Residents' Awareness and Compliance with COVID-19 Regulations in Shomolu Local Government Area, Lagos State, Nigeria

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Abstract

The devastating effects of the coronavirus pandemic on human health and socioeconomic activities remain a major global concern. Beyond triggering an economic recession, the pandemic has led to over 25 million job losses worldwide. To flatten the curve and effectively combat the spread, evidence-based policy remains critical. This can be achieved through empirical investigation. This study examines residents' awareness of and compliance with coronavirus pandemic regulations in Lagos State, Nigeria. The study area was stratified into three residential densities: high, medium, and low. A total of 181 respondents were randomly selected from a sampling frame of 8,530 buildings using systematic sampling with a random start and sampling interval of 40. Data were collected through questionnaire administration and analysed using descriptive and inferential statistics. Findings reveal that awareness of coronavirus regulations was high across all residential densities. However, One-Way ANOVA showed no significant difference in awareness levels among residents across densities ($F(2, 178) = 2.01$, $p > 0.05$). In terms of compliance, the Coronavirus Pandemic Regulation Index (CPRI) was highest for face mask use (4.28), hand sanitiser use (4.15), and frequent handwashing (3.95). The least complied-with regulation across the three densities was the restriction on international travel. ANOVA results also indicated no significant difference in compliance levels across residential densities, $F(2, 178) = 0.933$, $p > 0.05$. It is concluded that awareness of and compliance with coronavirus regulations are not a function of residential density. Therefore, strategies to improve awareness and compliance should be applied uniformly across high-, medium-, and low-density areas rather than be spatially differentiated.

Keywords: *COVID-19, Pandemic regulations, Compliance, Awareness, Residential density, Lagos State and Nigeria.*

Introduction

Decaro et al. (2010) describe coronaviruses as enveloped, single-stranded RNA viruses that infect a wide range of hosts, including avian species and wild, domestic, and human mammals. They are noted for their genetic plasticity, which allows rapid mutation, changes in tissue tropism, cross-species transmission, and adaptation to diverse epidemiological conditions. Among the seven known human coronaviruses, four strains — HCoV-OC43, HCoV-229E, HCoV-NL63, and HCoV-HKU1 — commonly cause mild, self-limiting illnesses similar to the common cold and occasional gastrointestinal symptoms (Wu et al., 2020). In contrast, severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) have raised significant public health concerns due to their zoonotic origin, ability to cross species barriers, and association with high pathogenicity and mortality in humans. SARS-CoV emerged in 2002 following transmission from bats to palm civets and then to humans (Drosten et al., 2014; Cui et al., 2019). SARS-CoV-2, the virus responsible for COVID-19, also has a zoonotic origin and is phylogenetically related to bat coronaviruses, though the exact intermediate host remains under investigation. This capacity for interspecies spillover underscores why coronaviruses are a persistent focus of global surveillance and pandemic preparedness efforts.

Coronavirus disease 2019 (COVID-19) emerged in Wuhan City, China, in December 2019, with early cases epidemiologically linked to the Huanan Seafood Wholesale Market (Cui et al., 2019; Liu et al., 2020). On 30 January 2020, the World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern (PHEIC) (WHO, 2020a). Two months later, on 11 March 2020, the WHO formally declared COVID-19 a pandemic following its rapid global spread (WHO, 2020b). The pandemic has had severe socioeconomic consequences worldwide. The Asian Development Bank (ADB, 2020) estimated that global economic losses from COVID-19 ranged from US$5.8 to US$8.8 trillion, equivalent to 6.4% to 9.7% of global gross domestic product (GDP). In terms of health impact, WHO reported over 81 million confirmed

cases and more than 1.8 million deaths globally by the end of 2020 (WHO, 2021). The International Labour Organization (ILO, 2021) further noted that employment losses equivalent to 255 million full-time jobs occurred in 2020 due to lockdowns and economic disruptions. Thus, COVID-19 represents not only a public health crisis but also one of the most disruptive socioeconomic shocks of the 21st century.

In Africa, many settlements lack functional healthcare facilities, not to mention an acute shortage of health personnel (Amzat, 2011). Early in the pandemic, global health analysts feared that African nations could bear a disproportionate burden of COVID-19 if efficient containment strategies were not implemented quickly (Johns Hopkins University, 2020). Nigeria, like other low- and middle-income countries, faces significant challenges in curtailing the spread of the coronavirus due to systemic constraints (Ihekweazu, 2020). Nigeria's vulnerability is compounded by the fragile state of its healthcare infrastructure. Marbot (2020) noted that limited ICU capacity, inadequate diagnostic laboratories, and uneven distribution of health facilities increase the country's exposure risk. This situation has raised concerns among individuals, civil society organisations, researchers, and government agencies alike. Although the Nigerian government has implemented several measures to control the spread of COVID-19, including lockdowns, public awareness campaigns, and the establishment of treatment centres, evidence suggests that gaps remain in implementation and access, particularly in densely populated urban areas. Addressing these gaps is therefore critical to improving compliance with preventive regulations.

Several studies document government efforts to curtail the spread of COVID-19 in Nigeria. Early in the pandemic, Ogunleye (2020) reported that the Nigerian government restricted international travel from 13 countries with high COVID-19 prevalence. Returning Nigerians were advised by the Nigeria Centre for Disease Control (NCDC, 2020) to self-isolate for 14 days to reduce the risk of importation. To enforce this directive, the federal government and NCDC deployed surveillance teams at Nigeria's five major international airports and activated the National Coronavirus Incident Management System in March 2020 (NCDC, 2020). While these early containment measures were critical during the emergency phase, WHO's 2024–2025 strategic plan emphasises a shift from travel restrictions and incident systems toward long-term, integrated management of COVID-19 within broader respiratory disease programmes (WHO, 2024). Recent evaluations indicate that sustained strategies now focus on strengthening surveillance, improving vaccination coverage among high-risk groups, and integrating COVID-19 response into routine health systems rather than relying on airport screening and mandatory quarantine (NCDC, 2023; WHO, 2025). Thus, government efforts have evolved from emergency containment in 2020 to sustained public health integration, though implementation gaps persist in high-density urban areas such as the Shomolu Local Government Area (LGA).

Furthermore, COVID-19 cases in Nigeria have remained concentrated in Lagos State, an epicentre of local and international commerce and home to Murtala Muhammed International Airport, one of the country's busiest airports (Koiki, 2018; NCDC, 2020). Lagos is characterised by high population density and marked socioeconomic inequalities, with informal settlements and overcrowded housing common in many areas (Lawanson, 2020). These conditions likely contributed to higher infection rates in the state, as international travel and adverse economic conditions increased the risk of exposure. For instance, overcrowding and high rates of homelessness in Lagos make social distancing difficult, if not impossible, thereby limiting compliance with preventive regulations (Roberts, 2020; UN-Habitat, 2023). While studies have shown that urban dwellers differ in socioeconomic characteristics across residential zones, there remains a dearth of empirical research on residents' compliance with COVID-19 pandemic regulations in high-, medium-, and low-density areas of Nigerian cities. This gap is particularly evident in Shomolu Local Government Area, one of Lagos's most densely populated LGAs, where housing density, poverty levels, and access to health services vary sharply between zones. Investigating compliance patterns in such settings is therefore critical for designing targeted public health interventions.

Moreover, existing literature on COVID-19 has largely focused on its health consequences (Wang et al., 2020), government containment measures (Ogunleye, 2020), and macroeconomic impacts, including an estimated loss of US$5.8–US$8.8 trillion in global GDP (Asian Development Bank, 2020). While these studies provide valuable insights, few have examined how compliance with COVID-19 regulations varies across residential zones within Nigerian cities, particularly in high-density urban LGAs. This study addresses that gap by investigating residents' awareness of and compliance with COVID-19 pandemic regulations across high-,

medium-, and low-density areas of Shomolu LGA, Lagos State. Specifically, it assesses levels of knowledge of preventive guidelines and evaluates adherence to measures such as mask use, social distancing, and hand hygiene. The findings are expected to inform evidence-based policy for pandemic response in Nigeria. Given similarities in urban density, informal settlements, and healthcare constraints across many developing countries, the implications of this study may also extend to other low- and middle-income contexts facing comparable challenges in enforcing public health regulations (WHO, 2024; UN-Habitat, 2023).

Literature Search

The year 2020 was marked by the emergence of a novel respiratory pathogen, coronavirus disease 2019 (COVID-19), initially designated as 2019-novel coronavirus (2019-nCoV). The outbreak was first reported in December 2019 in Wuhan, the capital of Hubei Province, China, with early cases epidemiologically linked to the Huanan Seafood Wholesale Market. The virus was subsequently named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a betacoronavirus belonging to the Sarbecovirus subgenus (Kampf, 2020). From Wuhan, the disease spread rapidly within China and internationally through respiratory droplets and close contact, triggering an exponential rise in morbidity and mortality. On 11 March 2020, the World Health Organization (WHO) formally declared COVID-19 a pandemic after confirming 118,000 cases in 114 countries and 4,291 deaths worldwide. WHO noted that cases outside China had increased 13-fold in two weeks and the number of affected countries had tripled, meeting the epidemiological criteria for pandemic classification (WHO, 2020a). This declaration prompted a global shift from containment to mitigation strategies. Although WHO terminated the Public Health Emergency of International Concern (PHEIC) status for COVID-19 on 5 May 2023, the virus continues to circulate and remains a public health priority. As of early 2025, WHO epidemiological updates still report sustained SARS-CoV-2 transmission, with the JN.1 variant of interest and XEC variant under monitoring accounting for 16.3% and 42.7% of global sequences, respectively, alongside thousands of weekly cases and deaths (WHO, 2025). WHO is 2024–2025 strategic plan now emphasises long-term, integrated management of COVID-19 within broader respiratory disease control programmes rather than emergency response (WHO, 2024). Thus, while the acute phase of the pandemic has transitioned, COVID-19 continues to evolve and pose serious health and socioeconomic challenges globally.

Clinical manifestations of COVID-19 range from mild to severe respiratory illness. The most frequently reported symptoms include fever, dry cough, fatigue, sore throat, shortness of breath, and breathing difficulties. In severe cases, the disease can progress to lower respiratory tract complications such as pneumonia, bronchitis, acute respiratory distress syndrome (ARDS), and multi-organ failure. These severe outcomes are disproportionately observed among individuals with underlying health conditions, including cardiopulmonary disease, diabetes, and immunosuppression, as well as among infants and older adults whose physiological reserves are limited (WHO, 2020). Early in the pandemic, global case fatality estimates hovered around 3–4% in 2020. This figure has since declined significantly due to widespread vaccination, improved clinical management, and the emergence of less virulent Omicron sub-variants. Despite this decline, COVID-19 continues to cause severe disease and mortality. According to WHO's epidemiological update for 6 January–2 February 2025, approximately 147,000 new cases and 4,500 deaths were reported globally over 28 days, representing a 16% decrease in cases and a 28% increase in deaths compared with the previous period (WHO, 2025). WHO emphasises that mortality and hospitalisation remain concentrated among older adults and people with comorbidities, underscoring the persistent vulnerability of high-risk groups.

Regarding Africa, initial concerns in early 2020 focused on the continent's commercial ties with China and the relative fragility of health systems. However, subsequent surveillance data showed lower-than-expected case fatality rates in many tropical African countries. Several hypotheses have been proposed to explain this, including a younger population structure, prior exposure to other human coronaviruses, and environmental factors that may affect viral survival and transmission. Nonetheless, WHO continues to stress that Africa remains at risk due to uneven vaccination coverage, limited ICU capacity, and gaps in surveillance. WHO is 2024–2025 strategic plan therefore calls for sustained, integrated management of COVID-19 within broader respiratory disease programmes, with particular attention to vulnerable populations and health system strengthening (WHO, 2024).

The work of Tripathi *et al*. (2020) reported that most of the residents confirmed awareness of COVID-19 (98.7%) as a deadly, contagious, and life-threatening disease (99.6%) that is transmitted through human-to-human contact (97.7%). They were familiar with the associated symptoms and common causes of

COVID-19. Health organisations were chosen as the most reliable source of information by the majority of the participants (89.6%). Hand hygiene (92.7%) and social distancing (92.3%) were the most common preventive measures taken by respondents, followed by avoiding travel to an infected area or country (86.9%) and wearing face masks (86.5%). Significant proportions of HCWs ($P<0.05$) and more-educated participants ($P<0.05$) demonstrated considerable knowledge of the disease, and all respondents displayed good preparedness for the prevention and control of COVID-19.

Empirical evidence shows that socioeconomic characteristics vary systematically across residential zones within cities, and this spatial differentiation can directly or indirectly influence disease incidence and transmission patterns. Classical urban spatial models provide a theoretical basis for understanding these variations. Burgess's Concentric Zone Model (1925) proposed that cities expand outward from a central business district (CBD), with lower-income households occupying inner zones near the CBD while wealthier households reside progressively farther out in suburban areas. Hoyt's Sector Model (1939) challenged this pattern, arguing that urban growth occurs along transportation corridors and topographical advantages, with high-income groups occupying premium sectors such as waterfronts and hilltops, away from noise and industrial pollution. Harris and Ullman's Multiple Nuclei Model (1945) further advanced this discourse by suggesting that modern cities develop around several activity nodes, leading to more complex and fragmented residential patterns. Recent COVID-19 studies in Nigeria empirically validate these models. Wafula and Madukoma (2025) developed a composite vulnerability index for Nigeria. They found that high-density urban areas, such as Lagos, recorded risk scores of 673.47, compared to the national average of 28.16, accounting for 35.4% of national cases. Their model weighted population density at 0.2, poverty at 0.4, and healthcare access at 0.3, confirming that inner-city zones face disproportionate exposure risk. Similarly, Zhu et al. (2024) used spatially resolved modelling. They reported that population density, building order, and humidity were significant determinants of COVID-19 severity, suggesting that overcrowded inner zones typical of Burgess's model experienced higher transmission rates.

Socioeconomic disparities compound these spatial effects. Akinseinde et al. (2023) analysed Nigeria's COVID-19 mortality. They found that urban residence was positively associated with deaths during the early pandemic waves, while wealth served as a protective factor for men and health insurance for women. Ogden et al. (2024) further demonstrated that a one-unit increase in the Social Vulnerability Index was associated with a 1.61% increase in COVID-19 seroprevalence across Nigerian LGAs, with the most vulnerable areas showing 9.21% higher prevalence than less vulnerable ones. Thus, the convergence of classical urban theory and recent evidence from Nigeria suggests that residential density and socioeconomic status jointly shape exposure risk and compliance behaviour. High-density, low-income zones near the CBD often face overcrowding, inadequate water and sanitation, and limited access to health facilities, increasing vulnerability. In contrast, low-density, high-income sectors typically have better housing quality, lower occupancy ratios, and stronger access to preventive resources. This spatial logic is critical to explaining why COVID-19 transmission and adherence to preventive measures may vary across high-, medium-, and low-density areas within Shomolu LGA.

Scholarly literature establishes a clear relationship between residential zones and socioeconomic status within urban areas. Classical and contemporary urban theories consistently show that housing quality, income level, and access to services vary systematically across high-density inner zones, medium-density transitional areas, and low-density suburban zones. Given this spatial stratification, residential location may plausibly influence residents' exposure to information and their capacity to comply with public health directives. Therefore, this study tests the relationship between the residential area of the Shomolu Local Government Area and residents' awareness of and compliance with COVID-19 pandemic regulations. Specifically, it examines whether variations in population density and socioeconomic characteristics across high, medium, and low-density zones translate into differences in knowledge of regulations and adherence to preventive measures.

Methods and Materials

Lagos, Nigeria's commercial capital, accounts for almost 20 million of the country's population and is therefore regarded as the largest city (*www.britannica.com*). Despite its large population, it is also Nigeria's smallest state by area. The state is located in the southwestern part of the country, covering an area of 3,577 km2. Shomolu is one of the 20 Local Government Areas (LGAs) in Lagos State (See Figure 1). It is a residential suburb in northern Lagos State. The town faces problems such as overcrowding, poor housing, and inadequate

sanitation. Its local activities include leather works, handicrafts, and printing. According to the 2006 census, the population of the LGA is 402,673 persons (NPC, 2006). However, Shomolu Local Government Area was formerly known as Mushin East Local Government
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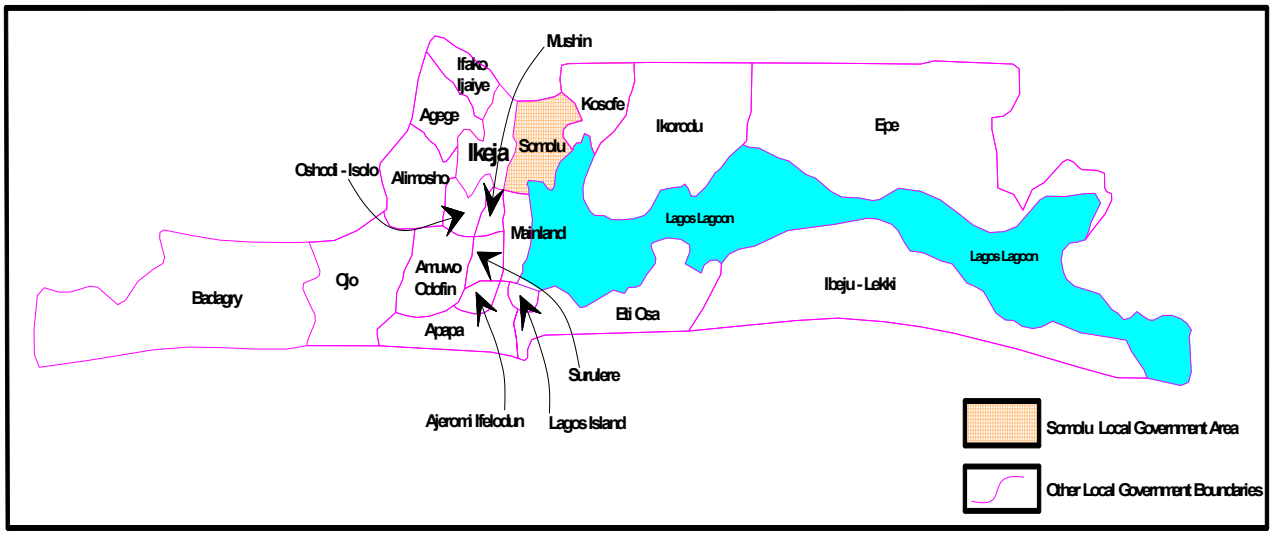


Figure 1: Shomolu Local Government Area in the Context of Lagos State
Source: Ministry of Physical Planning and Urban Development, Lagos (2021)

Shomolu Local Government Area comprises areas such as Community Road, Akoka, east of Ikorodu Road up to Anthony Oke interchange, including Somolu, Bashua, Bariga, Igari, Obanikoro, Pedro village, Abule Okuta, Seriki village, Apelehin, and Ilaje. The study area is divided into eight communities under eight administrative wards: Onipanu, Okesuna/Alase, Igbari, Fadeyi/Igbobi, Bashua, Orile/Alade, Bajulaiye, and Ijebu-Tedo. This formed the basis for analysis in this study.

This study adopted a quantitative survey research design. The design was considered appropriate because it allows for the systematic collection of numerical data from a large population to examine patterns of awareness and compliance with COVID-19 pandemic regulations across different residential densities (Creswell & Creswell, 2018). The cross-sectional approach was used to obtain data at a single point in time from residents of high-, medium-, and low-density areas in the Shomolu Local Government Area, Lagos State. The study population consisted of all buildings within the three residential density strata in the study area. A total of 8,530 buildings were identified across high, medium, and low-density zones based on the Shomolu LGA Physical Planning records. Using the formula for sample size determination for a finite population (Taro Yamane, 1967) at a 95% confidence level and a 0.05 margin of error, a sample size of 216 households was derived.

Table 1: Political Ward, Number of Buildings and Sample Size

Residential density	Political ward	No. of Buildings	Sample Size
High	Onipanu	1,509	38
High	IjebuTedo	1,795	45
High	**Sub-total**	3,304	83
Medium	Igbari	912	23
Medium	Okesuna/Alase	1,039	26
Medium	Bashua	793	20
Medium	**Sub-total**	2,744	69
Low	Fadeyi/Igbobi	675	17
Low	Bajulaye	896	23
Low	Orile/Alade	911	23
Low	**Sub-total**	1,571	64
Low	**Grand total**	8,530	216

Source: Author's fieldwork, 2021

A systematic random sampling technique was employed. The sampling interval k = N/n = 8,530/216 ≈ 40. A random start between 1 and 40 was selected, and every 40th building was chosen until the required sample was achieved. In each selected building, one household head aged 18 years or older was purposively selected as a respondent to ensure informed responses regarding household compliance behaviour. Data were collected using a

structured questionnaire. The instrument was divided into three sections: Section A: Socio-demographic characteristics measured using nominal and ordinal scales. Section B: Awareness of COVID-19 regulations measured on a 5-point Likert scale: 1 = Strongly Disagree to 5 = Strongly Agree. Section C: Level of compliance with preventive measures such as mask use, social distancing, and hand hygiene, also measured on a 5-point Likert scale: 1 = Never to 5 = Always. The Likert scale was adopted because it provides interval-level data suitable for parametric statistical analysis and allows respondents to express intensity of agreement or frequency of behaviour (Likert, 1932; Boone & Boone, 2012).

To ensure content validity, the questionnaire underwent face and content reviews by two experts in public health and urban planning from the Department of Geography, University of Lagos. Their corrections and suggestions were incorporated before administration. Reliability was established through a pilot test conducted with 20 residents in Mushin LGA, which shares urban characteristics similar to Shomolu but was excluded from the main study. Data from the pilot were analysed using Cronbach's Alpha. The instrument yielded reliability coefficients of $\alpha = 0.84$ for the awareness scale and $\alpha = 0.88$ for the compliance scale, both exceeding the acceptable threshold of 0.70 (Nunnally & Bernstein, 1994). This confirmed the internal consistency of the instrument. A total of 216 copies of the questionnaire were administered to household heads in the sampled buildings. Of these, 181 copies were retrieved and found usable, representing an 83.8% response rate. The high response rate was attributed to direct administration by trained research assistants and assurance of confidentiality to respondents. Data were coded and analysed using SPSS Version 26. Descriptive statistics, including frequency distributions, percentages, and cross-tabulations, were used to summarise respondents' socio-demographic characteristics. Mean and standard deviation were computed for awareness and compliance scores. Inferential statistics were applied to test the hypothesis. One-way ANOVA was used to determine whether there were statistically significant differences in residents' awareness of and compliance with COVID-19 regulations across high-, medium-, and low-density residential areas at the $p < 0.05$ significance level. Post hoc tests were conducted when significant differences were observed.

Ethical consideration

The participants were fully informed about the study's purpose, the nature of the data being collected, the procedures involved, and any potential risks or benefits. A detailed consent form was provided and signed by participants before data collection. The form emphasised that participation is voluntary and that participants have the right to withdraw from the study at any time without repercussion. Participants' personal information was kept confidential throughout the study. Data collected were anonymised by removing identifiers such as names and addresses to prevent responses from being traced.

Results and Discussions

This section is divided into two sub-sections. The first sub-section focuses on findings and discussion of residents' awareness of coronavirus pandemic regulations. In contrast, the second subsection is devoted to residents' compliance with these regulations.

Residents' Awareness of and Compliance with Coronavirus Pandemic Regulations

Table 3 presents residents' awareness of coronavirus pandemic regulations across the three residential densities. Respondents were asked to indicate their level of awareness of each regulation listed. Overall, the results show that awareness was generally high across high, medium, and low-density areas, suggesting widespread exposure to public health information during the pandemic. The proportion of residents who reported being unaware of any regulation was minimal. This low level of non-awareness may reflect either limited access to information or a post hoc justification by respondents who were non-compliant, as acknowledging ignorance could serve as a rationalisation for non-adherence. Disaggregating by residential density, awareness of specific regulations remained consistently high. For instance, awareness of the mandatory use of face masks was reported by 97.3% of residents in high-density areas and by 100% of residents in both medium- and low-density areas. This near-universal awareness aligns with findings from Tripathi, Alqahtani, Albarraq, et al. (2020), who reported that 98.7% of residents in their study confirmed awareness of COVID-19 preventive measures. The high awareness across all densities implies that public health campaigns, mass media, and community sensitisation were effective in disseminating information, irrespective of settlement pattern. However, the slight variation in high-density areas may reflect challenges such as information overload, crowded living conditions, or differential access to formal communication channels.

Table 2: Awareness of Residents on Coronavirus Pandemic Regulations

Regulation	Residential Density	Residential Density	Residential Density	Residential Density	Residential Density	Residential Density
Regulation	High	High	Medium	Medium	Low	Low
Regulation	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Use of facemask	73 (97.3)	2 (2.7)	65 (100)	0 (0.0)	41 (100)	0 (0.0)
Hand washing	70 (93.3)	5 (6.7)	64 (98.5)	1 (1.5)	41 (100)	0 (0.0)
Use of hand sanitiser	70 (93.3	5 (6.7)	64 (98.5)	1 (1.5)	41 (100)	0 (0.0)
Social distancing	70 (93.3)	5 (6.7)	59 (90.8)	6 (9.2)	41 (100)	0 (0.0)
Stay at home order	72 (96.0)	3 (4.0)	60 (92.3)	5 (7.7)	41 (100)	0 (0.0)
Closure of borders	66 (88.0)	9 (12.0)	59 (90.8)	6 (9.2)	41 (100)	0 (0.0)
Ban on social gathering	70 (93.3)	5 (6.7)	60 (92.3)	5 (7.7)	41 (100)	0 (0.0)
Restriction on inter-state travelling	64 (85.3)	11 (14.7)	57 (87.7)	8 (12.3)	41 (100)	0 (0.0)
Touching of eyes, nose & mouth	69 (92.0)	6 (8.0)	64 (98.5)	1 (1.5)	41 (100)	0 (0.0)
Sneeze to elbow	71 (94.7)	4 (6.3)	62 (95.4)	3 (4.6)	41 (100)	0 (0.0)
Proper sanitation	71 (94.7)	4 (5.3)	64 (98.5)	1 (1.5)	41 (100)	0 (0.0)

Source: Author's field survey, 2021

The pattern of high awareness observed for facemask use was consistent across other preventive regulations, though slight variations emerged by residential density. Regarding hand hygiene, awareness of the need for frequent handwashing was reported by 93.3% of residents in high-density areas, 98.5% in medium-density areas, and 100% in low-density areas. Similarly, awareness of hand sanitiser use followed an almost identical trend, with 93.3%, 98.5%, and 100% of residents in high, medium, and low-density areas, respectively, indicating familiarity with the regulation. This near-uniform awareness of hand hygiene measures suggests that messaging on personal hygiene was widely disseminated and easily internalised across all settlement types. Awareness of social distancing regulations also remained high but showed marginally lower figures in medium-density areas. Specifically, 93.3% of residents in high-density areas, 90.8% in medium-density areas, and 100% in low-density areas reported awareness of social distancing. Likewise, the regulation on staying at home or lockdown was widely acknowledged, with 96.0%, 90.8%, and 100% awareness recorded in high, medium, and low-density areas, respectively. The consistently high awareness of movement restrictions implies that government directives and media campaigns effectively penetrated residential communities regardless of density.

For regulations involving mobility and congregation, awareness levels remained robust. The closure of international borders was acknowledged by 88.0% of residents in high-density areas, 90.8% in medium-density areas, and 100% in low-density areas. The slightly lower figure in high-density areas may reflect higher dependence on cross-border trade and travel, which could influence perception and recall of such restrictions. Similarly, awareness of the ban on social gatherings was very high across all densities: 93.3% in high-density areas, 92.3% in medium-density areas, and 100% in low-density areas. Overall, the findings indicate that while awareness was universally high, low-density areas consistently recorded 100% awareness across all regulations, suggesting stronger compliance with information dissemination in less crowded settlements. In contrast, high- and medium-density areas showed minor but negligible gaps.

Awareness of additional preventive regulations further reinforces the pattern of high knowledge across all residential densities. For restrictions on inter-state travel, 85.3% of residents in high-density areas, 87.7% in medium-density areas, and 100% in low-density areas indicated awareness. The slightly lower figures in high- and medium-density areas may reflect the greater mobility needs and economic dependence on inter-state movement in more urbanised settlements, which could affect both exposure to and recall of such restrictions. Similarly, awareness of the precautionary measures to avoid touching the eyes, nose, and mouth was high: 92.0% in high-density areas, 98.5% in medium-density areas, and 100% in low-density areas. Respiratory etiquette also showed strong awareness, with 94.7%, 95.4%, and 100% of residents in high-, medium-, and low-density areas, respectively, affirming knowledge of how to sneeze or cough into the elbow.

In aggregate, the majority of residents across all densities reported awareness of COVID-19 regulations, with 94.7% in high-density, 98.5% in medium-density, and 100% in low-density areas. This suggests that public health campaigns successfully reached diverse settlement patterns, though low-density areas consistently reported complete awareness. To test whether these observed differences were statistically meaningful, a One-Way ANOVA was conducted. The results indicate no statistically significant difference in residents' mean awareness scores across the three residential densities ($F = 2.01$, $df = 2, 178$, $p = 0.136$, $p > 0.05$). Therefore, it can be concluded that residential density

did not significantly influence residents' awareness of coronavirus pandemic regulations.

Residents' Compliance with Coronavirus Pandemic Regulations

Table 3 also summarises residents' level of compliance with coronavirus pandemic regulations, measured using the Coronavirus Pandemic Regulation Index (CPRI). The mean CPRI scores across residential densities were 3.99 for high-density, 3.47 for medium-density, and 3.83 for low-density areas. This indicates that, on average, residents reported moderate-to-high compliance, with high-density areas recording the highest overall compliance index despite expectations that crowding would hinder adherence. Disaggregating by specific regulation reveals notable differences in priority behaviours across densities. In high-density areas, facemask usage recorded the highest CPRI at 4.28, suggesting that visible and easily enforceable measures received greater public compliance where population concentration and surveillance were higher. In contrast, the regulation with the highest CPRI in medium-density areas was frequent handwashing, with a score of 3.95, implying that personal hygiene practices were more readily adopted in less congested but still urbanised settings. For low-density areas, hand sanitiser usage emerged as the most complied-with regulation, recording a CPRI of 4.15. This may reflect greater access to sanitising materials and fewer logistical barriers in less densely populated neighbourhoods. Overall, the variation in the highest-complied regulation across densities suggests that compliance behaviour was shaped not only by awareness, which was uniformly high, but also by contextual factors such as enforcement intensity, accessibility of preventive materials, and perceived risk associated with settlement patterns.

Beyond the single regulation with the highest CPRI, several other preventive measures also recorded compliance levels above the computed mean within each residential density, indicating clusters of "high-compliance" behaviours. In high-density areas, six regulations showed positive deviation from the mean CPRI of 3.99: frequent hand-washing (4.27), maintaining a clean and healthy environment (4.20), avoidance of social gatherings (4.11), hand sanitiser usage (4.05), observance of social distancing (4.03), and adherence to stay-at-home orders (4.03). Notably, all six indices exceeded 4.00 on the 5-point scale, implying that residents' compliance with these measures was often to very often. This pattern likely reflects stronger enforcement, greater visibility of violations, and higher perceived risk in crowded settlements. In medium-density areas, six regulations also exceeded the mean CPRI of 3.47, though at a lower absolute level: facemask usage (3.94), maintaining a clean and healthy environment (3.80), hand sanitiser usage (3.72), avoidance of social gatherings (3.71), observance of social distancing (3.65), and adherence to restrictions on international travel (3.48). While these values are above the mean density, all fall below the 4.00 threshold, suggesting that compliance was occasional to frequent rather than consistent. The lower scores may reflect weaker enforcement and reduced perceived susceptibility compared to high-density areas.

Table 3: Residents' Level of Compliance with Coronavirus Pandemic Regulations in Residential Densities

High Density	High Density	High Density	Medium Density	Medium Density	Medium Density	Low Density	Low Density	Low Density
Regulations	**CPRI**	**MD**	**Regulations**	**CPRI**	**MD**	**Regulations**	**CPRI**	**MD**
Facemask usage	4.28	0.29	Frequent hand washing	3.95	0.48	Hand sanitiser usage	4.15	0.31
Frequent hand washing	4.27	0.28	Facemask usage	3.94	0.47	Frequent hand washing	4.12	0.28
Maintaining a clean & healthy environment	4.20	0.21	Maintaining a clean & healthy environment	3.80	0.33	Facemask usage	4.07	0.23
Avoiding social gathering	4.11	0.12	Hand sanitiser usage	3.72	0.25	Maintaining a clean & healthy environment	4.07	0.23
Hand sanitiser usage	4.05	0.06	Avoiding social gathering	3.71	0.24	Observing social distancing	4.02	0.18
Observing social distancing	4.03	0.04	Observing social distancing	3.65	0.18	Avoiding touching eyes, nose & mouth	3.85	0.01
Obeying the stay-at-home order	4.03	0.04	Obeying restrictions on international travel	3.48	0.01	Obeying the stay-at-home order	3.80	-0.04
Sneeze into elbow	3.91	-0.08	Sneeze into elbow	3.37	-0.10	Sneeze into elbow	3.66	-0.18
Avoiding touching eyes, nose & mouth	3.81	-0.18	Avoiding touching eyes, nose & mouth	3.14	-0.33	Avoiding social gathering	3.61	-0.23
Obeying ban on interstate travel	3.64	-0.35	Obeying ban on interstate travel	2.83	-0.64	Obeying ban on interstate travel	3.54	-0.30
Obeying restrictions on international travel	3.55	-0.44	Obeying restrictions on international travel	2.62	-0.85	Obeying restrictions on international travel	3.34	-0.50
Mean	3.99			3.47			3.84	

Source: Author's field survey, 2021

For low-density areas, five regulations recorded CPRI values above the mean of 3.83: frequent hand-washing (4.12), facemask usage (4.07), maintaining a clean and healthy environment (4.07), observance of social distancing (4.02), and avoidance of touching the eyes, nose, and mouth (3.85). With the exception

of the last measure, all indices were above 4.00, indicating compliance from often to very often. The relatively high compliance in low-density areas, despite lower population pressure, may be attributed to better access to water, sanitisers, and open spaces that make physical distancing easier. Overall, the findings show that residents across all densities complied most consistently with hygiene-related and movement-related regulations. This aligns with Tripathi, Alqahtani, Albarraq, et al. (2020), who reported that hand hygiene (92.7%) and social distancing (92.3%) were the most commonly adopted preventive measures, followed by avoidance of travel to infected areas (86.9%) and use of face masks (86.5%). The convergence of results suggests that basic, individually controlled behaviours were more readily adopted than restrictions requiring structural or institutional compliance.

Table 3 also identifies regulations with the lowest compliance, as indicated by CPRI values below the computed mean for each residential density. Restrictions on international travel recorded the lowest CPRI across all three densities, though the absolute values varied: 3.55 in high-density, 2.62 in medium-density, and 3.34 in low-density areas. The consistently low index suggests that mobility restrictions were the least-adhered-to measures, likely due to economic dependence on travel and cross-border trade, and the perception that international movement posed less immediate personal risk than local transmission. Other regulations with negative deviations from the mean in high-density areas included sneezing or coughing into the elbow (3.91), avoiding touching the eyes, nose, and mouth (3.81), and adhering to the ban on inter-state travel (3.64). Medium-density areas showed a similar pattern of low compliance for the same three measures, with CPRI values of 3.37, 3.14, and 2.62, respectively. In low-density areas, the number of low-compliance regulations was slightly higher at four: adherence to stay-at-home orders (3.80), sneezing into the elbow (3.66), avoidance of social gatherings (3.61), and adherence to the ban on inter-state travel (3.54). The fact that these indices all fall below their respective density means implies occasional to infrequent compliance.

The pattern of negative deviation suggests that residents were less inclined to comply with measures perceived as restrictive, difficult to monitor, or having indirect health benefits. Behaviours such as sneezing etiquette and avoiding face-touching require continuous self-regulation and may have been viewed as less critical than face mask use or handwashing. Similarly, travel bans and stay-at-home orders directly conflict with livelihood and mobility needs, which likely weakened compliance. Inferential analysis confirms this trend, as the One-Way ANOVA test reveals no statistically significant difference in mean compliance levels across the three residential densities ($F = 0.933$, $df = 2, 178$, $p = 0.395$, $p > 0.05$). The implication is that residential density did not significantly determine residents' level of compliance with COVID-19 regulations; rather, the nature of the regulation itself appears to have been the stronger influence.

Recommendations

The findings of this study reveal that residents in high-, medium-, and low-density areas had uniformly high awareness of COVID-19 regulations. This broad awareness can be attributed to the aggressive multi-channel campaigns by government agencies, religious institutions, civil society organisations, and the media during the peak of the pandemic. However, awareness alone did not translate into consistent compliance, particularly for regulations that were restrictive, difficult to enforce, or perceived to have indirect health benefits.

Based on these findings, the following recommendations are proposed:

1. Sustain and contextualise public health campaigns: government at all tiers, in collaboration with religious bodies, NGOs, and community leaders, should sustain regular sensitisation on COVID-19 and other public health emergencies. Campaign messages should be contextualised using local dialects and mother tongues to enhance comprehension, especially among residents with limited formal education. This linguistic adaptation will reduce misinterpretation and ensure that the rationale behind each regulation is clearly understood, not just the rule itself.
2. Complement mass media with interactive engagement: town hall meetings, community dialogues, and ward-level sensitisation should be organised to complement radio, television, and social media campaigns. These interactive forums will provide residents with opportunities to engage directly with health officials and policymakers, ask questions, and clarify grey areas in the regulations. Direct engagement builds trust and addresses misconceptions that mass media alone cannot resolve.
3. Strengthen compliance monitoring and enforcement: although no statistically significant variation in compliance was found

across residential densities, the overall CPRI scores indicate selective adherence, with mobility and self-regulation measures recording the lowest compliance. Governments and relevant agencies should therefore strengthen monitoring mechanisms through community health workers, local vigilante groups, and environmental health officers. Routine compliance checks will provide real-time data on adherence levels and identify specific regulations or areas requiring targeted intervention.

4. Institutionalise graduated penalties and positive reinforcement: to deter non-compliance, a system of graduated penalties should be institutionalised for defaulters caught violating critical regulations. Penalties must be fair, transparent, and consistently applied to serve as a credible deterrent. However, enforcement should be balanced with positive reinforcement, such as public recognition of compliant communities or distribution of free preventive materials, to encourage voluntary adherence rather than reliance on punitive measures alone.

Conclusion

This study examined residents' awareness of and compliance with COVID-19 pandemic regulations across high-, medium-, and low-density residential areas in the Shomolu Local Government Area, Lagos State, Nigeria. The findings reveal that awareness of the regulations was uniformly high across all residential densities, with low-density areas recording complete awareness and high- and medium-density areas also exceeding 85% for most measures. This suggests that intensive multi-channel public health campaigns successfully penetrated diverse settlement patterns, ensuring that knowledge of preventive protocols was not constrained by residential density. In contrast, compliance behaviour was selective rather than uniform. While the Coronavirus Pandemic Regulation Index (CPRI) indicated moderate-to-high overall compliance, residents across all densities showed stronger adherence to hygiene-related and visible measures, such as facemask use and handwashing, compared with mobility restrictions and self-regulated behaviours, such as avoiding face-touching or sneezing into the elbow. Importantly, inferential analysis using One-Way ANOVA confirmed that there were no statistically significant differences in either awareness ($F = 2.01$, $p = 0.136$) or compliance levels ($F = 0.933$, $p = 0.395$) across the three residential densities.

It is therefore concluded that residents' awareness of and compliance with COVID-19 regulations were not significantly dependent on place of residence. Instead, compliance appeared to be shaped more by the nature of the regulation, enforcement intensity, and perceived personal or economic impact than by settlement density. The implication is that future pandemic response strategies should prioritise behavioural reinforcement and contextualised enforcement over density-based targeting, since awareness and adherence challenges cut across all residential patterns.

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