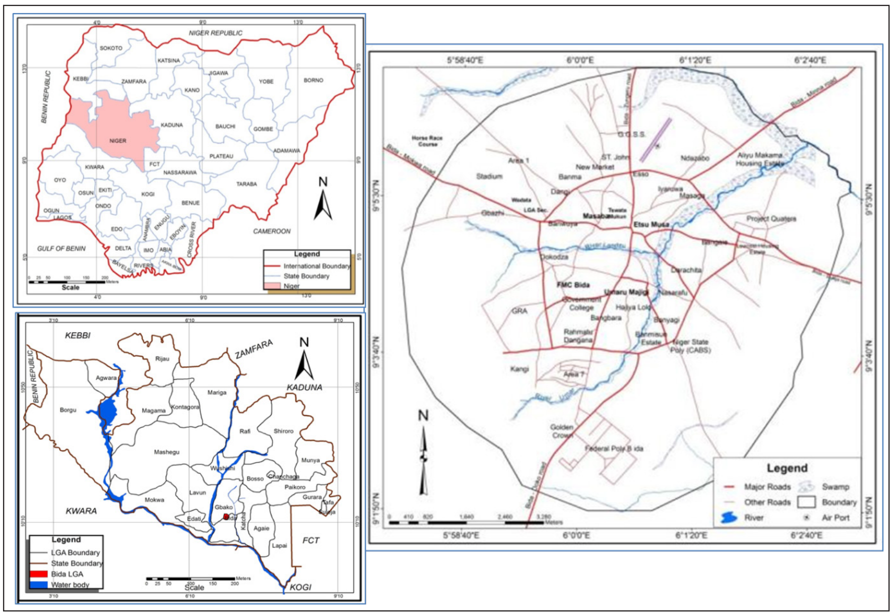


Figure 1.Location map of the study area

Source: Niger State Geographic Information System, 2022.

The rainy season begins in April and ends in October when daytime temperatures reach 28°C to 30°C and nighttime lows hover around 22°C to 23°C. In the dry season, daytime temperatures can soar as high as 40°C and nighttime temperatures can dip low to 12°C. Even the chilliest nights can be followed by daytime temperatures well above 30°C. The high altitudes and undulating terrain of the study area act as a moderating influence on the weather of the study area (Ogunjumo, 2010).

2.2. SOURCES OF DATA

Hospital records of cholera cases in Bida Metropolis between the periodsof year 2000 to 2020 were collected from Umaru Sanda Ndayako General Hospital and the Federal Medical Centre Bida, Niger State. The records utilized were confirmed cholera cases after clinical symptoms and histopathological and bacteriological investigations. Twenty years of data were utilized due to availability from the sample hospitals.

2.3. DATA SAMPLING AND ANALYSIS

The study utilized retrospective hospital data from Umaru Sanda Ndayako General Hospital and the Federal Medical Centre Bida, covering the years 2000 to 2020. Skewness and Kurtosis were applied to determine the distribution of cholera cases over time. Data validation was conducted by cross-checking with national health records, and ethical approval was obtained from the hospital review board. While Skewness measured the asymmetry of the probability distribution of a real-valued random variable about its mean, Kurtosis measured how data disperse between a distribution's center and tails, with larger values indicating a data distribution may have "heavy" tails that are thickly concentrated with observations or that are long with extreme observations.

The standardized coefficient of Skewness (Z1) was calculated thus:

$$Z_1 = \left[\left(\sum_{i=1}^{N} (x_i - \bar{x})^3 / N \right) \Big/ \left(\sum_{i=1}^{N} (x_i - \bar{x})^2 / N \right)^{3/2} \right] \Big/ \left(6/N \right)^{1/2} \text{ .... eq. 1}$$

The standardized coefficient of Kurtosis (Z2) was determined as

$$Z_2 = \left[\left(\sum_{i=1}^{N} (x_i - \bar{x})^4 / N \right) \Big/ \left(\sum_{i=1}^{N} (x_i - \bar{x})^2 / N \right)^2 \right] - 3 \Big/ \left(24/N \right)^{1/2} \text{ .... eq. 2}$$

Where: $\bar{x}$ is the long-term mean of X1 values,

N is the number of years in the sample.

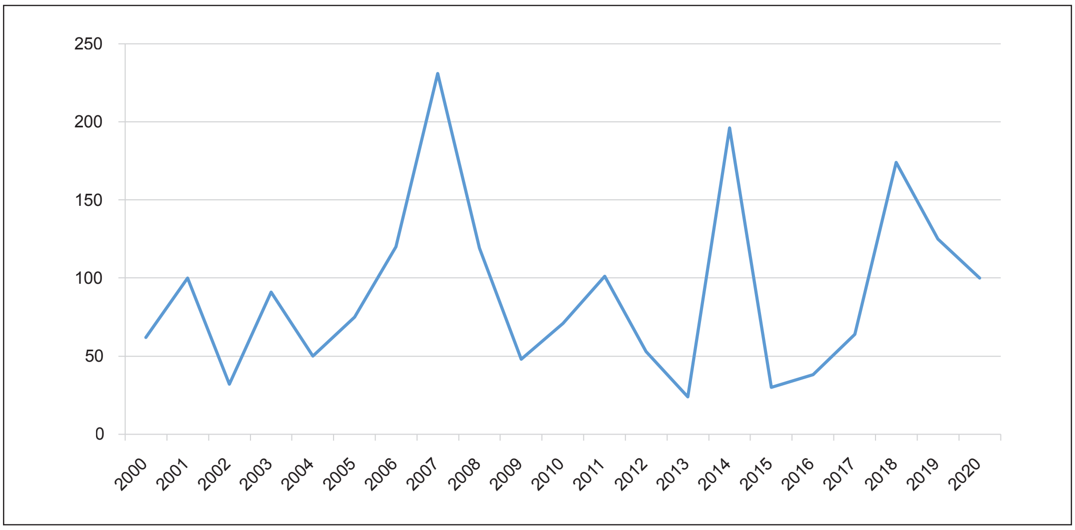
When the calculated value of Z1 or Z2 is greater than 1.96, it depicts a significant deviation from the normal curve indicated at the 95% level of confidence.

3. RESULTS

3.1. Trend of Cholera Cases between 2000 – 2020 in the Research Area

The trend of study cholera casesfrom year 2000 to 2020 is shown in Figure 2. The results showed an increased trend in cholera cases which was observed from 2000-2020 with an average annual incidence which revealed that year 2007 ranked the highest with 231 cases of cholera, followed by the 2014 with 198 cases and the least was observed in the 2013 with 26 cases as revealed in Figure 2.

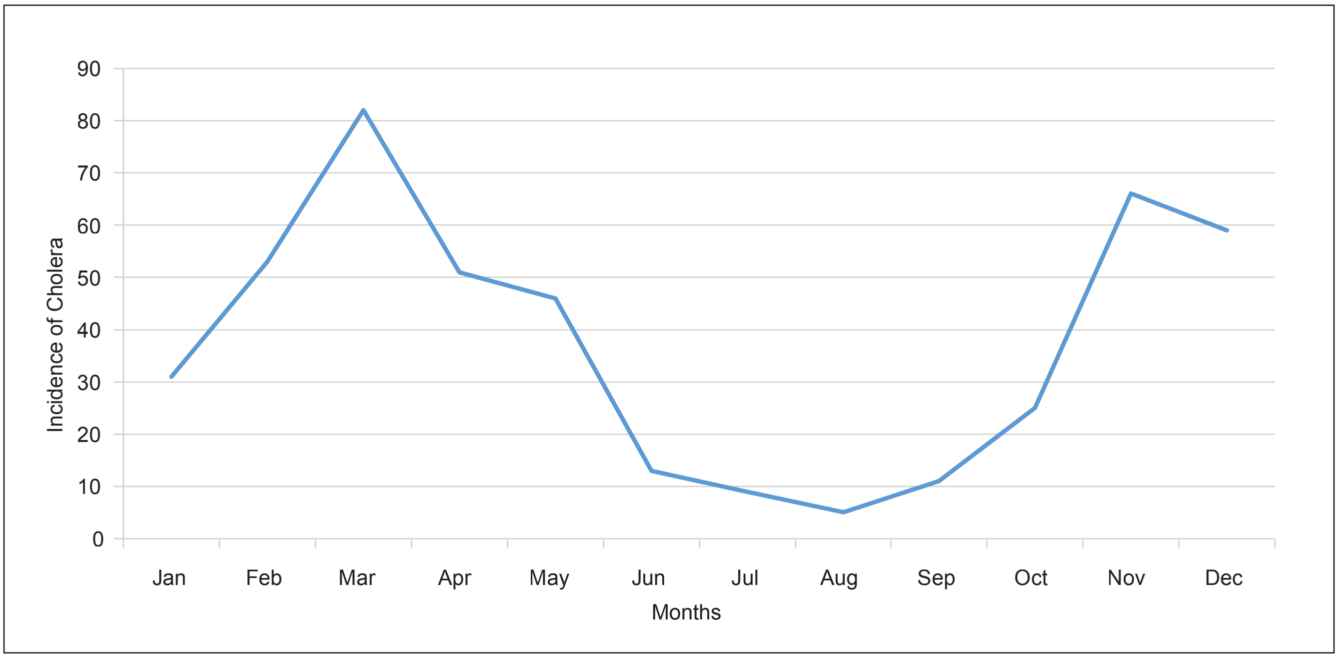
Figure 2: Annual Incidence of Cholera Cases in Bida Metropolis



Source: Authors (2022)

The results revealed that cholera cases peaked during the rainy season (March – November) with March ranking the highest with 82 cases followed by November with 66 cases and least was observed in August with 5 cases as shown in Figure 3.

Figure 3: Monthly Incidence of Cholera in Bida Metropolis



Source: Authors (2022)

3.2. Distribution Pattern of Cholera Cases in the Study Area from 2000 - 2020

The distribution pattern of cholera cases in the study area were analyses using Skewness and Kurtosis statistical measures presented in Table 1.

Table 1: Distribution Pattern Cholera Cases

Distribution	Calculate value
Skewness	1.11
Kurtosis	1.83

Source: Authors (2022)

The Skewness result of approximately 1.11was calculated (see Table 1). It indicates that the distribution of cholera cases from 2000 to 2020 is positively skewed. This suggests that over these two decades, there have been more years with relatively low or moderate numbers of cholera cases, but a few years experienced significantly higher numbers (e.g. 2007 and 2014). This pattern of distribution is critical for understanding the epidemiology of cholera during this period.

The kurtosis of the cholera cases data is approximately 1.83 as presented in Table 1. This value indicates that the distribution is moderately peaked compared to a normal distribution.This 1.83 suggests that the distribution of cholera cases over the years is platykurtic, meaning it is flatter and less peaked compared to a normal distribution. This indicates that the distribution has fewer extreme values or outliers. In practical terms, this implies that the cholera incidence data tends to be more evenly distributed, with fewer dramatic spikes or drops in case numbers. The flatter shape of the distribution means that large fluctuations in cholera cases are less common.This lower kurtosis value also highlights that the distribution of cholera cases is relatively stable and less prone to extreme variability. Also that, the incidence of cholera tends to be more consistent over time.

4. DISCUSSION

The findings in this study revealed that there was a significant increase in cholera cases observed from 2000–2020 with an average annual incidence of 231 cases of cholera. This implies that cholera incidence is on the increase despite some fluctuation in some years. This might be attributed to incidents of consumption of contaminated water and food. The upward trend in cholera cases in Bida aligns with findings from similar studies in Northern Nigeria, where poor sanitation and contaminated water sources are leading contributors. This result is similar to the work of Fagbamila *et al.*, (2023), who reported that the 1995–1996 cholera outbreak in Kano State revealed that poor hygiene, a lack of proper sanitation, and contaminated water were major sources of infection. Contamination of wells and other types of water, overflowing latrines, and frequent modifications of water sources for human behaviour and consumption may also result in cholera outbreaks (Osunla and Okoh, 2014). Similarly, Gidado *et al.*, (2018) reported that Bashuri in Jigawa State had experienced a major cholera outbreak in September 2010 with high mortality rates and that the major sources for getting water for consumption for most people dwelling in that locality were uncovered wells dispersed across the streets in unclean areas. However, the seasonality of outbreaks, peaking during the dry season, suggests that water scarcity may exacerbate the spread of the disease. Public health efforts should focus on improving water infrastructure and educating residents on sanitation practices, particularly during high-risk months.

The asymmetry in the distribution cholera incidences in the study area also suggests that the average number of cholera cases (mean) is higher than the median, due to these higher values pulling the mean up. This has important implications for public health policy. If most years see only moderate numbers of cases, but a few years see very high numbers, it may indicate a need for better preparedness and targeted interventions during those critical years.The Skewed and Kurtosis distributions provide the importance of historical context when analyzing cholera data. The years with higher cases might correspond with specific events or conditions that made populations more vulnerable to cholera outbreaks.

In the study area, during the dry season, there were high record cases of cholera outbreaks. This might be due to the increase in the bacterial load. This implies that cholera incidence is on the increase during the dry season despite fluctuation in some months. This further indicated that throughout the dry season, there is a shortage of good drinking water which allows people to take untreated water. Idoga *et al*. (2019) also reported the seasonal distribution of cholera infection, time of outbreaks, and geographical distribution is however predictable for the cholera outbreak. This was similar to the reports of Adewale *et al*., (2016) who reported that V. cholerae in boreholes, wells, streams, and tap water from the 2007–2013 cholera outbreaks in Kano State, northern Nigeria.

5. CONCLUSION

The study found that cholera cases increased in Bida between 2000 and 2020, which was attributable to causes such as polluted water, poor hygiene, and inadequate sanitation. The imbalance in incidence indicates the necessity for focused public health measures at sensitive periods. The study emphasises the significance of historical context when calculating cholera risks, particularly during the dry season. In conclusion, This study reveals a persistent rise in cholera cases in Bida over the last two decades, with pronounced seasonal patterns. Targeted interventions, particularly in improving water access and enforcing waste management policies, are essential to mitigate future outbreaks. The study recommended that the public must be educated by the government on the importance of proper environmental sanitation. Since indiscriminate trash disposal contributes to the cholera outbreak in the research region, tough regulations should be in place against it.

6. CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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