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(RESEARCH ARTICLE)

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Geospatial modeling and analysis of COVID-19 prevalence in Lagos state Nigeria

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Abstract

The impact of COVID-19 pandemic has spatial dimensions which when properly interpreted could lead to better understanding of different characteristics of the pandemic. Thus, the impact of COVID-19 can be mapped for spatial analysis of its attributes. From health science, the research needs include the ability to cross variables of different kinds to interpret the COVID-19 phenomenon, its spatial analysis and spatiotemporal dimensions, its geographical impact on decision-making and everyday life, and predictive modelling of the evolution of the disease. For these reasons, this research aimed at geospatial modelling and analysis of COVID-19 prevalence in Lagos State Nigeria with a view to determine the spread and distribution pattern of COVID-19 as well as its hotspots in Lagos State Nigeria. Its objectives are to: identify and model the spatial distribution of COVID-19 in Lagos State and map the prevalence of COVID-19 in Lagos State. The methodology involved the analysis of the spatial distribution of COVID-19 between 2020 and 2022 and COVID-19 prevalence analysis. Results indicate a substantial surge in confirmed COVID-19 cases, rising from 21,717 to 56,596 during the study period. Alimosho and Eti-Osa LGAs emerged as the most affected regions, reporting the highest total confirmed cases. Additionally, confirmed deaths increased from 4,090 in 2020 to 9,874 in 2022, with Eti-Osa consistently reporting the highest number of fatalities, followed by Ikorodu and Surulere. Assessing the prevalence of confirmed cases and deaths across different LGAs, Eti-Osa consistently exhibited the highest prevalence, indicating a significant proportion of cases and deaths relative to its population.

Keywords: COVID-19; GIS; Modelling; Pandemic; Prevalence

1. Introduction

The COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, has had a profound and far-reaching impact on public health, economies, and societies worldwide. As the pandemic continues to evolve, the importance of understanding its spatial dynamics becomes increasingly evident. Geospatial modeling and analysis have emerged as powerful tools for studying the spread of COVID-19, enabling researchers to investigate the distribution, transmission, and determinants of the virus within specific geographic regions. This research paper focuses on Lagos State, Nigeria, a densely populated and economically significant area, and aims to provide a comprehensive geospatial analysis of COVID-19 prevalence within the state.

Lagos State, Nigeria's economic hub and most populous region, presents a unique and complex landscape for the study of COVID-19. Its demographic diversity, urbanization, and transportation networks make it susceptible to disease spread. Lagos State serves as a microcosm of the challenges and opportunities associated with managing a pandemic in

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a rapidly urbanizing African context. Understanding the spatial dynamics of COVID-19 within Lagos State is essential for effective public health responses, resource allocation, and future pandemic preparedness.

The application of geospatial modeling and analysis techniques to the study of COVID-19 is rooted in a robust and multidisciplinary research tradition. This approach integrates data from various sources, including clinical, epidemiological, environmental, and sociodemographic datasets, and leverages geographic information systems (GIS), remote sensing, and spatial statistics to provide insights into disease transmission, patterns, and risk factors.

This research paper builds upon the extensive body of literature that highlights the significance of geospatial analysis in the context of COVID-19 research. The utilization of geospatial data for epidemiological modeling and surveillance has become increasingly relevant (Lau et al., 2020; Tatem, 2020). Moreover, several studies have demonstrated the effectiveness of spatial analysis in understanding the spread of COVID-19 (Li et al., 2020; Pullan et al., 2020).

In the context of Lagos State, there is a growing body of work that recognizes the potential benefits of geospatial analysis in combating COVID-19. Studies have explored the application of geospatial tools for contact tracing, assessing the impact of interventions, and identifying high-risk areas (Adeleke et al., 2020; Ogunlade et al., 2021). Lagos State, with its unique challenges, provides an ideal setting to further investigate the utility of geospatial modeling in understanding COVID-19 transmission.

1.1. Study Area

The study area, Lagos State is located between Longitudes 2° 40 E and 4° 15 E and Latitudes 6° 15 N and 6° 45 N, The State took off as an administrative entity on April 11, 1968. However, with the creation of the Federal Capital Territory of Abuja in 1976, Lagos ceased to be the capital of the State. Nevertheless, Lagos remains the nation's economic and the dominant vegetation of the State is the swamp forest of the fresh water and mangrove swamp forests, both of which are influenced by the double rainfall pattern of the state, which makes the environment a wetland region. Generally, the State has two climatic seasons: Dry [November-March] and Wet [April-October]. The drainage system of the State is characterized by a maze of lagoons and waterways, which constitutes about 22% or 787 sq. km. [75.755 hectares] of the State's territory. The major water bodies are the Lagos and Lekki Lagoons, Yewa, Ogun, Oshun, and Kweme Rivers. Others are Ologe Lagoon, Kuramo Waters, and Badagry, Five Cowries and Omu Creeks respectively.

2. Material and methods

The research conducted an extensive and comprehensive data acquisition process to gather both primary and secondary datasets pertaining to healthcare facilities and COVID-19 within the confines of Lagos State. This data acquisition phase was instrumental in obtaining a holistic understanding of the healthcare infrastructure and the spatial dynamics of the pandemic in the region.

- **Primary Data Acquisition:** To capture primary datasets, field visits were organized, and GPS equipment was employed to precisely record the location data of healthcare facilities. During these visits, detailed descriptive information about these facilities was collected. This information encompassed various aspects, including facility type, capacity, services offered, and the presence of medical equipment and personnel. Such primary data acquisition on healthcare facilities allowed for a comprehensive assessment of the local healthcare infrastructure in Lagos State.
- **Secondary Data Compilation:** Secondary datasets were sourced from reputable and established authorities and research repositories. COVID-19-related data was gathered from authoritative sources such as the World Health Organization's COVID-19 dashboard, which provides a globally recognized and comprehensive repository of pandemic-related statistics. Furthermore, research papers and publications were referenced to ensure the inclusion of up-to-date and reliable information regarding the pandemic's status and dynamics within Lagos State.
- **Data Processing and Modeling:** The amassed datasets underwent a rigorous data processing phase to refine and structure them for analysis. This process involved a series of modeling steps, including conceptual, logical, and physical modeling. Conceptual modeling focused on defining the data entities and relationships, logical modeling entailed the transformation of the conceptual model into a more structured representation, and physical modeling ensured the datasets were ready for the subsequent spatial analyses.
- **Spatial Distribution Analysis:** The research conducted a comprehensive spatial distribution analysis of COVID-19 cases and related deaths within Lagos State. This analysis involved spatial interpolation techniques to understand the dispersion and concentration of cases and fatalities. It enabled the identification of localized clusters and patterns of infection spread, shedding light on areas significantly impacted by the virus.

- **Prevalence Mapping:** Prevalence mapping was another crucial component of the research, providing insights into the prevalence of COVID-19 in different regions of Lagos State. To achieve this, a prevalence index was computed, allowing for the identification of areas most profoundly affected by the virus. Prevalence mapping facilitated a nuanced understanding of the pandemic's impact, helping to direct resources, interventions, and healthcare services to areas in need.

3. Results and discussion

3.1. Spatial Distribution of COVID-19 in Lagos State Nigeria

3.1.1. COVID-19 Confirmed Cases in Lagos State between 2020 and 2022

In the momentous year of 2020, Lagos State witnessed a total of 21,717 confirmed COVID-19 cases. The spatial distribution of these cases across Local Government Areas (LGAs) revealed varying levels of impact. The LGA of Alimosho emerged as the most affected, accounting for the highest percentage with 11.25% of the total confirmed cases, totalling 2,789 cases. Following closely was Ikorodu, representing 8.07% of the cases, with a count of 2,001. Several LGAs, namely Surulere, Ifako-Ijaiye, Eti-Osa, and Mushin, shared a similar burden, each comprising 6.81%, 6.37%, 6.32%, and 6.06% of the confirmed cases, respectively. Their confirmed case counts were 1,687, 1,578, 1,567, and 1,502, respectively.

Lagos Mainland, Agege, Kosofe, Ikeja, Ajeromi-Ifelodun, and Oshodi also experienced considerable infection rates, each contributing 5.24%, 4.98%, 4.53%, 3.98%, 3.86%, and 3.72% of the total confirmed cases, respectively. The confirmed case numbers for these LGAs were 1,299, 1,234, 1,123, 987, 956, and 921, respectively. Lastly, Shomolu, Lagos Island, Amuwo-Odofin, Ojo, Apapa, Ibeju-Lekki, Badagry, and Epe bore the least impact but still faced challenges, each representing 3.08%, 3.01%, 2.60%, 2.36%, 1.70%, 1.57%, 1.31%, and 0.80% of the total confirmed cases, respectively. The confirmed case counts for these LGAs were 764, 745, 645, 586, 421, 389, 325, and 198, respectively. This is illustrated in figures 1 and 2.

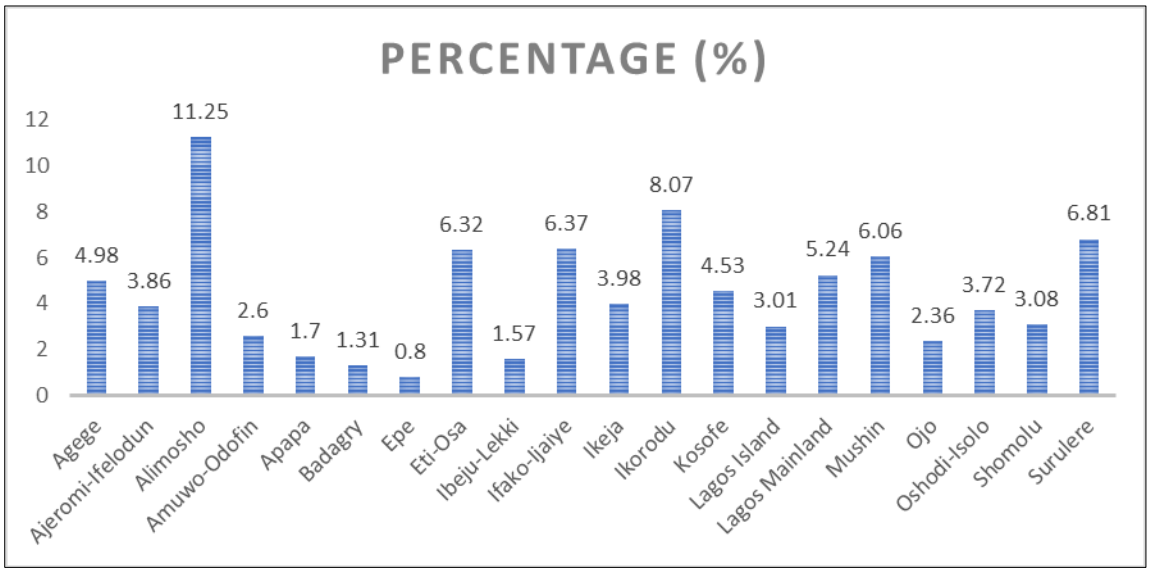

Figure 1 Distribution of COVID-19 Confirmed Cases for Lagos State in 2020

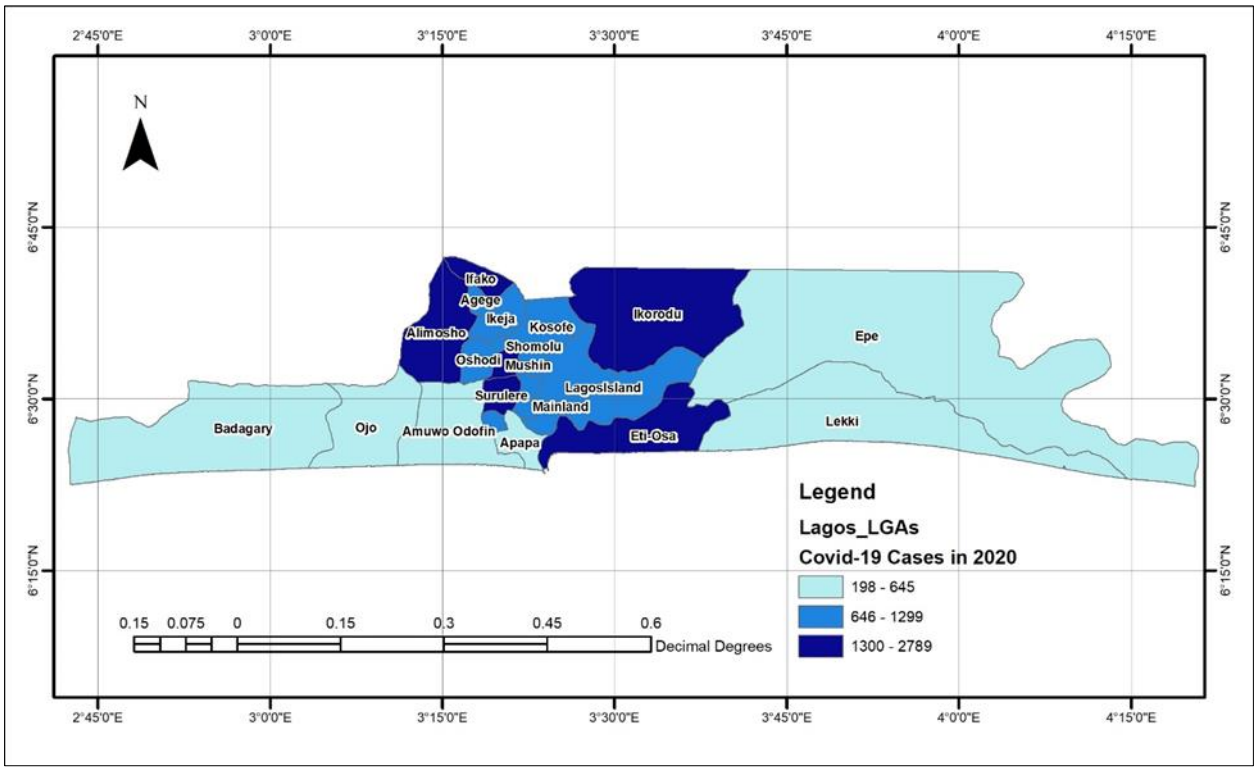

Figure 2 Map of COVID-19 Confirmed Cases for Lagos State in 2020

In the eventful year 2021, Lagos State recorded a total of 45,539 confirmed COVID-19 cases. Once again, the spatial distribution of these cases across Local Government Areas (LGAs) demonstrated varying degrees of impact. The LGA of Eti-Osa emerged as the most affected, constituting the highest percentage with 9.49% of the total confirmed cases, accounting for 4,321 cases. Following closely was Ikorodu, representing 9.00% of the cases, with a count of 4,098.

Several LGAs, namely Mushin, Alimosho, and Surulere, shared a similar burden, each comprising 7.59%, 7.84%, and 7.13% of the confirmed cases, respectively. Their confirmed case counts were 3,456, 3,567, and 3,245, respectively. Lagos Mainland, Kosofe, and Agege also experienced considerable infection rates, each contributing 6.57%, 6.07%, and 6.36% of the total confirmed cases, respectively. The confirmed case numbers for these LGAs were 2,990, 2,765, and 2,897, respectively.

Ifako-Ijaiye and Ajeromi-Ifelodun registered a moderate impact, each representing 5.27% and 4.81% of the total confirmed cases, respectively. The confirmed case counts for these LGAs were 2,398 and 2,189, respectively. Shomolu, Ikeja, Lagos Island, and Oshodi-Isolo bore a lesser burden but were still significantly affected, each representing 3.88%, 4.32%, 3.69%, and 4.80% of the total confirmed cases, respectively. The confirmed case counts for these LGAs were 1,765, 1,965, 1,678, and 2,187, respectively.

Lastly, Apapa, Ojo, Amuwo-Odofin, and Epe recorded the least impact but still faced challenges, each representing 2.17%, 2.85%, 3.93%, and 1.05% of the total confirmed cases, respectively. The confirmed case counts for these LGAs were 987, 1,298, 1,789, and 478, respectively. This is illustrated in figures 3 and 4.

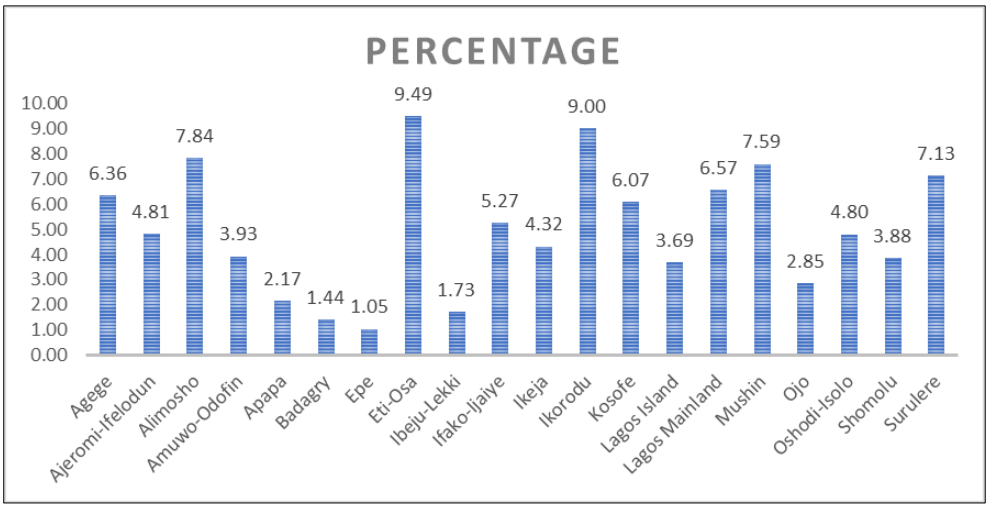

Figure 3 Distribution of COVID-19 Confirmed Cases for Lagos State in 2021

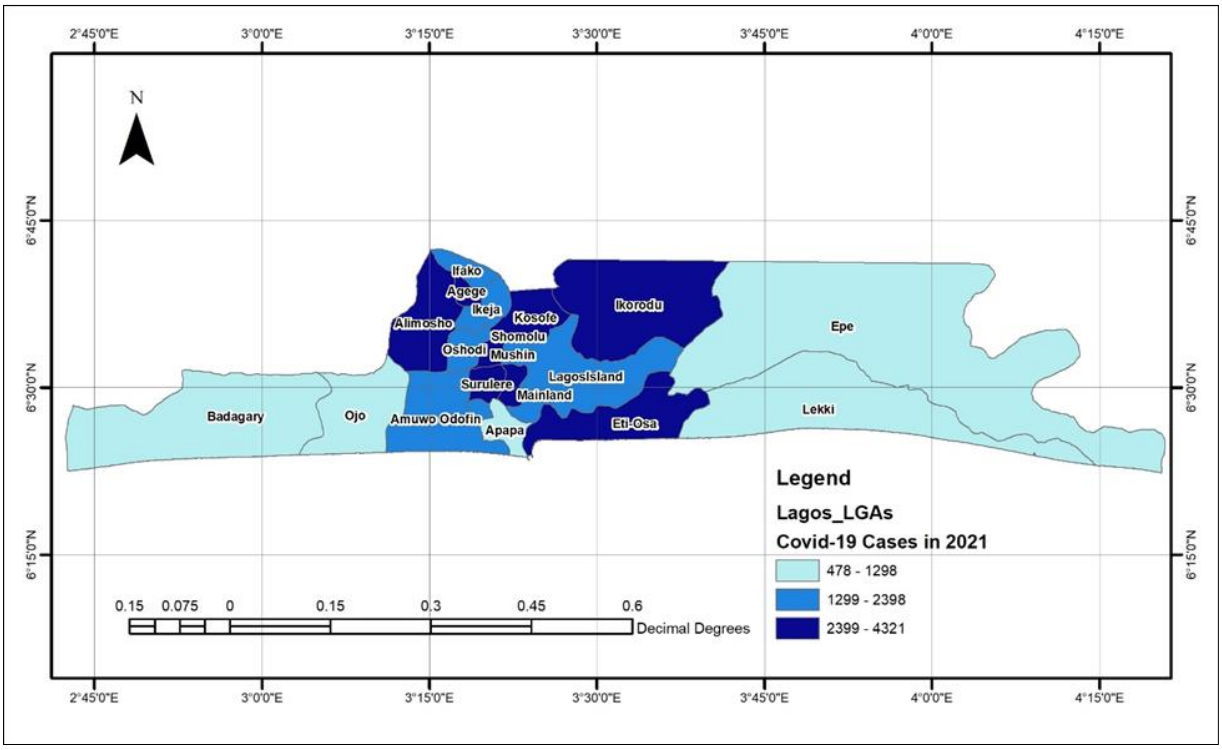

Figure 4 Map of COVID-19 Confirmed Cases for Lagos State in 2021

In the eventful year 2022, Lagos State recorded a total of 56,596 confirmed COVID-19 cases. Once again, the spatial distribution of these cases across Local Government Areas (LGAs) demonstrated varying degrees of impact. The LGA of Eti-Osa emerged as the most affected, constituting the highest percentage with 9.59% of the total confirmed cases, accounting for 5,432 cases. Following closely was Ikorodu, representing 8.95% of the cases, with a count of 5,067. Several LGAs, namely Alimosho, Mushin, and Surulere, shared a similar burden, each comprising 8.10%, 7.63%, and 7.08% of the confirmed cases, respectively. Their confirmed case counts were 4,587, 4,321, and 4,012, respectively.

Lagos Mainland, Agege, and Kosofe also experienced considerable infection rates, each contributing 6.69%, 6.69%, and 6.84% of the total confirmed cases, respectively. The confirmed case numbers for these LGAs were 3,789, 3,789, and 3,876, respectively.

Ifako-Ijaiye and Ajeromi-Ifelodun registered a moderate impact, each representing 6.10% and 5.27% of the total confirmed cases, respectively. The confirmed case counts for these LGAs were 3,456 and 2,987, respectively. Shomolu, Ikeja, Ibeju-Lekki, and Oshodi-Isolo bore a lesser burden but were still significantly affected, each representing 4.88%, 5.27%, 1.75%, and 5.27% of the total confirmed cases, respectively. The confirmed case counts for these LGAs were 2,765, 2,987, 989, and 2,987, respectively. Lastly, Apapa, Lagos Island, Amuwo-Odofin, and Epe recorded the least impact but still faced challenges, each representing 2.53%, 4.06%, 4.53%, and 0.94% of the total confirmed cases, respectively. The confirmed case counts for these LGAs were 1,432, 2,301, 2,563, and 532, respectively. This is illustrated in figures 5 and 6.

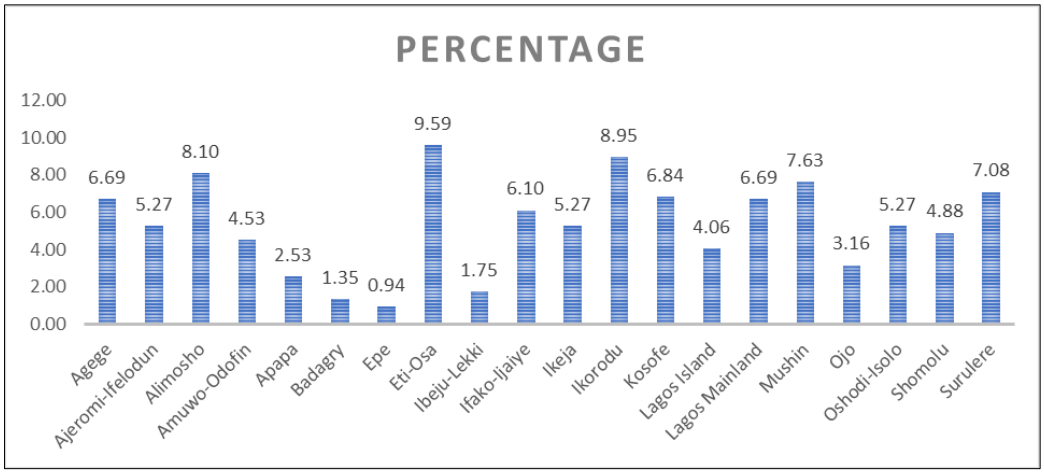

Figure 5 Distribution of COVID-19 Confirmed Cases for Lagos State in 2022

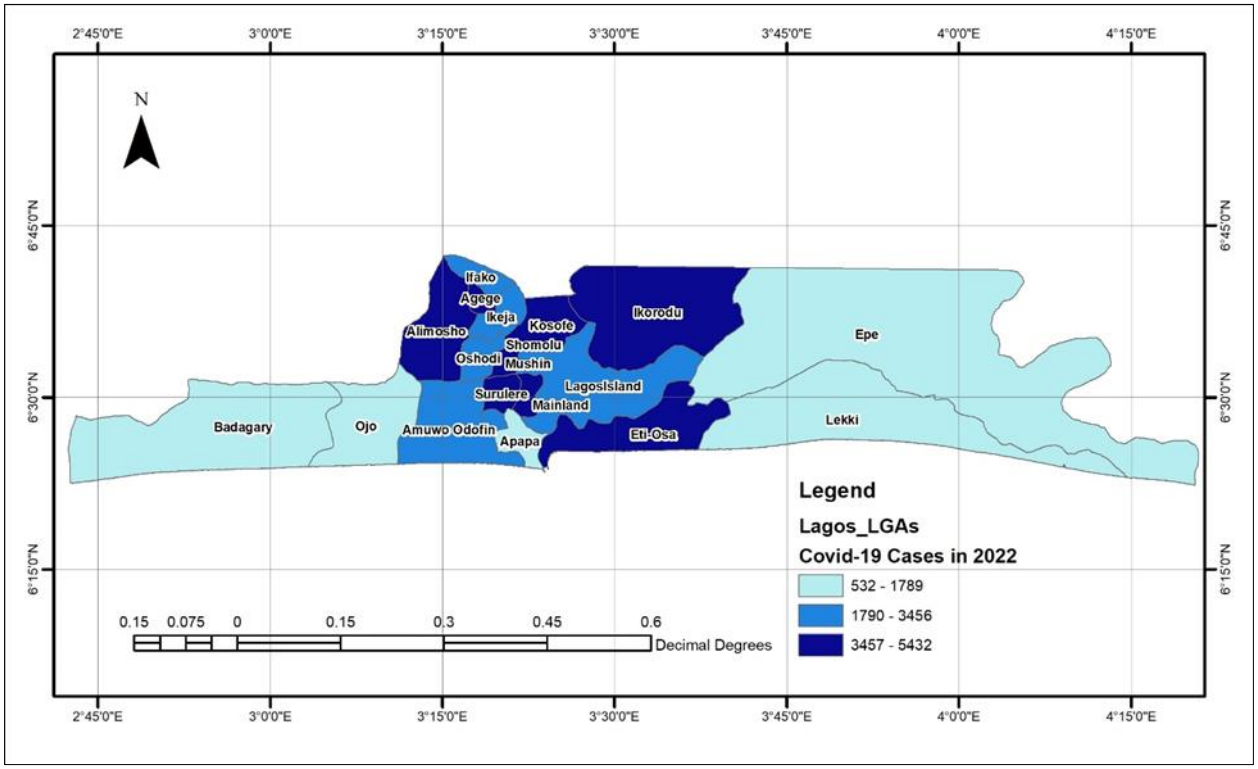

Figure 6 Map of COVID-19 Confirmed Cases for Lagos State in 2022

Summarily, between 2020 and 2022, Lagos State witnessed a significant rise in confirmed COVID-19 cases. In 2020, the state reported a total of 21,717 cases, while in 2022, the number surged to 56,596 cases. This considerable increase in

confirmed cases over the two years underscored the ongoing impact of the pandemic on the region. During 2020, the spatial distribution of cases revealed varying levels of impact across different Local Government Areas (LGAs). Alimosho emerged as the most affected LGA, accounting for 11.25% of the total confirmed cases. It was followed closely by Ikorodu, representing 8.07% of the cases. Additionally, LGAs such as Surulere, Ifako-Ijaiye, Eti-Osa, and Mushin shared a similar burden, each contributing around 6-7% of the confirmed cases.

In 2022, the situation evolved, with Eti-Osa becoming the most affected LGA, comprising 9.59% of the total confirmed cases. Ikorodu retained a high percentage, representing 8.95% of the cases. Similar to 2020, Alimosho, Mushin, and Surulere continued to experience a considerable burden, each contributing around 7-8% of the confirmed cases. The LGAs of Lagos Mainland, Agege, and Kosofe consistently faced considerable infection rates during both years, with each contributing approximately 6-7% of the total confirmed cases in each year.

While the percentages of confirmed cases fluctuated across LGAs from 2020 to 2022, some LGAs, such as Ifako-Ijaiye and Ajeromi-Ifelodun, registered a moderate impact in both years, accounting for around 5-6% of the total confirmed cases. On the other hand, Shomolu, Ikeja, Ibeju-Lekki, and Oshodi-Isolo experienced a lesser burden, but their significance in contributing to the overall case count remained notable.

The LGAs of Apapa, Lagos Island, Amuwo-Odofin, and Epe consistently recorded the least impact in both years, with each contributing around 1-4% of the total confirmed cases, see figure 7.

The implications of this analysis are significant for public health authorities and policymakers. It highlights the evolving nature of the pandemic's impact on different LGAs in Lagos State over time. Understanding the spatial distribution of cases can aid in allocating resources effectively, implementing targeted interventions, and deploying healthcare facilities where they are most needed. Additionally, it emphasizes the importance of continued vigilance and strategic planning to mitigate the spread of COVID-19 in the state.

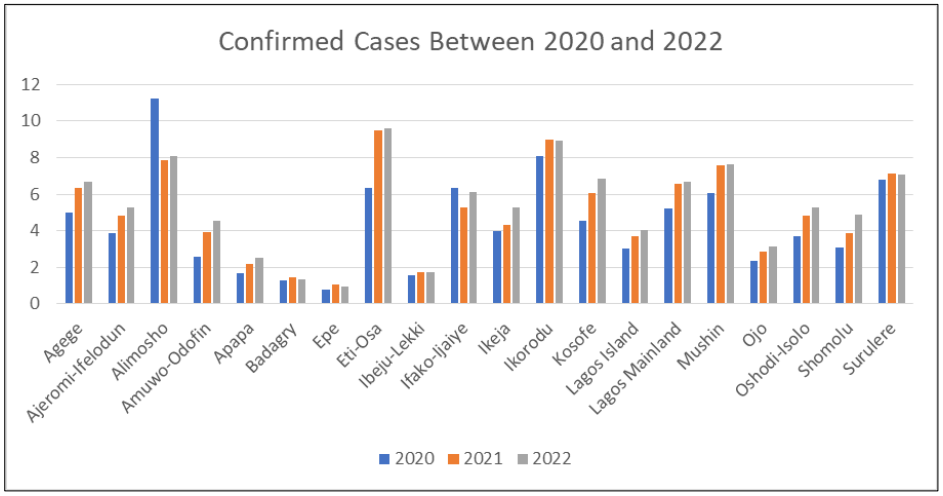

Figure 7 Distribution of COVID-19 Confirmed Cases for Lagos State between 2020 and 2022

3.1.2. COVID-19 Confirmed Deaths in Lagos State between 2020 and 2022

In the eventful year 2020, Lagos State witnessed a total of 4,090 confirmed COVID-19 deaths. The spatial distribution of these deaths across Local Government Areas (LGAs) demonstrated varying degrees of impact. The LGA of Eti-Osa emerged as the most affected, constituting the highest percentage with 9.76% of the total confirmed deaths, accounting for 400 cases. Following closely were Ikorodu and Surulere, each representing 8.54% of the deaths, with counts of 350 each.

Several LGAs, namely Alimosho, Mushin, and Lagos Mainland, shared a similar burden, each comprising 7.80% of the confirmed deaths, with their counts being 320 each. Agege, Ifako-Ijaiye, and Ajeromi-Ifelodun also experienced considerable impact, each contributing around 6.10% to 6.83% of the total confirmed deaths, with counts of 250, 280, and 180, respectively. Kosofe and Ikeja registered moderate impact, representing 5.85% and 4.63% of the total confirmed deaths, respectively, with counts of 240 and 190.

Shomolu, Oshodi-Isolo, and Lagos Island bore a lesser burden but were still significantly affected, each representing around 4.15% to 4.63% of the total confirmed deaths, with counts of 170, 190, and 130, respectively. Lastly, Apapa, Amuwo-Odofin, Ojo, and Epe recorded the least impact but still faced challenges, each representing around 1.22% to 2.93% of the total confirmed deaths, with counts of 70, 100, 120, and 30, respectively. This is illustrated in figures 8 and 9.

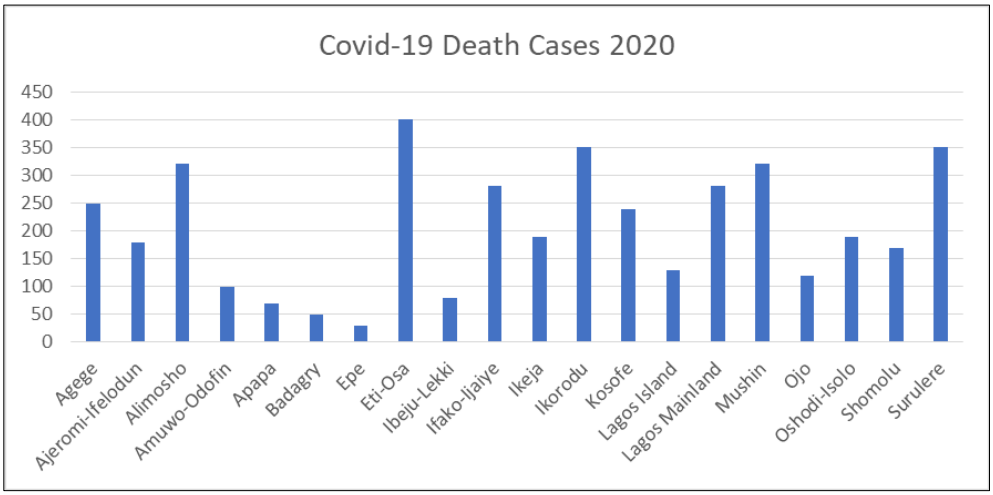

Figure 8 Distribution of COVID-19 Confirmed Deaths for Lagos State in 2020

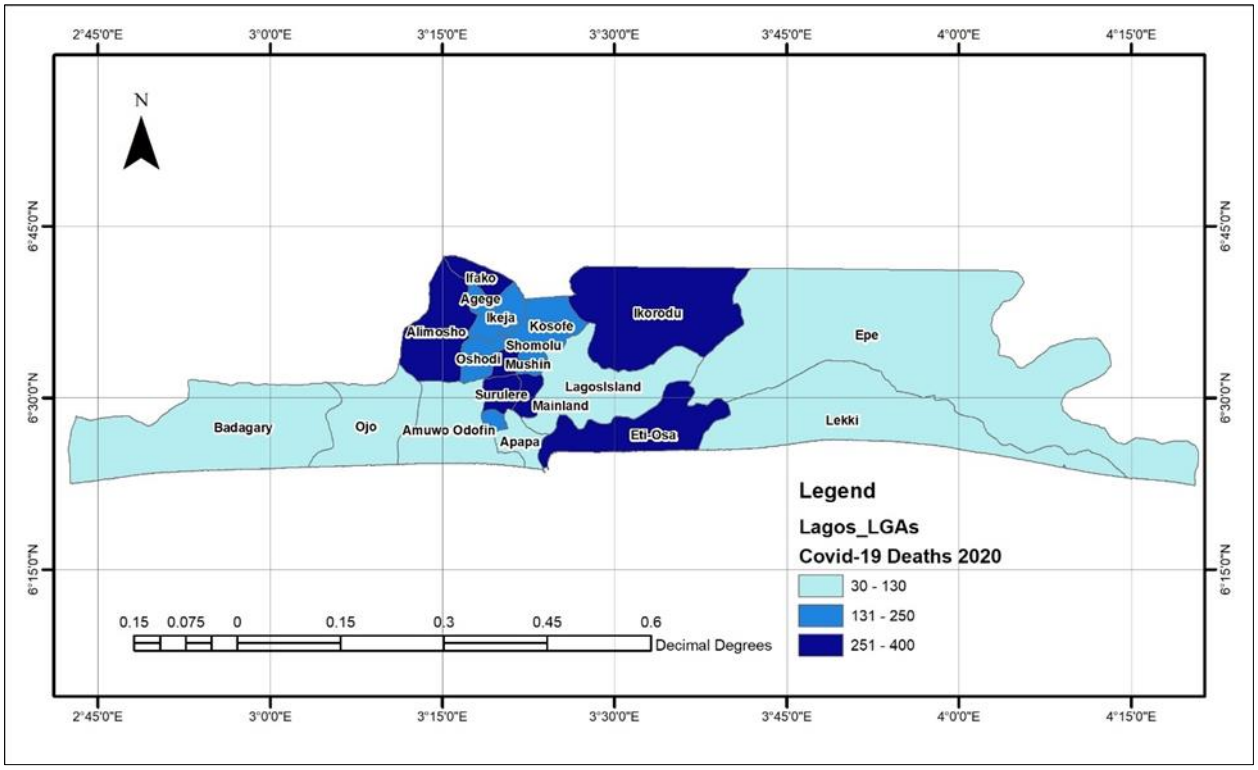

Figure 9 Map of COVID-19 Confirmed Deaths for Lagos State in 2020

In 2021, Lagos State recorded a total of 7,066 confirmed COVID-19 deaths. The spatial distribution of these deaths across Local Government Areas (LGAs) once again demonstrated varying degrees of impact. The LGA of Eti-Osa emerged as the most affected, constituting the highest percentage with 8.78% of the total confirmed deaths, accounting for 620 cases. Following closely was Ikorodu, representing 8.36% of the deaths, with a count of 590.

Several LGAs, namely Alimosho, Mushin, and Surulere, shared a similar burden, each comprising 8.07% to 8.64% of the confirmed deaths, with counts of 570, 580, and 610, respectively. Lagos Mainland, Agege, and Kosofe also experienced considerable impact, each contributing 5.95% to 5.67% of the total confirmed deaths, with counts of 420 each. Ifako-Ijaiye and Ajeromi-Ifelodun registered moderate impact, representing 6.09% and 4.53% of the total confirmed deaths, respectively, with counts of 430 and 320.

Shomolu, Oshodi-Isolo, and Ikeja bore a lesser burden but were still significantly affected, each representing around 4.11% to 4.53% of the total confirmed deaths, with counts of 290, 320, and 320, respectively.

Lagos Island, Ibeju-Lekki, and Ojo recorded the least impact but still faced challenges, each representing around 1.70% to 3.40% of the total confirmed deaths, with counts of 220, 120, and 240, respectively. Lastly, Apapa, Amuwo-Odofin, Badagry, and Epe had the lowest impact on confirmed deaths, each representing around 1.42% to 0.85% of the total confirmed deaths, with counts of 150, 280, 100, and 60, respectively. This is illustrated in figures 10 and 11.

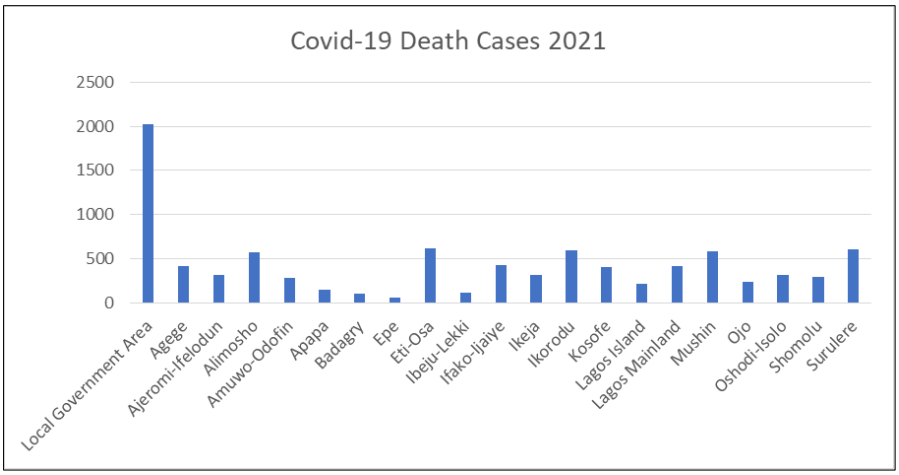

Figure 10 Distribution of COVID-19 Confirmed Deaths for Lagos State in 2021

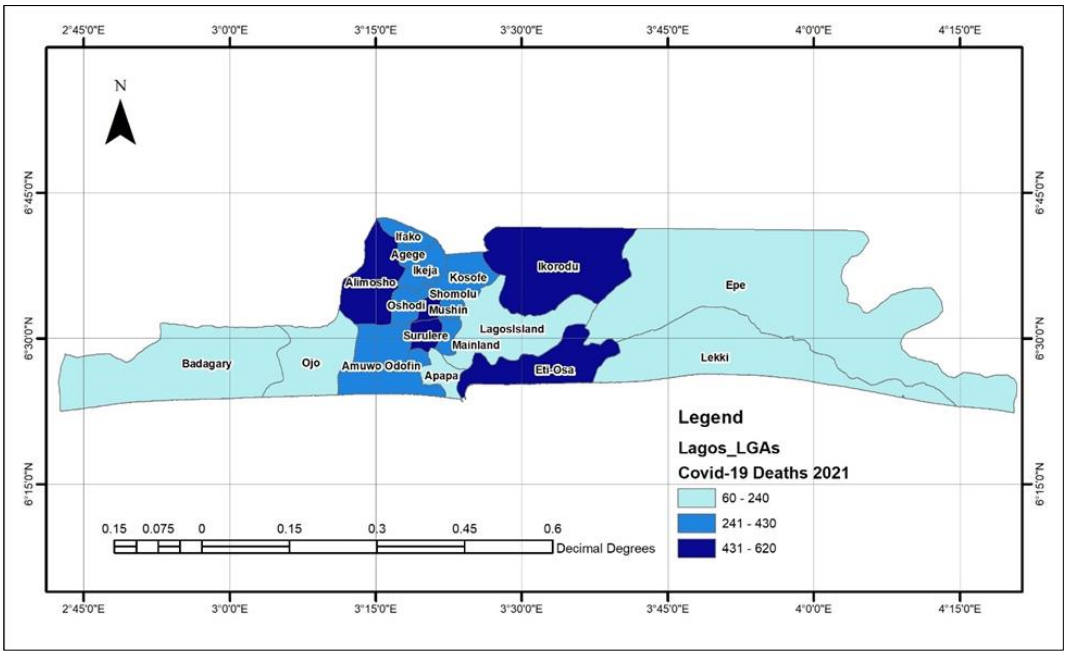

Figure 11 Map of COVID-19 Confirmed Deaths for Lagos State in 2021

In the eventful year 2022, Lagos State recorded a total of 9,874 confirmed COVID-19 deaths. The spatial distribution of these deaths across Local Government Areas (LGAs) continued to demonstrate varying degrees of impact. The LGA of Surulere emerged as the most affected, constituting the highest percentage with 9.01% of the total confirmed deaths, accounting for 890 cases. Following closely was Eti-Osa, representing 8.60% of the deaths, with a count of 850. Several LGAs, namely Alimosho, Mushin, Ikorodu, and Lagos Mainland, shared a similar burden, each comprising 7.59% to 7.89% of the confirmed deaths, with counts of 750, 780, 780, and 670, respectively.

Agege and Ajeromi-Ifelodun also experienced considerable impact, each contributing 6.78% and 5.06% of the total confirmed deaths, respectively, with counts of 670 and 500. Kosofe and Ifako-Ijaiye registered moderate impact, representing 6.07% and 5.67% of the total confirmed deaths, respectively, with counts of 600 and 560.

Shomolu, Oshodi-Isolo, and Ikeja bore a lesser burden but were still significantly affected, each representing around 3.85% to 4.35% of the total confirmed deaths, with counts of 380, 420, and 430, respectively. Lagos Island, Amuwo-Odofin, and Ojo recorded the least impact but still faced challenges, each representing around 1.21% to 3.34% of the total confirmed deaths, with counts of 330, 420, and 300, respectively. Lastly, Apapa, Ibeju-Lekki, Badagry, and Epe had the lowest impact on confirmed deaths, each representing around 0.71% to 2.13% of the total confirmed deaths, with counts of 70, 150, 120, and 210, respectively. This is illustrated in figures 12 and 13.

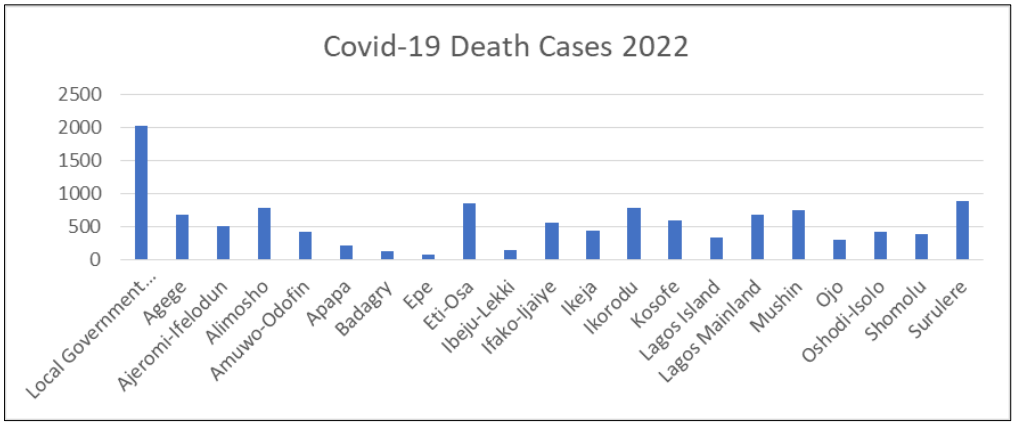

Figure 12 Distribution of COVID-19 Confirmed Deaths for Lagos State in 2022

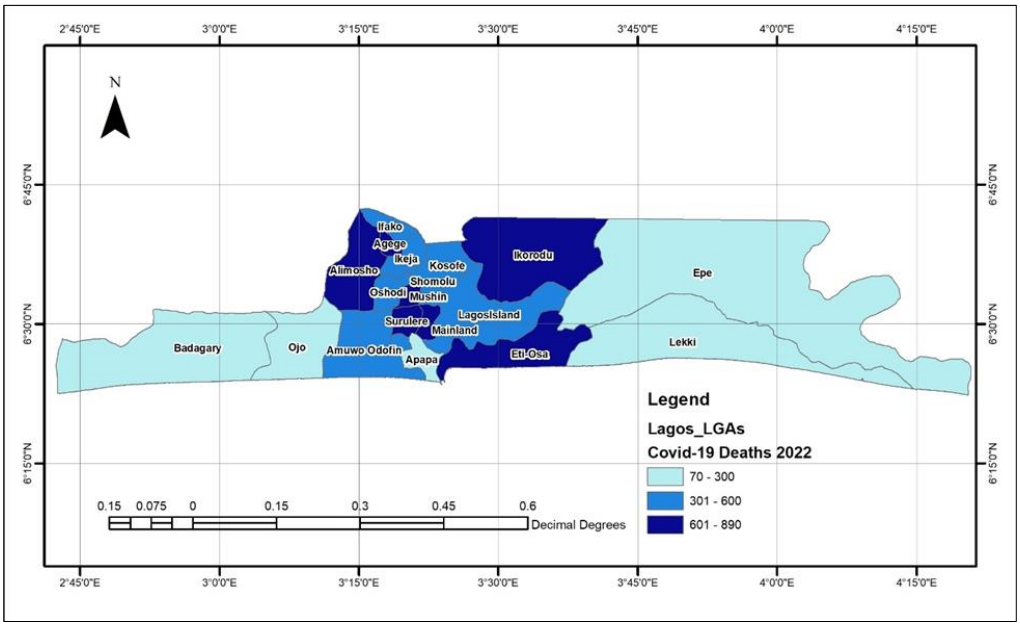

Figure 13 Map of COVID-19 Confirmed Deaths for Lagos State in 2022

Between the years 2020 and 2022, Lagos State experienced a significant increase in confirmed COVID-19 deaths, from 4,090 in 2020 to 9,874 in 2022. The spatial distribution of these deaths across Local Government Areas (LGAs) exhibited varying degrees of impact, with certain LGAs being more severely affected than others. This analysis sheds light on the changing trends in the distribution of COVID-19 deaths within the state during this critical period.

In 2020, the LGA of Eti-Osa stood out as the most impacted, accounting for 9.76% of the total confirmed deaths, with 400 cases reported. Ikorodu and Surulere closely followed, each contributing 8.54% of the deaths with counts of 350. By 2021, Eti-Osa remained the most affected LGA, with 8.78% of the total confirmed deaths, now accounting for 620 cases. Ikorodu continued to rank high, representing 8.36% of the deaths with a count of 590. However, it's essential to note that the overall number of confirmed deaths increased to 7,066 in 2021.

In the year 2022, the pattern persisted, with Surulere emerging as the most affected LGA, contributing 9.01% of the total confirmed deaths, with 890 cases. Eti-Osa followed closely, representing 8.60% of the deaths with a count of 850. Lagos State recorded a total of 9,874 confirmed COVID-19 deaths in this year.

The implications of this analysis are crucial for public health planning and resource allocation. The consistently high impact on certain LGAs like Eti-Osa, Ikorodu, Surulere, and others suggests the need for targeted interventions and support in these areas. The identification of the most affected LGAs can help healthcare authorities allocate resources more efficiently, establish dedicated healthcare facilities, and implement preventive measures to curb the spread of the virus.

Furthermore, understanding the varying degrees of impact in different LGAs can guide policy-makers and health agencies in implementing region-specific strategies to combat the pandemic effectively. These strategies may include focused vaccination campaigns, community outreach programs, and targeted awareness campaigns.

Overall, the data on confirmed COVID-19 deaths and their distribution in Lagos State between 2020 and 2022 underscores the significance of local-level monitoring and response in managing public health emergencies. By identifying hotspots and understanding the local dynamics of the virus's spread, authorities can work towards mitigating the impact of the pandemic and protecting the health and well-being of the population.

3.2. Prevalence Analysis of COVID-19 in Lagos State between 2020 and 2022

3.2.1. Prevalence of COVID-19 in Lagos State based on Confirmed Cases

In the year 2020, the prevalence of COVID-19 based on confirmed cases in Lagos State varied across different Local Government Areas (LGAs), revealing distinct levels of impact. Eti-Osa emerged as the LGA with the highest COVID-19 prevalence, scoring 0.54, indicating a significant proportion of confirmed cases relative to its population. Lagos Mainland closely followed with a prevalence score of 0.41, see figure 14.

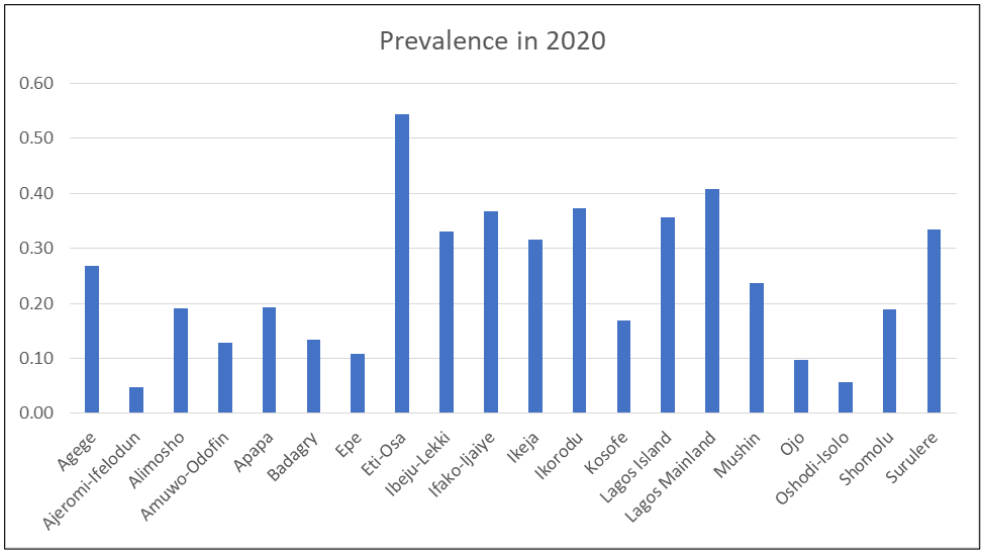

Figure 14 Distribution of COVID-19 Prevalence based on Confirmed Cases for Lagos State in 2020

LGAs like Ifako-Ijaiye, Ikorodu, Lagos Island, Ibeju-Lekki, Surulere, Ikeja, Agege, Mushin, Alimosho, and Apapa exhibited moderate prevalence, with scores ranging from 0.37 to 0.19. On the other hand, Shomolu, Kosofe, Amuwo-Odofin, Badagry, Epe, Ojo, Oshodi-Isolo, and Ajeromi-Ifelodun had the lowest prevalence scores, ranging from 0.19 to 0.05.

These prevalence scores, as illustrated in figures 15 highlight the varying degrees of impact that COVID-19 had on different LGAs in Lagos State during 2020. It provides crucial insights for public health authorities and policymakers in formulating targeted interventions and resource allocation to effectively combat the spread of the virus in the region.

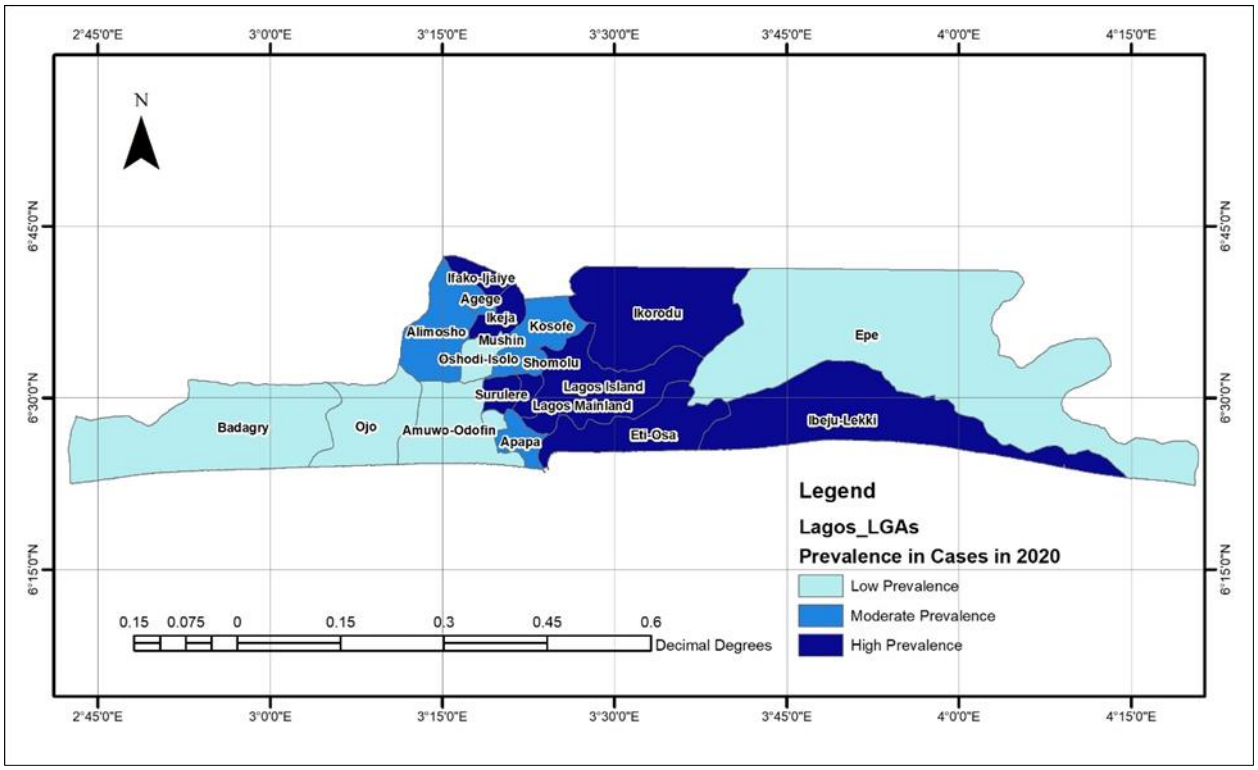

Figure 15 COVID-19 Prevalence based on Confirmed Cases for Lagos State in 2020

The prevalence of COVID-19 for Lagos State in 2021, continued to show fluctuations across different LGAs, indicating the evolving nature of the pandemic in the state. Eti-Osa remained the LGA with the highest prevalence, with a score of 1.50. Lagos Mainland, Ikeja, and Lagos Island also experienced a notable increase in prevalence, with scores of 0.94, 0.63, and 0.80, respectively.

Several LGAs, including Ifako-Ijaiye, Ikorodu, Ibeju-Lekki, Surulere, Mushin, Amuwo-Odofin, Apapa, and Agege, exhibited moderate prevalence in 2021, with scores ranging from 0.56 to 0.76.

Meanwhile, Ajeromi-Ifelodun, Badagry, Epe, Ojo, Oshodi-Isolo, Kosofe, Shomolu, and Alimosho recorded lower prevalence scores in 2021, ranging from 0.11 to 0.42, see figures 16 and 17.

The prevalence data from 2021 further emphasizes the importance of continued vigilance and targeted measures to control the spread of COVID-19 across different LGAs in Lagos State. Public health authorities need to closely monitor and respond to the changing prevalence patterns to implement appropriate strategies and safeguard public health.

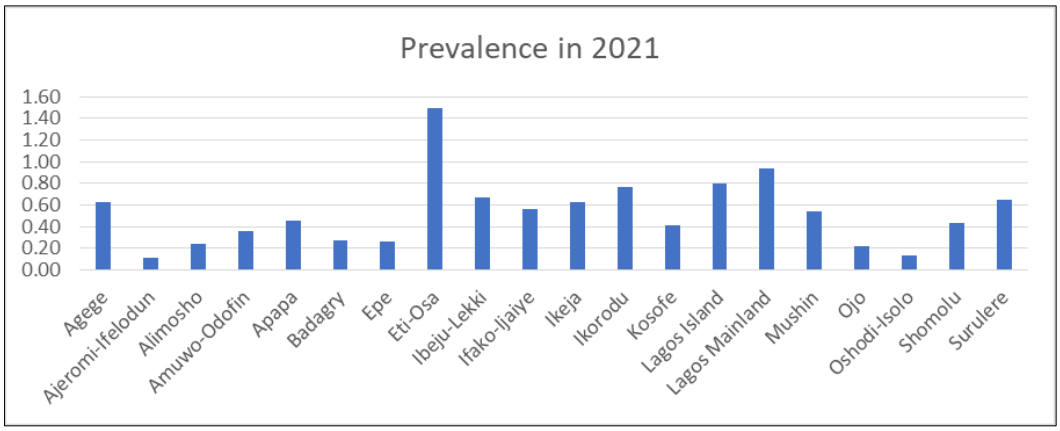

Figure 16 Distribution of COVID-19 Prevalence based on Confirmed Cases for Lagos State in 2021

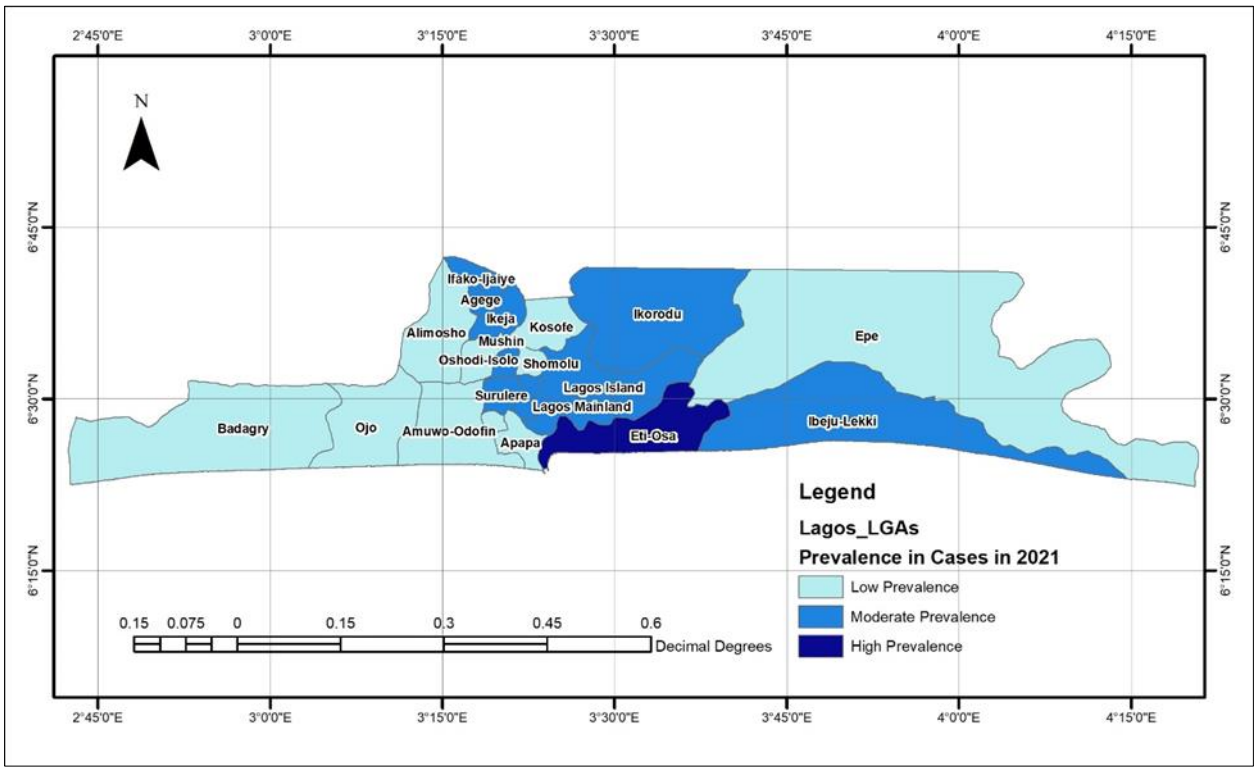

Figure 17 COVID-19 Prevalence based on Confirmed Cases for Lagos State in 2021

In the year 2022, the prevalence of COVID-19 based on confirmed cases in Lagos State continued to show significant fluctuations across different Local Government Areas (LGAs), indicating the evolving nature of the pandemic.

Eti-Osa remained the LGA with the highest COVID-19 prevalence, scoring 1.89, indicating a substantial proportion of confirmed cases relative to its population. Lagos Mainland closely followed with a prevalence score of 1.19, and Lagos Island had a prevalence score of 1.10.

Several LGAs, including Agege, Ifako-Ijaiye, Ikeja, and Ikorodu, experienced an increase in prevalence, with scores ranging from 0.81 to 0.95.

Meanwhile, Ajeromi-Ifelodun, Amuwo-Odofin, Mushin, Shomolu, and Surulere exhibited moderate prevalence in 2022, with scores ranging from 0.15 to 0.80.

The LGAs of Alimosho, Apapa, Badagry, Epe, Ibeju-Lekki, Kosofe, Ojo, and Oshodi-Isolo recorded lower prevalence scores in 2022, ranging from 0.18 to 0.66, see figure 18 ad 19.

These results underscore the ongoing impact of COVID-19 in different LGAs in Lagos State. It emphasizes the importance of continued vigilance and targeted measures to control the spread of the virus and protect public health. Public health authorities need to closely monitor the prevalence patterns and adapt their strategies accordingly to effectively combat the pandemic in the region.

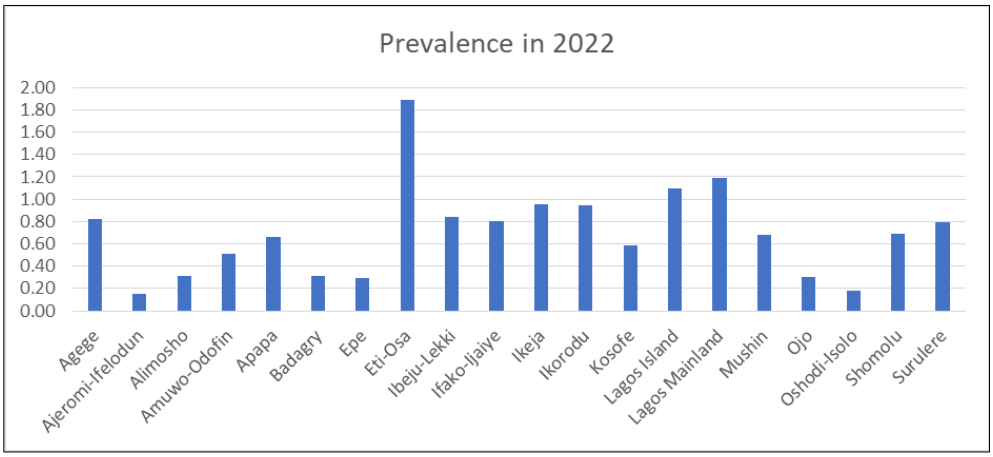

Figure 18 Distribution of COVID-19 Prevalence based on Confirmed Cases for Lagos State in 2022

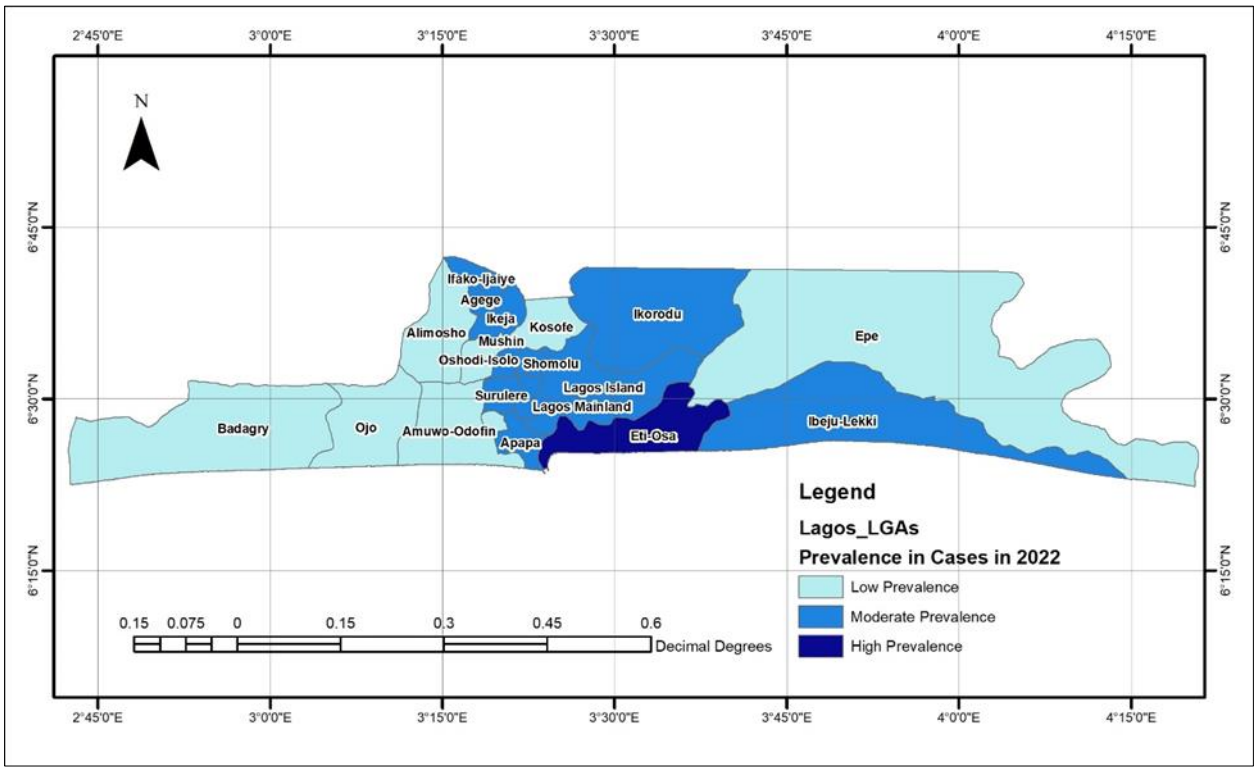

Figure 19 COVID-19 Prevalence based on Confirmed Cases for Lagos State in 2022

The prevalence of COVID-19 in Lagos State based on confirmed cases exhibited varying degrees of impact across different Local Government Areas (LGAs) from 2020 to 2022. Eti-Osa consistently emerged as the LGA with the highest prevalence, indicating a significant proportion of confirmed cases relative to its population.

In 2020, Eti-Osa had a prevalence score of 0.54, followed closely by Lagos Mainland with a score of 0.41. LGAs like Ifako-Ijaiye, Ikorodu, Lagos Island, Ibeju-Lekki, Surulere, Ikeja, Agege, Mushin, Alimosho, and Apapa exhibited moderate prevalence, while Shomolu, Kosofe, Amuwo-Odofin, Badagry, Epe, Ojo, Oshodi-Isolo, and Ajeromi-Ifelodun had the lowest prevalence scores.

In 2021, Eti-Osa maintained the highest prevalence with a score of 1.50, and Lagos Mainland, Ikeja, and Lagos Island also experienced notable increases. Several LGAs showed moderate prevalence, while some had lower prevalence scores.

In 2022, Eti-Osa continued to have the highest prevalence with a score of 1.89, followed by Lagos Mainland and Lagos Island. Certain LGAs experienced an increase in prevalence, while others remained at moderate or lower levels.

These findings highlight the dynamic nature of the pandemic's impact in different LGAs of Lagos State over the years. Public health authorities need to remain vigilant, closely monitoring prevalence patterns, and implementing targeted interventions and resource allocation to effectively combat the spread of COVID-19 in the region. These insights are crucial for formulating evidence-based strategies to safeguard public health and control the pandemic's spread effectively.

3.2.2. Prevalence of COVID-19 in Lagos State based on Confirmed Deaths

In 2020, the prevalence of COVID-19 based on confirmed deaths in Lagos State varied across different Local Government Areas (LGAs), highlighting distinct levels of impact.

Eti-Osa had the highest COVID-19 prevalence, with a prevalence score of 0.14, indicating a significant proportion of confirmed deaths relative to its population. Lagos Mainland followed closely with a prevalence score of 0.09, and Lagos Island had a prevalence score of 0.06.

Several LGAs, including Agege, Ifako-Ijaiye, Ikeja, Ikorodu, and Surulere, experienced moderate prevalence, with scores ranging from 0.05 to 0.07.

Meanwhile, Ajeromi-Ifelodun, Alimosho, Amuwo-Odofin, Apapa, Badagry, Epe, Ibeju-Lekki, Kosofe, Mushin, Ojo, Oshodi-Isolo, and Shomolu had lower prevalence scores in 2020, ranging from 0.01 to 0.04, this trend is illustrated in figures 20 and 21.

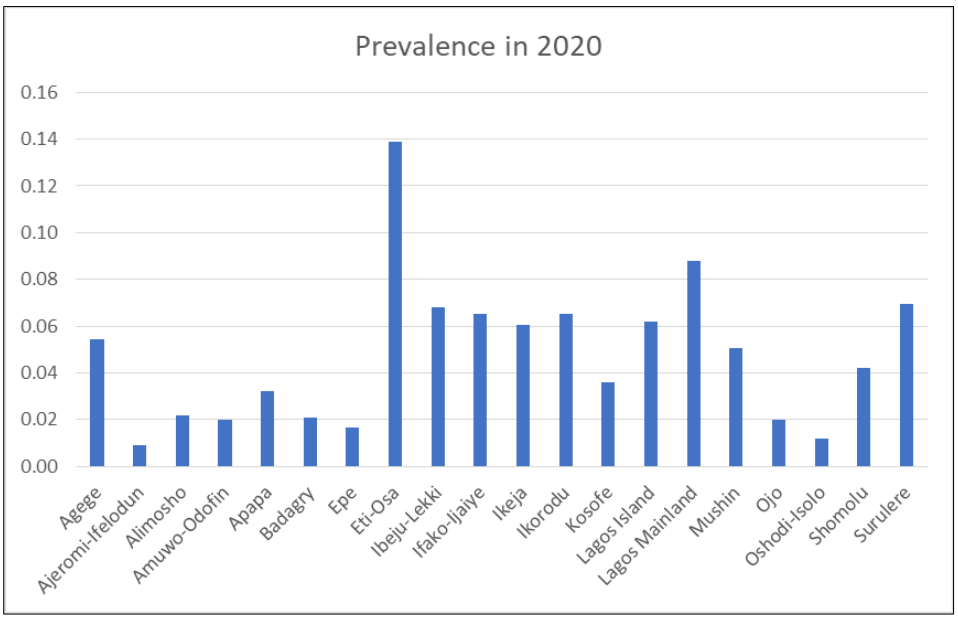

Figure 20 Distribution of COVID-19 Prevalence based on Confirmed Deaths for Lagos State in 2020

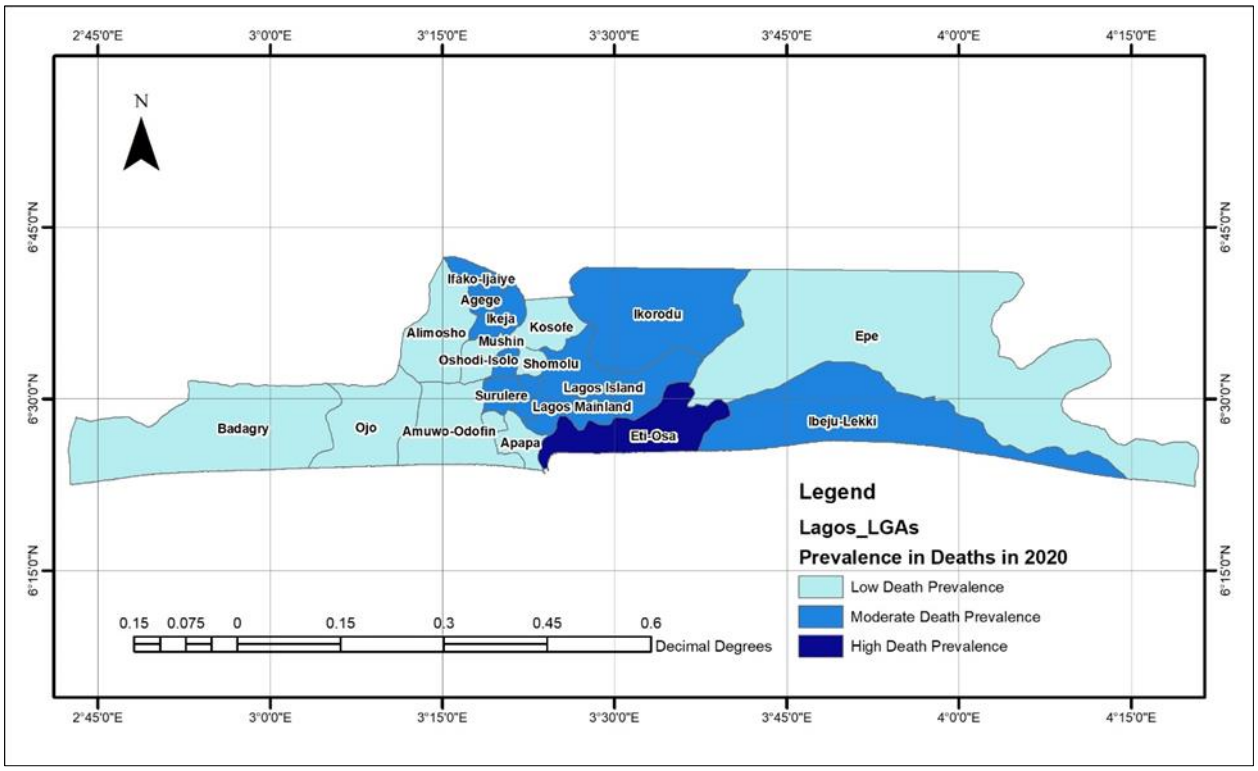

Figure 21 Map of COVID-19 Prevalence based on Confirmed Deaths for Lagos State in 2020

In 2021, the prevalence of COVID-19 based on confirmed deaths continued to fluctuate across different LGAs in Lagos State. Eti-Osa remained the LGA with the highest prevalence, with a score of 0.22, followed by Lagos Mainland with a prevalence score of 0.13, and Lagos Island with a score of 0.10.

Several LGAs, including Agege, Ifako-Ijaiye, Ikeja, Ikorodu, and Surulere, experienced an increase in prevalence, with scores ranging from 0.09 to 0.12. Meanwhile, Ajeromi-Ifelodun, Alimosho, Amuwo-Odofin, Apapa, Badagry, Epe, Ibeju-Lekki, Kosofe, Mushin, Ojo, Oshodi-Isolo, and Shomolu exhibited moderate prevalence in 2021, with scores ranging from 0.02 to 0.07, this is also illustrated in figure 22 and 23.

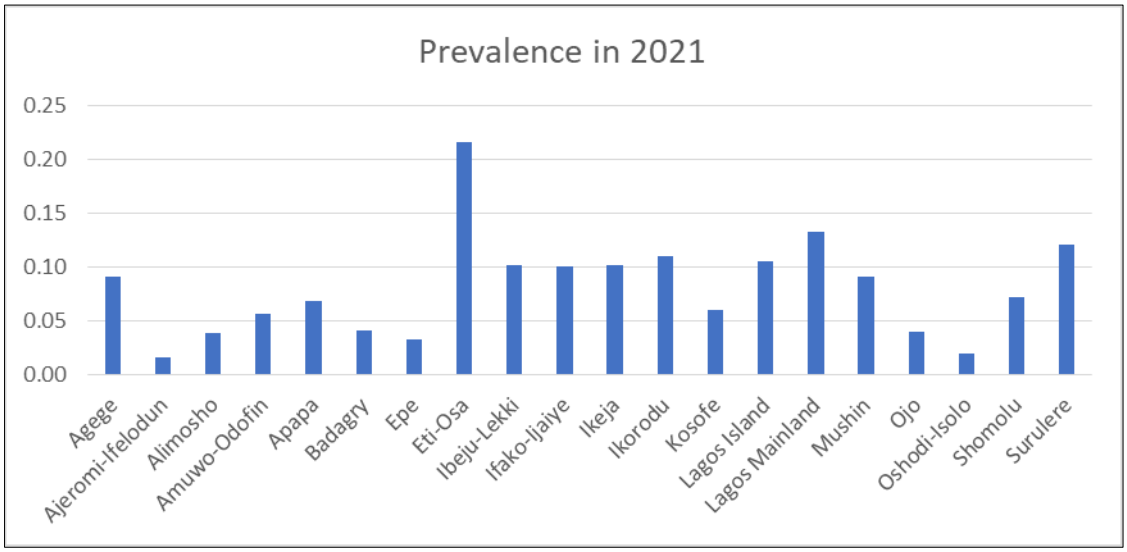

Figure 22 Distribution of COVID-19 Prevalence based on Confirmed Cases for Lagos State in 2021

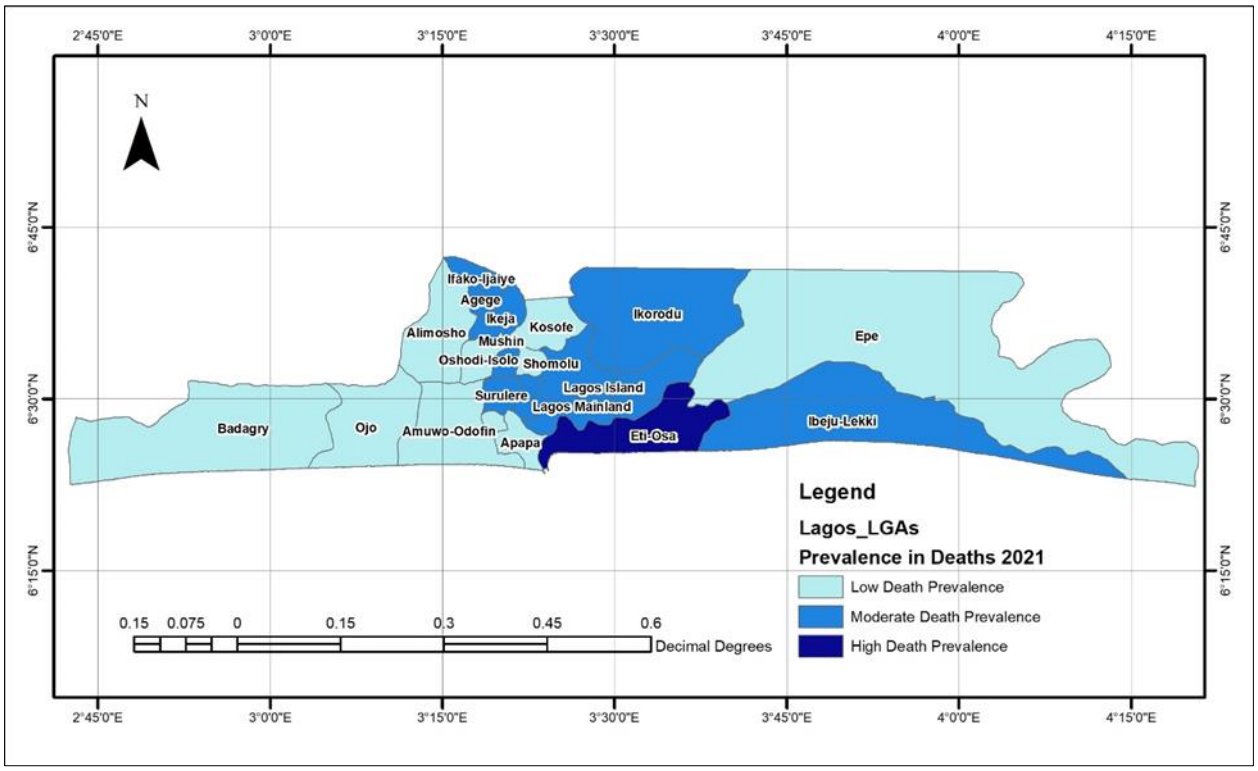

Figure 23 Map of COVID-19 Prevalence based on Confirmed Deaths for Lagos State in 2021

In the year 2022, the prevalence of COVID-19 based on confirmed deaths in Lagos State continued to show significant fluctuations across different LGAs. Eti-Osa remained the LGA with the highest COVID-19 prevalence, scoring 0.30, indicating a substantial proportion of confirmed deaths relative to its population. Lagos Mainland followed closely with a prevalence score of 0.21, and Lagos Island had a prevalence score of 0.16.

Several LGAs, including Agege, Ifako-Ijaiye, Ikeja, Ikorodu, and Surulere, experienced an increase in prevalence, with scores ranging from 0.13 to 0.18. Meanwhile, Ajeromi-Ifelodun, Alimosho, Amuwo-Odofin, Apapa, Badagry, Epe, Ibeju-Lekki, Kosofe, Mushin, Ojo, Oshodi-Isolo, and Shomolu exhibited moderate prevalence in 2022, with scores ranging from 0.03 to 0.09, this is also illustrated in figures 24 and 25.

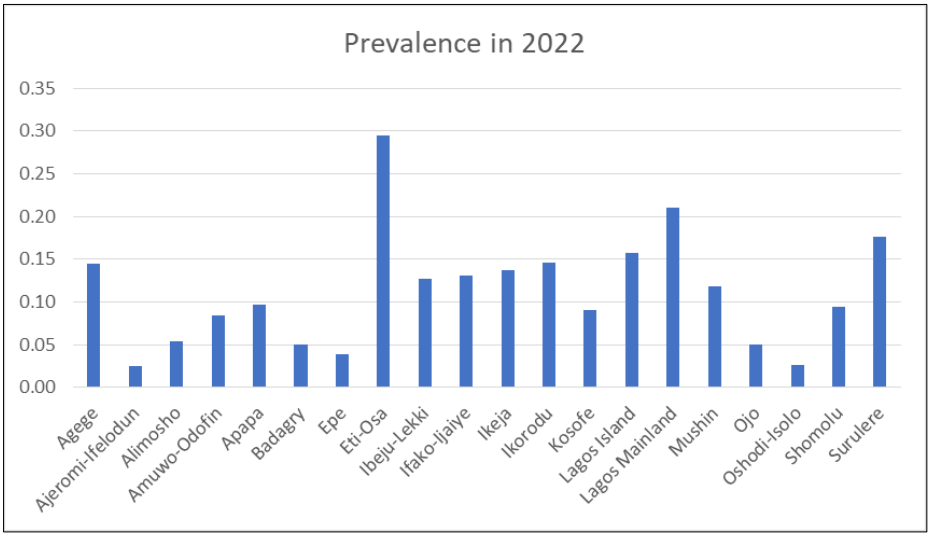

Figure 24 Distribution of COVID-19 Prevalence based on Confirmed Cases for Lagos State in 2022

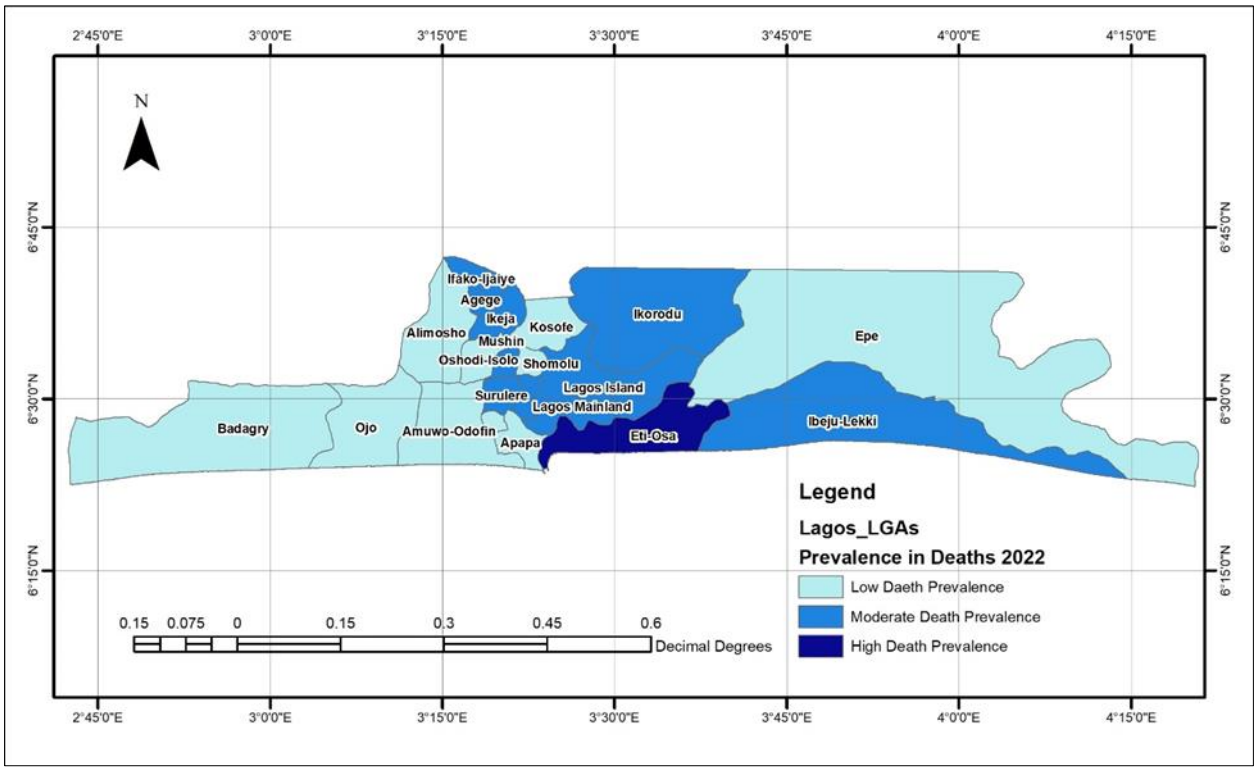

Figure 25 Map of COVID-19 Prevalence based on Confirmed Deaths for Lagos State in 2022

These results demonstrate the evolving nature of the COVID-19 pandemic's impact in different LGAs of Lagos State over the years. Public health authorities need to closely monitor prevalence patterns and implement targeted interventions and resource allocation to effectively combat the spread of the virus and protect public health. The prevalence data provides crucial insights for formulating evidence-based strategies to control the pandemic in the region.

3.3. Overall Prevalence of COVID-19 in Lagos State

Over the years 2020, 2021, and 2022, Lagos State experienced varying levels of COVID-19 prevalence based on both confirmed cases and deaths across different Local Government Areas (LGAs), revealing distinct patterns of impact.

In terms of confirmed cases, Eti-Osa consistently emerged as the LGA with the highest prevalence, reflecting a substantial proportion of confirmed cases relative to its population. Lagos Mainland and Lagos Island followed closely with notable prevalence scores. Several LGAs, including Ifako-Ijaiye, Ikorodu, Surulere, and Ikeja, consistently exhibited moderate prevalence. Meanwhile, certain LGAs, such as Alimosho, Apapa, Amuwo-Odofin, and Badagry, recorded lower prevalence scores over the years.

When considering confirmed deaths, Eti-Osa remained the LGA with the highest prevalence, indicating a significant number of confirmed deaths relative to its population. Lagos Mainland consistently followed with notable prevalence scores, while Lagos Island also experienced an increase in prevalence over the years. Several LGAs, including Agege, Ifako-Ijaiye, Ikeja, Ikorodu, and Surulere, showed an increase in prevalence of confirmed deaths. Meanwhile, certain LGAs, such as Alimosho, Apapa, Amuwo-Odofin, and Badagry, recorded lower prevalence scores for confirmed deaths.

The data on both confirmed cases and deaths emphasize the evolving nature of the COVID-19 pandemic in Lagos State, with varying impacts observed over time. Eti-Osa and Lagos Mainland consistently remained among the LGAs with the highest prevalence based on both confirmed cases and deaths.

Overall, the prevalence data based on confirmed cases and deaths provides crucial insights for public health authorities and policymakers in formulating targeted interventions, resource allocation, and evidence-based strategies to effectively combat the spread of COVID-19 and safeguard public health in the region. Continued vigilance and responsive measures are essential to mitigate the impact of the pandemic and protect the well-being of the population in Lagos State.

4. Conclusion

Based on the findings from the results regarding COVID-19 trends in Lagos State between 2020 and 2022, we can draw the following conclusions:

- **Increase in Confirmed Cases**: There was a substantial increase in confirmed COVID-19 cases in Lagos State during this period, with the number more than doubling from 21,717 in 2020 to 56,596 in 2022. This indicates a significant and concerning spread of the virus within the state.
- **Geographical Disparities in Confirmed Cases and Deaths**: The data reveals that the impact of COVID-19 was not evenly distributed across Lagos State. The local government areas (LGAs) of Alimosho and Eti-Osa were the most affected in terms of total confirmed cases. Additionally, Eti-Osa consistently had the highest number of confirmed deaths, followed by Ikorodu and Surulere. This suggests that certain areas within the state were more vulnerable to the virus and its associated health outcomes.
- **Persistent High Prevalence in Eti-Osa**: Eti-Osa stood out as an LGA with consistently high prevalence in both confirmed cases and deaths each year. This highlights the need for targeted interventions and resources in this specific area to address the ongoing challenge of COVID-19.

In conclusion, these findings underscore the importance of ongoing efforts to control the spread of COVID-19 in Lagos State, particularly in the most affected areas such as Eti-Osa. The significant increase in confirmed cases and deaths over the two-year period demonstrates the need for continued public health measures, vaccination campaigns, and resources to mitigate the impact of the virus and reduce the disparities in different LGAs.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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