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Temporal and Geographic Trends in Burden of Cholera and Case Fatality Rates in Sub-Saharan Africa (2000-2023)

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Abstract

Cholera remains a significant public health challenge in sub-Saharan Africa (SSA), with notable regional variations in disease burden and case fatality rates (CFR). This study examines temporal and geographic trends in cholera incidence and mortality from 2000 to 2023, revealing distinct patterns across different countries and sub-regions. Statistical analyses indicate an overall weak correlation ($r = -0.082$, p-value < 0.016) between total cholera cases and CFR, suggesting that improved outbreak response measures can mitigate mortality despite rising cases. However, country-specific disparities were observed, with Malawi showing a significant positive correlation ($r = 0.512$ and p-value < 0.015) between case numbers and CFR, likely due to healthcare system strain, whereas Niger exhibited a moderate negative but significant correlation ($r = -0.570$ and p-value < 0.013), suggesting improved outbreak management or underreporting. Regional disparities significantly influence cholera mortality

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trends, as evidenced by an analysis of variance (F = 7.592, p < 0.001), which confirms that sub-regional factors—such as conflict, water access, and emergency response capacity—are critical determinants of CFR. However, when the equality of variance in CFR was independently assessed in coastal and inland regions, no statistical significance (F = 0.987, p-value < 0.321) was observed, indicating that water access might not be of the crucial determinants. The findings underscore the urgency of region-specific public health interventions, integrating climate resilience strategies and strengthening healthcare infrastructure.

Keywords

Cholera, Sub-Saharan Africa, Case Fatality Rate, Regional Disparities

1. Introduction

Cholera remains a significant public health challenge in sub-Saharan Africa (SSA), characterized by recurrent outbreaks and high case fatality rates (CFR). The region is particularly vulnerable due to a combination of environmental, social, and infrastructural factors that facilitate the transmission of Vibrio cholera, the causative agent of cholera [1]-[3]. Recent studies have highlighted that SSA accounts for a substantial proportion of the global cholera burden, with estimates suggesting over 140 million suspected cases annually, contributing to approximately 95000 deaths each year [4] [5]. The epidemiology of cholera in SSA is influenced by various risk factors, including inadequate water and sanitation services, poor health literacy, and environmental conditions such as droughts and floods [6] [7]. For instance, the dynamics of cholera outbreaks have been shown to correlate with climatic events, where both droughts and floods can exacerbate the risk of cholera transmission by affecting water quality and availability [3] [6]. For instance, Perez-Saez and others show there is a strong association between increased rainfall and increased cholera incidence across different regional settings in SSA [8]. This seasonal nature of cholera peaking during rainy season, demonstrate how seasonal weather patterns can influence the spread of cholera [8] [9].

Socio-economic factors are critical determinants of the burden off cholera. Regions with high poverty levels often experience greater burden of cholera due to limited access to clean water and sanitation services which are important for diseases prevention [7] [10] [11]. For example, Leckebusch and Abdulssalam described cholera as a "disease of poverty", attributing its prevalence to poor environmental sanitation and untreated water [11]. Furthermore, in rural areas, household vulnerability is even higher due to limited choices regarding water treatment [12]. The impact of cholera on local economy is monumental, with estimates suggesting that cholera-related illnesses cost many African countries over $130 million annually, causing further financial burdens for these nations with already limited resources [10]. Additionally, socio-economic factors, such as overcrowding and the absence of national health plans, further complicate the cholera landscape, making it imperative to address these underlying determinants [7] [13].

Geographic disparities also play a crucial role in cholera incidence and mortality rates across SSA. Certain areas, particularly those with high population density and limited access to clean water, are identified as cholera hotspots [14] [15]. Mapping efforts have revealed that cholera incidence varies significantly across different regions, necessitating localized strategies for cholera prevention and control [14]. Furthermore, the introduction of multi-drug resistant strains of Vibrio cholerae has raised concerns about the effectiveness of existing treatment protocols, thereby complicating outbreak management [16].

The case fatality rates associated with cholera in SSA are alarmingly high, often exceeding the global average. Reports indicate that the CFR in this region can reach up to 5%, particularly in settings with poor sanitation and healthcare infrastructure [9] [17]. Children under five years old are disproportionately affected, highlighting the urgent need for targeted interventions aimed at vulnerable populations [18]. The integration of oral cholera vaccines (OCVs) into public health strategies has shown promise, yet challenges remain in terms of accessibility and implementation [19] [20].

Cholera remains a significant public health issue in SSA, characterized by high incidence rates and alarming CFR, particularly in vulnerable populations. This research aims to analyze temporal and geographic trends in cholera burden and CFR from 1991 to 2023, addressing critical questions regarding changes in total cases across countries, the correlation between total cases and CFR, regional differences in mortality trends, and variability in CFR between coastal and inland regions. Understanding these dynamics is essential for informing targeted public health interventions, resource allocation, and policy formulation to effectively combat cholera outbreaks and reduce mortality rates in the region.

1.1. Data Source and Description

The data used in the study was a secondary data obtained from the World Health Organization (WHO) [21]. Variables in the dataset include country, sub-region, year, total cases, deaths, imported cases, autochthonous cases, and case fatality rates (CFR) of all Sub-Saharan African countries member states reported to WHO from 2000 to 2023. All member states are expected to report annually the occurrence or absence of cholera case in their countries. The data was gathered as part of WHO's collaboration with Global Taskforce on Cholera Control (GTFCC) to strengthen cholera surveillance [22].

1.2. Ethical Considerations

The study adhered to ethical principles by respecting individuals as autonomous agents and protecting their rights and privacy using the WHO dataset, which ensured anonymity. To uphold beneficence, the potential for harm from misinterpretation or misuse of data was mitigated by accurately reporting findings that benefit stakeholders. Equity was promoted by considering the representativeness of the secondary data, avoiding bias towards specific demographics, and ensuring diverse representation to fill gaps in prior research. Overall, the selected WHO data adhered to ethical collection standards, including informed consent and anonymization, while the statistical analysis avoided selective reporting and maintained representation of the population, with integrity supported by transparent documentation of assumptions and limitations.

1.3. Statistical Methodology

The data was processed and analyzed using statistical software such as R programming language, and SPSS software which are well-equipped to handle large datasets and conduct the variety of statistical tests. Descriptive statistics to understand the distribution of the variables and appropriate statistical test (e.g., time plots, ANOVA for comparisons, Correlation, etc) were carried out at 5% level of significance.

2. Results

2.1. Changes in Total Cases across Different Countries in Sub-Saharan Africa from 2000 to 2023

Refer to the graphs in the Appendix, they represent the trend of total cases over a period, with data points corresponding to specific years on the x-axis and the total number of cases on the y-axis. Here is a detailed interpretation for all the countries.

1) Colour Scale

a) The gradient color scale suggests a varying intensity of total cases. Darker shades correspond to lower case counts, and lighter shades indicate higher case counts.

b) The sharp increase in 2010 is evident as the lightest region on the graph, emphasizing its magnitude.

2) Trend Overview

a) The graph exhibits a mostly low level of total cases between 2000 and 2009, with only minor fluctuations.

b) There is a sharp and significant spike in total cases around the year 2009 or 2010, peaking at over 60000 cases.

3) Magnitude of Spikes

The 2010-2013 spike is the most dominant feature of this graph, representing an unprecedented surge in cases. This could reflect a significant epidemic, public health crisis, or data-reporting anomaly during that year.

4) Post 2020 Trends

a) Having identified the minimum and maximum number of total cases, together with the mean number of total cases. Our interest is on the post 2020 trend. The spike in 2020, though smaller, might align with other global or regional health events, possibly the COVID-19 pandemic. The key post 2020 trends for the countries can be generally summarized as follows:

b) Flattening: The trend tends to flatten out in the following countries: Cote d'Ivoire, Liberia, Ghana, Togo, and DRC.

c) Upwards: The trend tends to move upwards in the following countries: Kenya, Niger Republic, Mozambique, Zambia, Zimbabwe, Somalia, Tanzania, and Malawi.

d) Downwards: The trend tends to move downwards in the following countries namely Benin Republic, Nigeria, and Uganda.

Further Interpretation and Context

1) Potential Health Crisis in 2010: The sharp peak around 2010 might correspond to a specific health outbreak, such as a cholera epidemic or another communicable disease that caused a dramatic increase in cases.

2) Steady Decline After 2010: The decline to near-zero cases following the 2010 peak could reflect the resolution of the crisis, improved healthcare interventions, or better control measures.

3) Resurgence in 2020. The smaller peak around 2020 might indicate the impact of a global health event such as COVID-19 or another localized outbreak in Zimbabwe.

In general, between 2000 and 2009, most countries in this study recorded low level of total cases with minor fluctuations. However, significant spike in total cases were observed (Appendix) around the year 2009 or 2010 peaking at over 60000 cases. The most dominant period in the surge in cases was between 2010-2013. Given the recent health crisis because of the COVID-19 pandemic, our interest is on the post 2020 trend. Countries like Cote d'Ivoire, Liberia, Ghana, Togo, DRC have experienced stable trend during post 2020.However, there has been an upward trend in the cases of cholera in Kenya, Niger Republic, Mozambique, Zambia, Zimbabwe, Somalia, Tanzania, and Malawi. This is in contrasts with Benin Republic, Nigeria, and Uganda where a downward trend in cases has been observed. The summary of total death cases was given in **Table 1**. From 2000 to 2023, the table displays the cases and mortality in several African nations. Along with the years, it displays the lowest and highest known cases as well as the average numbers across the duration. With 24547.7 for the DRC and 14940 cases for Nigeria, both nations have high average case numbers. 2017 and 2021 saw the highest counts. Other prominent peaks are Liberia with 34740 cases in 2003, Mozambique with 39101 in 2023, and Zimbabwe's 68153 cases in 2009.

2.2. Correlation between Total Cases and CFR in Sub-Saharan Africa over the Study Period

In **Table 2**, a weak negative correlation ($r = -0.082$) was established between the number of cholera cases and the crude fatality rate (CFR) in an extensive dataset of 372 samples with a p-value of 0.116. This indicates that there is no statistically significant linear relationship between cholera case incidence and CFR at the 5%

significance level. The provided scatter plot (**Figure 1**), also shows an absence of any pattern or trend, suggesting that other factors, such as healthcare infrastructure, outbreak response protocols, or regional differences, influence CFR independently of case numbers.

Table 1. Summary of the number of total cases of deaths across the continent from 2000-2023.

S/N	Country	Min No of cases (Year)	Max No of cases (Year)	Mean
1	Benin	11 (2017)	3943 (2001)	708.2
2	Burundi	11 (2021)	1557 (2013)	624.1
3	Cameroon	10 (2007)	22433 (2011)	3653
4	Cote d'Ivoire	5 (2009)	5912 (2001)	870.7
5	DRC	5728 (2001)	56190 (2017)	24547.7
6	Ghana	1 (2019)	28944 (2014)	3828.4
7	Kenya	35 (2014)	13291 (2015)	3391.0
8	Liberia	2 (2018)	34740 (2003)	3089.0
9	Malawi	2 (2021)	32618 (2002)	4921.6
10	Mozambique	480 (2014)	39101 (2023)	8835.0
11	Niger	24 (2007)	5824.0 (2012)	1523.5
12	Nigeria	596 (2020)	111062 (2021)	14940.0
13	Somalia	208 (2009)	77636 (2011)	15331.0
14	Tanzania	54 (2021)	14297 (2006)	4900.0
15	Togo	3 (2023)	2696 (2001)	453.9
16	Uganda	173 (2000)	6326 (2012)	2168.0
17	Zambia	34 (2022)	12149 (2004)	2947.8
18	Zimbabwe	4 (2022)	68153 (2009)	8596.0

Table 2. Pearson correlation coefficient between total cases and CFR for the entire dataset at 5% level of significance.

Variables	Pearson Correlation Coefficient	Sample Size	P-value
Total Cases and CFR	-0.082	372	0.116

Table 3 examined the correlation between cholera cases and CFR per country for Sub-Saharan Africa between 2001 and 2023. Most countries had weak correlations, resulting in no statistically significant results, with Malawi ($r = 0.512$, $p = 0.015$) and Niger ($r = -0.570$, $p = 0.013$) being the exceptions. In Malawi, the moderate positive correlation suggests that an increase in case numbers is associated with a higher CFR (**Figure 2**), possibly due to the burden on healthcare systems during outbreaks. The moderate negative correlation in Niger (**Figure 3**), on the other hand, suggests either better management practices or underreporting of fatality rates during more widespread outbreaks.

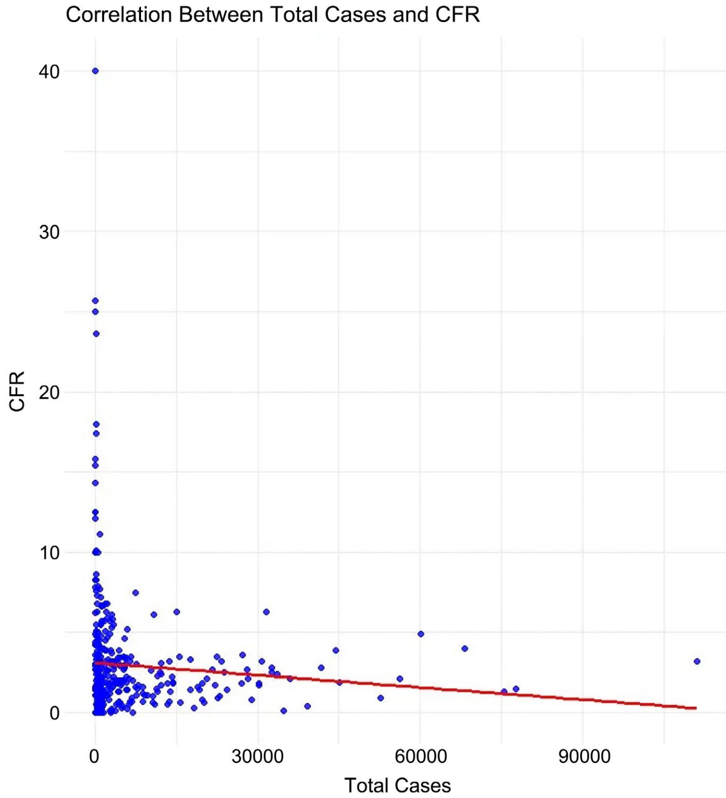

Figure 1. Correlation between total cases and CFR.

Table 3. Pearson correlation coefficient between the total cases of Cholera recorded in each country in Sub-Saharan Africa and the Crude Fatality Rate (CFR) from 2001-2023 at 5% level of significance.

S/N	Country	Pearson Correlation Coefficient	Sample Size	P-value
1	Benin	0.100	21	0.666
2	Burundi	0.145	24	1.000
3	Cameroon	−0.290	21	0.230
4	Cote d'Ivoire	−0.201	16	0.456
5	DRC	−0.122	24	0.570
6	Ghana	−0.103	19	0.675
7	Kenya	−0.305	21	0.179
8	Liberia	−0.407	19	0.847
9	Malawi	0.512	22	0.015*
10	Mozambique	0.220	24	0.301
11	Niger	−0.570	18	0.013*
12	Nigeria	−0.246	24	0.246
13	Somalia	−0.099	22	0.661
14	Tanzania	−0.289	20	0.216
15	Togo	0.027	19	0.912
16	Uganda	0.171	21	0.458
17	Zambia	0.132	18	0.601
18	Zimbabwe	−0.117	19	0.633

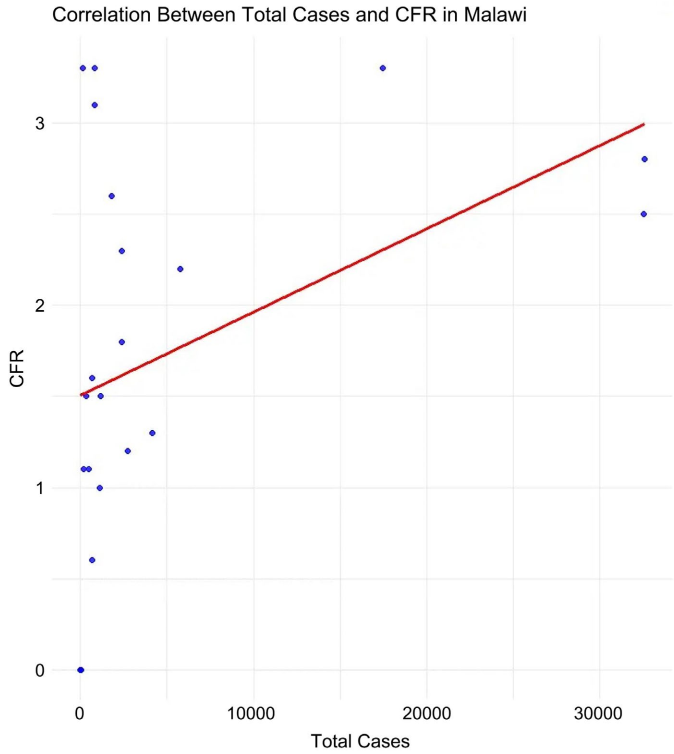

Figure 2. Correlation between total cases and CFR in Malawi.

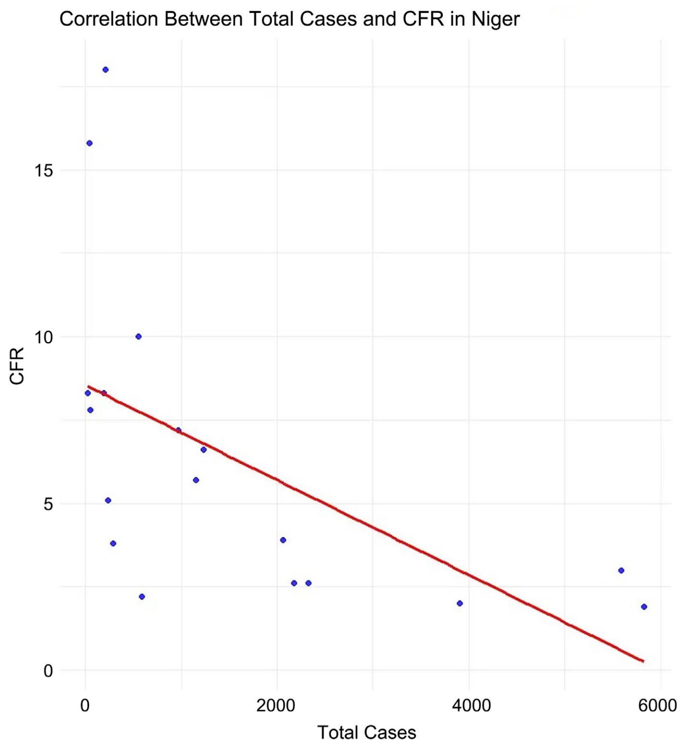

Figure 3. Correlation between total cases and CFR in Malawi.

Based on the reported p-values, only Malawi (0.015) with correlation coefficient of 0.512 indicating a minimal positive correlation (direct relationship between Total cases and CFR) and Niger (0.013) with correlation coefficient of −0.570 indicating a minimal negative correlation. (Inverse relationship between Total cases and CFR). The tests for both countries are found to be statistically significant at 5% level of significance. Both countries are inland countries by sub-regional classification.

2.3. Differences in Trends of Deaths over Time in Specific Regions of Sub-Saharan Africa

Using two-way in Table 4, subregion was the sole statistically significant factor affecting the variation in the trend of death trends in Sub-Saharan Africa (F = 7.592, p = 0.001). A significant influence was shown by neither the year (F = 0.033 F = 0.033, p = 0.856 p = 0.856) nor the interaction between subregion and year (F = 1.409 F = 1.409, p = 0.240 p = 0.240). This suggests that geographical variation between subregions mostly explains variations in deaths; temporal factors and their interaction with location have little effect on the observed variations.

Table 4. Differences in trends of deaths over time in Sub-Saharan Africa.

Source of Variation	Degree of Freedom	Sum Sq.	Mean Sq.	F-value	Pr (>F)
Subregion	3	2807239	935746	7.592	6.16e−05***
Year	1	4082	4082	0.033	0.856
Subregion*Year	3	521007	173669	1.409	0.240
Residuals	364	44866786	123260		

Figure 4 below shows that deaths across subregions exhibit considerable variety. With peaks before 2010 and between 2015 and 2020, Central Africa shows regular fluctuations most likely resulting from conflicts or epidemics. While Southern Africa shows a significant increase around 2010, exceeding 3000 deaths, East Africa exhibits much lower mortality. Until 2022-2023, West Africa was steady; then, there was a sudden increase, probably related to the pandemic. Generally, subregional events have more impact on mortality trends than annual patterns.

Only the subregion is statistically significant while the Year and the interaction between the Subregion and Year are found not to be statistically significant at 5% level of significance. This implies that the only source of variation in deaths is due to the Sub-regions and not due to Year and the interaction between Year and Subregion.

2.4. Differences in CFR Variability between Coastal and Inland Region in Sub-Saharan Africa

Both coastal and inland areas have generally low case fatality rates as shown in Figure 5, (CFRs; Coastal areas have a slightly higher median CFR). Both groups show similar consistency, as the central 50% of data's variability (IQR) is almost constant. Both areas show notable outliers, though, with CFR values above 40%, implying either major mortality episodes or outbreaks. These extreme outliers are more concentrated in inland areas, which helps to clearly show their right-skewness in distribution. Although CFRs typically remain low, both regions see sporadic, notable rises. We used Levene test in Table 5, to assesses whether the variances of CFR (Case Fatality Rate) are equal between the two groups (Coastal vs. Inland). Since the p-value (0.321) > 0.05, we concluded no significant difference in variation between the two regions.

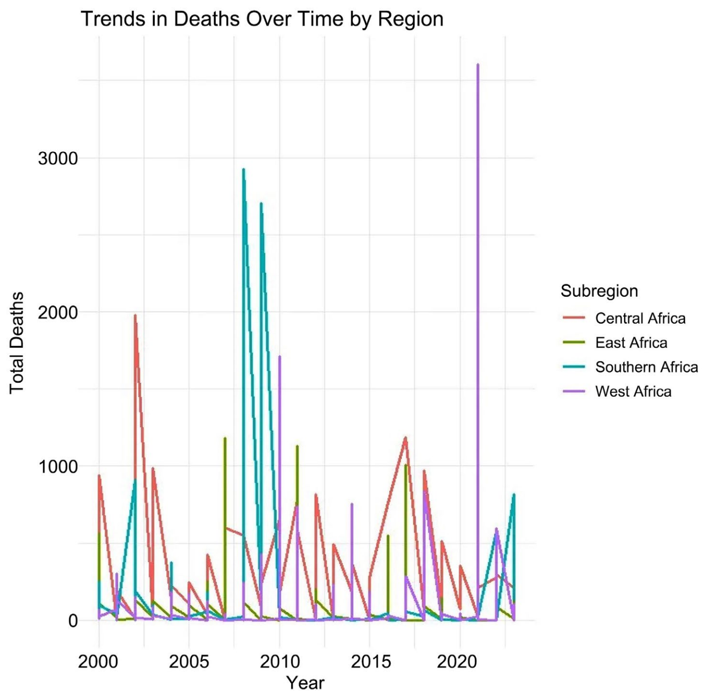

Figure 4. Trends in total deaths over time across four African subregion.

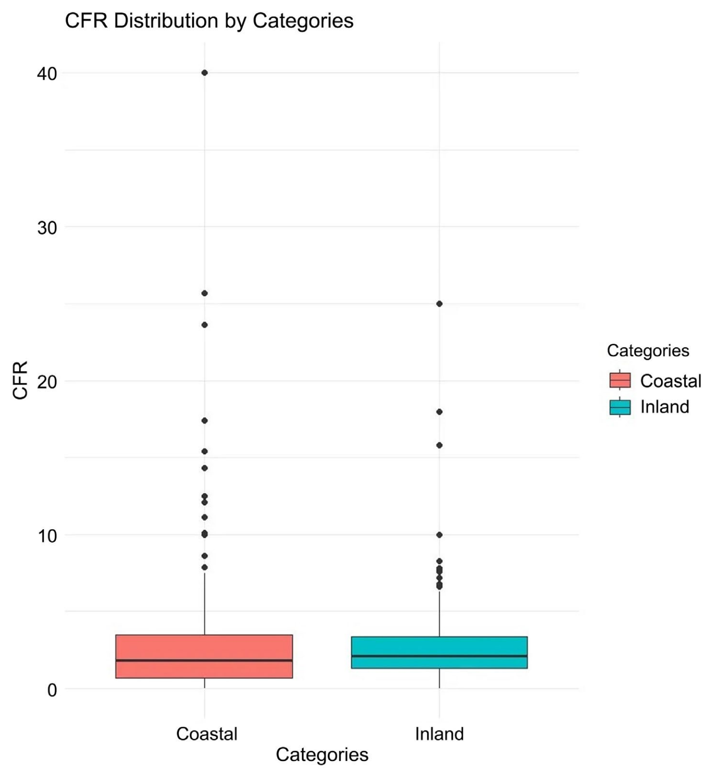

Figure 5. CRF distributions by categories.

Table 5. Levene test for the homogeneity of variance.

Source of Variation	D. f.	F-value	Pr. (>F)
Regions	1	0.987	0.321
Error	370		

3. Discussion

The findings from this study provide critical insights into the temporal and geographic trends of cholera burden and case fatality rates (CFR) in sub-Saharan Africa (SSA) from 2000 to 2023. The results reveal notable shifts in cholera incidence across different countries and regions, with significant increases in cases observed in Kenya, Niger, Mozambique, Zambia, Zimbabwe, Somalia, Tanzania, and Malawi post-2020. Meanwhile, countries such as Benin, Nigeria, and Uganda have demonstrated a downward trend. These trends align with previous studies that highlight the role of environmental factors, healthcare infrastructure, and socioeconomic conditions in cholera transmission [6] [13]. One of the key findings is the weak negative correlation (−0.082) between total cholera cases and CFR, suggesting that higher case numbers do not necessarily lead to higher fatality rates. A potential explanation for the weak correlation between rising case numbers and mortality rates may be the disparate efficacy of cholera interventions applied in various regions. Research indicates that the effectiveness of interventions like vaccination, surveillance, and enhancements in water and sanitation can vary considerably depending on local conditions, including health infrastructure, socioeconomic status, and community involvement. For example, during the 2017-2018 cholera outbreak in Kinshasa, targeted interventions, including specific water, sanitation, and hygiene (WaSH) strategies, effectively halted transmission, demonstrating the necessity of localized responses adapted to particular contexts. [23] [24]. This supports the notion that effective outbreak response measures, improved healthcare access, and vaccination campaigns may mitigate mortality despite increasing case numbers [19]. The resilience of local healthcare systems in managing cholera cases may conceal the expected correlation between case numbers and case fatality rates (CFRs). For instance, despite extraordinary case numbers in specific regions, effective case management and timely access to treatment can lower mortality rates, as demonstrated in scenarios where healthcare resources are rapidly and efficiently utilized [25] [26]. However, exceptions were noted in Malawi, where a moderate positive correlation (0.512) indicated that increased case numbers were associated with higher CFR, potentially due to overwhelmed healthcare systems during outbreaks. In contrast, Niger exhibited a moderate negative correlation (−0.570), reflecting improved outbreak management or underreporting of deaths.

The study further highlights significant regional disparities in cholera mortality trends. Statistical analysis ($F = 7.592$, $p = 0.001$) confirmed that sub-regional differences play a major role in shaping mortality trends, while temporal factors alone do not significantly impact CFR. This reinforces previous research emphasizing that localized factors such as conflict, access to clean water, and emergency response efficiency are critical determinants of cholera mortality [14] [15]. For instance, Central Africa experienced frequent mortality peaks, likely due to conflict-related disruptions, while West Africa saw a sharp rise post-2022, which can be linked to the broader impact of the COVID-19 pandemic on healthcare systems.

While most assumptions are that improved water access leads to lower cholera transmission rates, this result suggests that other local factors may play a more critical role in the dynamics of cholera outbreaks than previously considered. Studies have indicated that cholera outbreaks do not solely occur due to lack of water access but rather due to poor water quality associated with environmental contamination. Therefore, factors like water contamination and the interactions of water supplies with unsanitary conditions can create a conducive environment for the Vibrio cholerae growth [27]. Furthermore, sanitation infrastructure is frequently poorly maintained or completely absent in numerous areas, intensifying the hazards linked to contaminated water [28]. There is evidence that improved sanitation and hygiene practices exert a more significant influence on cholera prevalence than mere access to water [27] [29]. This also aligns with our observation where there were no differences in the CFR in coastal and inland regions. The study also highlights the role of climate variability and extreme weather events in shaping cholera outbreaks. The observed fluctuations in cholera cases across different periods, particularly the spikes in cases between 2010 and 2013 and again post-2020, align with findings from Rieckmann and others [6], who demonstrated that both droughts and floods exacerbate cholera transmission by affecting water availability and quality. Mozambique, which recorded one of the highest case counts in 2023, has faced recurrent cyclones and flooding, conditions that create ideal environments for cholera outbreaks [1]. Similarly, the recent increase in cholera cases in East African nations such as Kenya and Somalia coincide with prolonged droughts and water shortages, further reinforcing the link between environmental factors and cholera resurgence. These findings stress the need for integrating climate resilience strategies into cholera prevention programs, including improved water management, early warning systems, and emergency preparedness plans.

Another critical issue revealed in the study is the impact of antimicrobial resistance (AMR) on cholera case management. The increasing emergence of multidrug-resistant Vibrio cholera strains in SSA has raised concerns about the effectiveness of conventional treatment protocols [16]. While the study does not directly assess AMR patterns, the persistently high CFR in certain regions suggests that treatment inefficacy may be contributing to mortality rates. Previous research by [17], emphasizes that limited access to second-line antibiotics and delayed treatment due to overwhelmed healthcare systems can lead to poor outcomes. Addressing this challenge requires strengthening laboratory surveillance for cholera resistance patterns, ensuring adequate stockpiles of effective antibiotics, and promoting the use of oral cholera vaccines [20]. Strengthening AMR monitoring and response efforts is essential to improving case management and reducing mortality rates in cholera-endemic regions. The study's findings highlight the need for region-specific public health interventions, including enhanced water and sanitation infrastructure, increased investment in healthcare capacity, and expanded cholera vaccination campaigns.

4. Conclusions

This study provides a more granular, data-driven analysis of cholera trends in SSA, highlighting key temporal patterns, country-specific dynamics, and regional disparities. Unlike previous studies that focused on broad trends, it uncovers significant differences between countries, challenges assumptions about case fatality rates, and identifies areas where intervention strategies need to be tailored. These findings offer actionable insights for policymakers to prioritize resources where they are most needed to control cholera outbreaks effectively. The findings from this study provide strong evidence that cholera remains a persistent public health challenge in SSA, with notable regional disparities in case burden and CFR. While improved healthcare responses and vaccination programs have helped reduce overall fatality rates, localized vulnerabilities—such as overwhelmed health systems in Malawi and underreporting concerns in Niger—highlight the need for targeted interventions. The study further confirms the critical role of environmental factors and climate events in cholera resurgence, reinforcing the urgency of climate-adaptive public health strategies. Additionally, the growing threat of antimicrobial resistance calls for stronger surveillance and treatment protocols to ensure effective case management.

Moving forward, cholera control efforts in SSA must focus on strengthening health systems by investing more in training of health workers for cholera diagnostics and management, expanding access to safe water and sanitation, and enhancing climate resilience in high-risk areas by implementing policies which ensures regular maintenance and monitoring of water and sanitation infrastructures, and embark on regular awareness programs of the effects of climate change on health and hygiene practices. A multifaceted approach that includes early detection, rapid response mechanisms, and sustained investment in oral cholera vaccination will be crucial in achieving long-term cholera reduction. Future research should explore the impact of socioeconomic factors, AMR trends, and regional health policies on cholera epidemiology to further refine intervention strategies.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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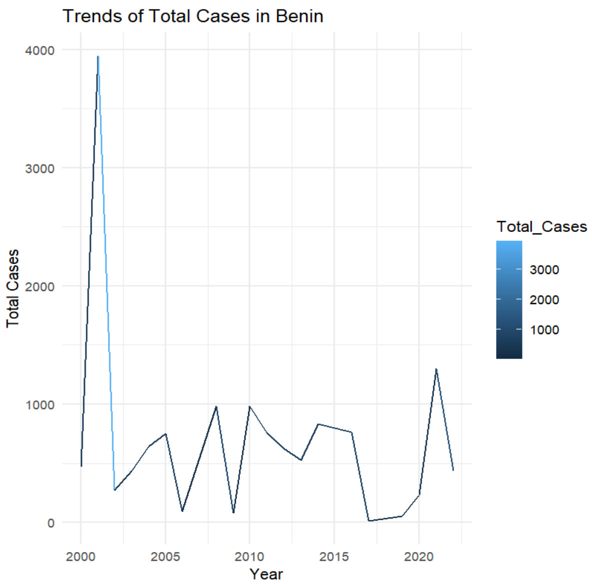
Appendix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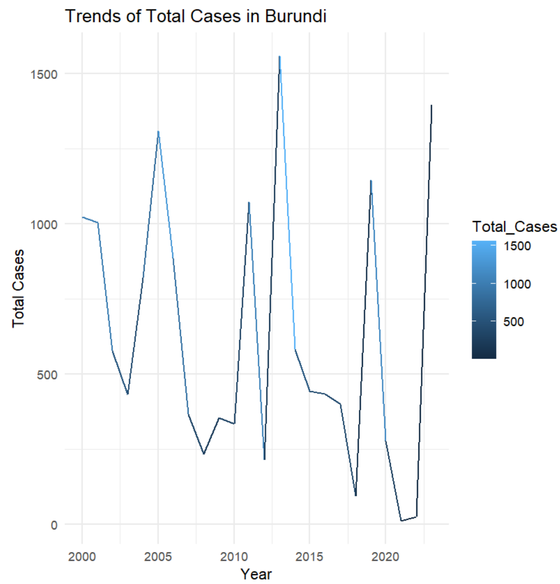
2000
2005
2010
2015
2020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Year
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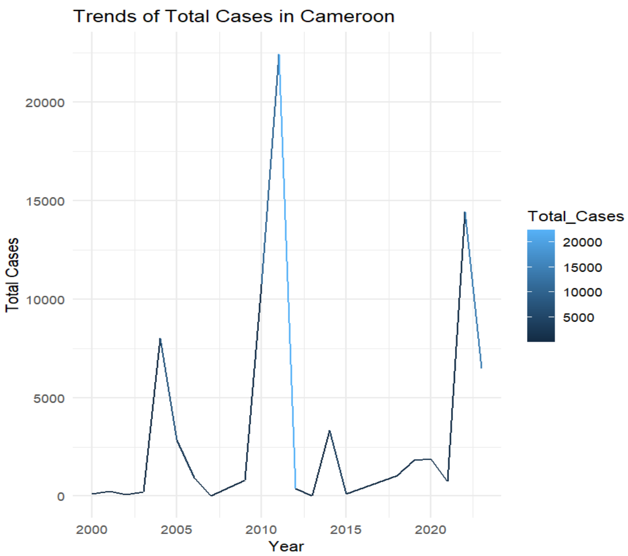
1500
2000
2005
2010
2015
2020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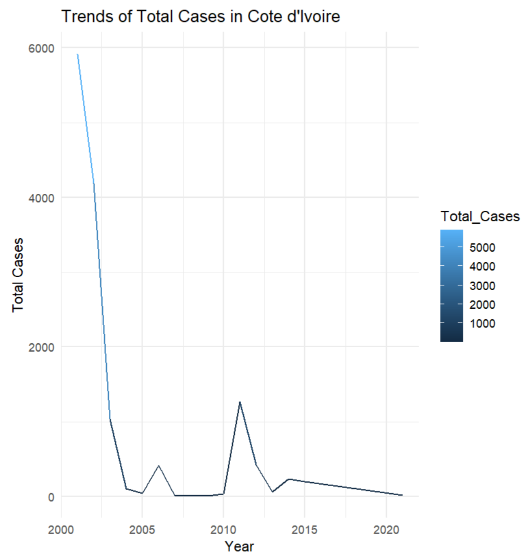
20000
2000
2005
2010
2015
2020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2000
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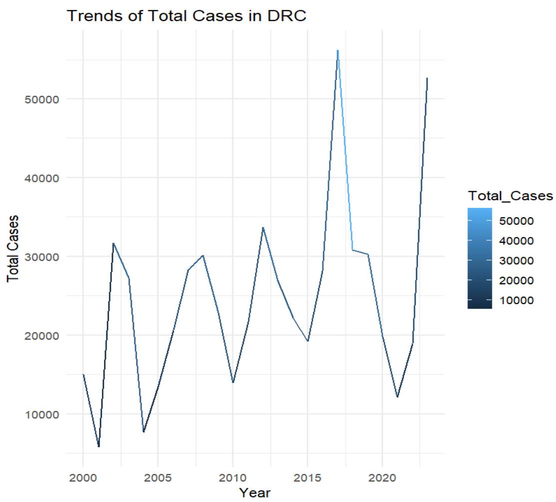
4000
5000
6000
2000
2005
2010
2015
2020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Year
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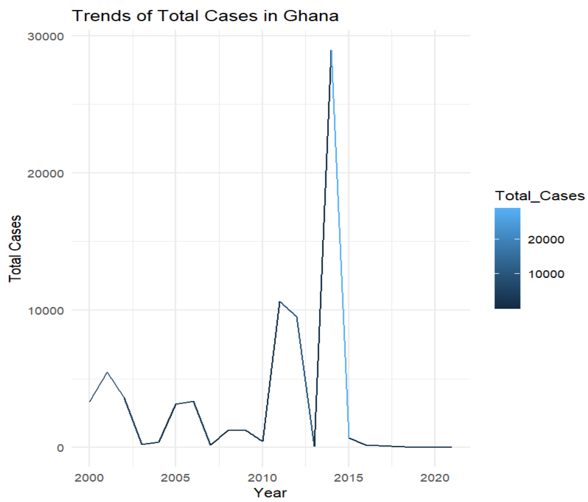
30000
40000
50000
2000
2005
2010
2015
2020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Year
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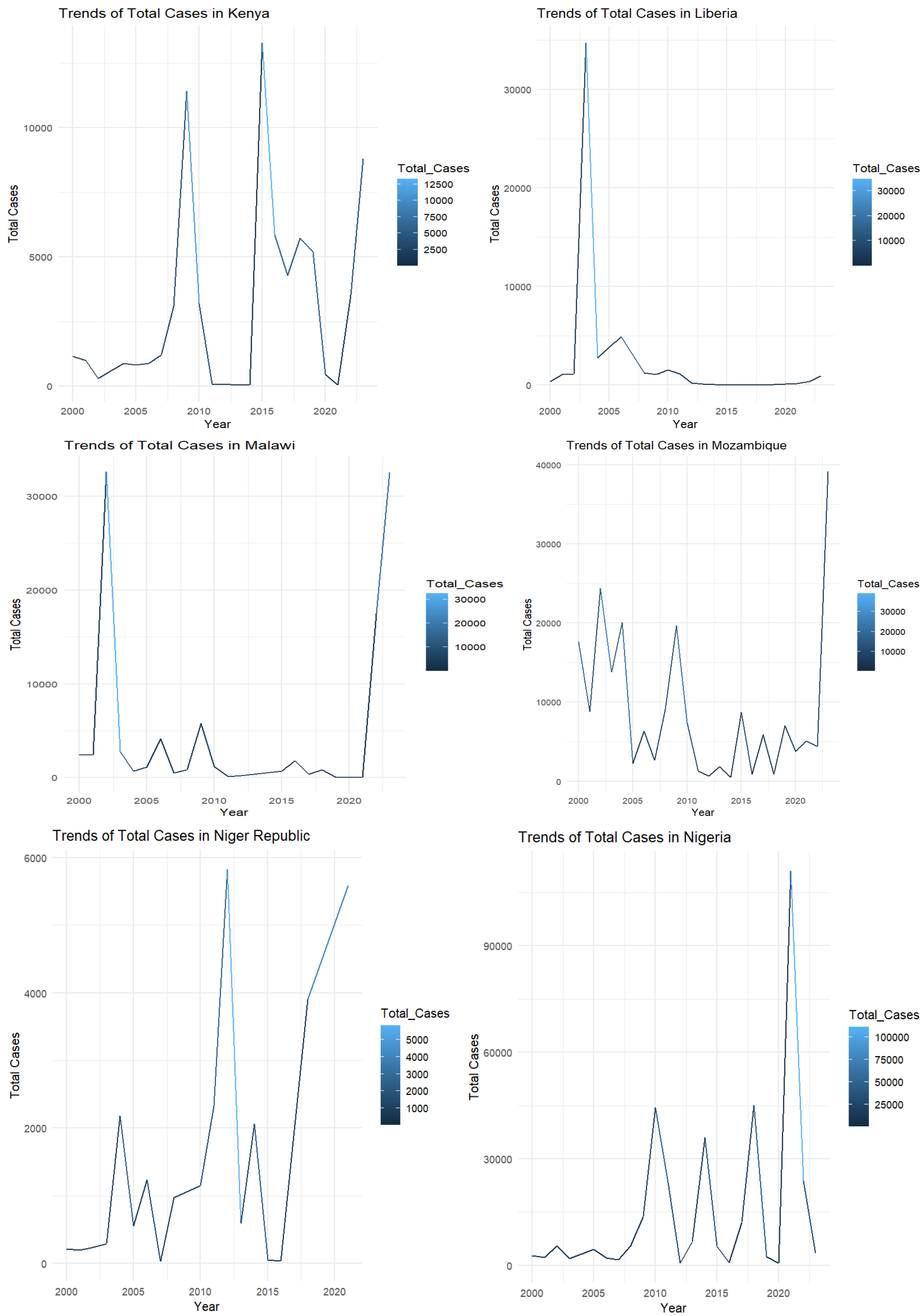
2000
2005
2010
2015
2020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2005
2010
2015
2020
Year
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10000
7500
5000
2500
Trends of Total Cases in Liberia
Total Cases
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10000
20000
30000
2000
2005
2010
2015
2020
Year
Total_Cases
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20000
10000
Trends of Total Cases in Malawi
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2015
2020
Year
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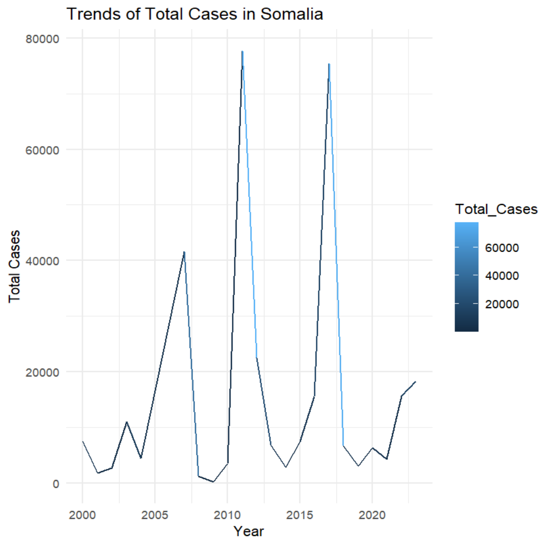
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2010
2015
2020
Year
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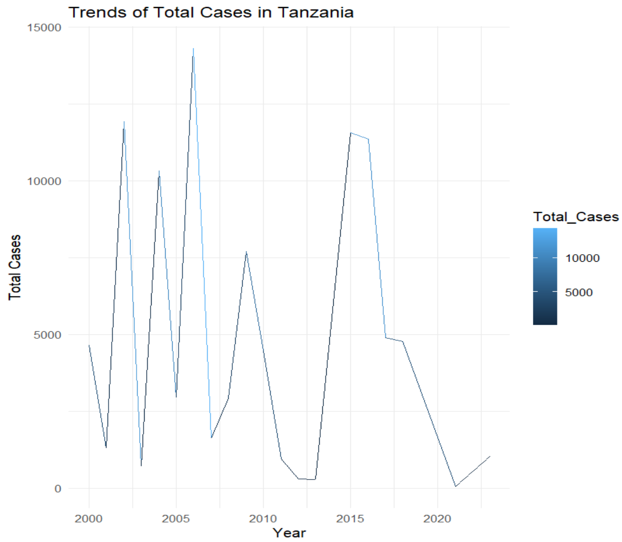
40000
20000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Total Cases
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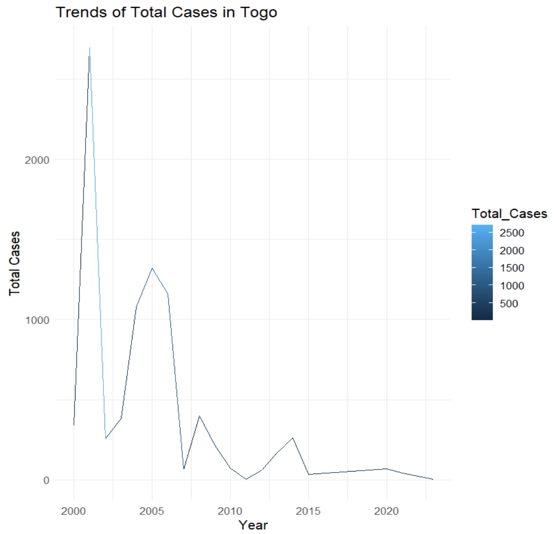
2005
2010
2015
2020
Year
Total_Cases
10000
5000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Total Cases
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2015
2020
Year
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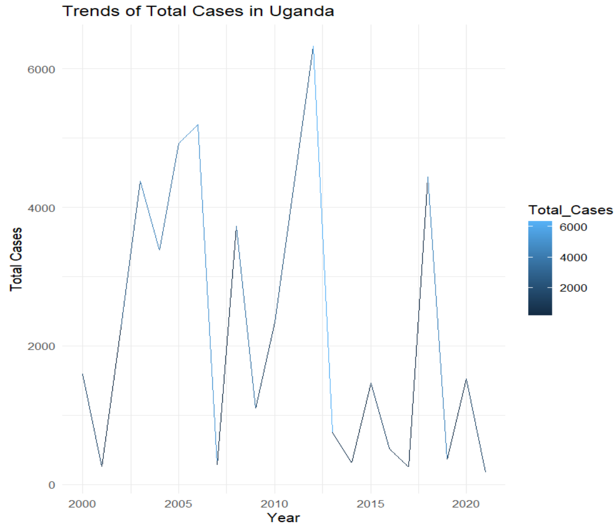
2000
1500
1000
500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Total Cases
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2010
2015
2020
Year
Total_Cases
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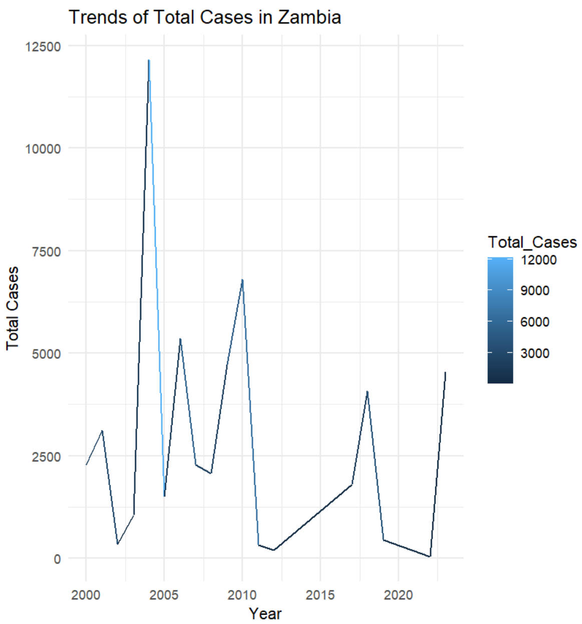
4000
2000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Total Cases
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2015
2020
Year
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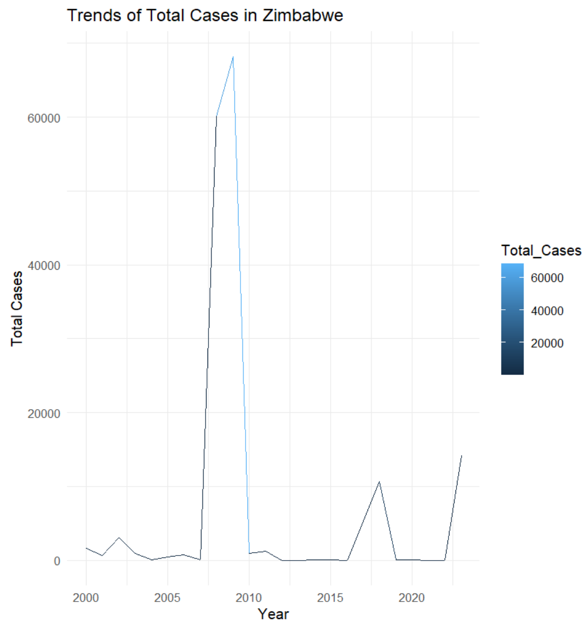
6000
3000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