



The Spread of COVID-19 in Nigeria: The Influence of Transportation and Economic Zones

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Authors' contributions

This work was carried out in collaboration among all authors. Author NOA designed the study, wrote the protocol and the draft of the manuscript. Author ROA managed the literature searches and the analysis of data. Author ASA suggested the use of Nigerian map to express the spread of the pandemic from State to State. Author AE helped to categorise the data. All authors read and approved the final manuscript.

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ABSTRACT

The novel coronavirus (2019-nCoV) now known as Covid-19 was first detected in the city of Wuhan, China in December 2019. The disease rapidly spread to other cities in China and to other parts of the world. The aim of this study is to investigate the contribution which the economic zones and movement of people into the country and from city to city and State to State within the country have on the spread of the disease in Nigeria. Data of the daily update of Covid-19 occurrence in Nigeria as given by the NCDC Covid-19 Situation report were assembled. The data of the first index in each State between February 27 and March 28, 2020 with the status of whether they were from foreign travel or from within the community was compiled. The results show that economic zones and human movement contribute to the early spread of the disease. The initial spatial spread

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in Nigeria was observed to follow closely behind the test laboratory distribution pattern. This may suggest that samples from the locations far from the laboratories were not obtained, hence the suggestion for early aggressive country-wide-large scale testing to cover almost everyone should be started very early before the spread is everywhere. The test labs should cover the whole country with the tests made free and mandatory to encourage and force people to come out for it and the restriction protocols should strictly be adhered to. The borders of the country should be closed early to stop further import of the disease from the high risk countries. When the airports are later re-opened, they should not be to the high-risk countries of the disease. There is also a need for a national policy on responding to and managing any future public health crisis such as Covid-19 pandemic before its occurrence. This policy will help the government to know what to start doing quickly when there is any occurrence. Government should also look inward to mobilize the scientists inside the country by providing research grants purposely to combat the pandemic. Such grants will enable our scientists to make their contribution in addition to the ones made by the scientists outside the country.

Keywords: Covid-19; spread; transportation; economic zones; lockdown, travel behavior; human mobility.

1. INTRODUCTION

The novel coronavirus (2019-nCoV) first case was detected in the city of Wuhan, China [1]. It spread from person to person [2] in the Wuhan City and to the other cities of China. Although the Chinese authorities implemented strict quarantine measures in Wuhan and the surrounding areas, the virus still spread to other regions of the world such as Europe, North America, Asia and Africa [3]. The World Health Organization (WHO) thus declared it a pandemic coronavirus disease 2019 (Covid-19) on March 11, 2020 [4, 5].

The three key symptoms of this disease are continuous cough, fever and loss of smell. The other symptoms are tiredness, muscle pain, body ache, shortness of breath, diarrhoea, confusion, loss of appetite and more. This disease is known to be highly contagious through the respiratory tract, respiratory secretions, mouth and nasal droplets and direct contact [2].

Therefore, the infection can be contracted by not wearing appropriate nose and mouth protective masks in the infected surrounding, not washing hands with soap and disinfecting them with sanitizers and by not maintaining the required social distancing to prevent person to person contact with infected persons [6].

Nigeria is one of the 13 high-risk African countries that WHO identified to be affected by Covid-19 but which had limited resources to cope with it [7]. These countries have direct links or greater number of people travelling to and from China [8].

Nigerians travel a lot to and from China on business purposes and many foreigners similarly travel to Nigeria on business trips. The first index of this disease came into Nigeria for a business purpose on February 24, 2020, from Italy, a high risk country, through the Murtala Mohammed International Airport, Lagos [9]. On the 25th February, he travelled to his company site in Ogun State where he started presenting the symptoms and was finally confirmed an index on the February 27, 2020. Since that time, more cases of Covid-19 had been confirmed in Nigeria, and by March 23, 2020, forty confirmed cases had been recorded.

Some of the infected people from abroad came into the country through the airports and land boundary crossings [10]. They mixed with the local community both in the urban and rural environment, especially through the use of public transportation, taxi and minibus system, and through the use of inter-state transport system. This has necessitated the imposition of transport and movement restrictions in the country in an effort to curb the spread.

In Nigeria, 50% of the trips in the urban centres like: Lagos, FCT Abuja, Port Harcourt, Ibadan, Benin City, Kano and Kaduna are made by using public transport system (buses, mini buses, shared taxis [11]).

1.1 Testing Capacity in Nigeria

Following the reports of Covid-19 in Wuhan, China in December, 2019, the Nigeria Centre for Disease Control (NCDC) promptly initiated measures to strengthen the country's

preparedness for early detection and timely response to the disease. This included the strengthening of the country's diagnostic capacity for testing the disease.

The capacity for quick testing in the country was limited. On March 28, 2020, Nigeria had only five testing laboratories: two in Lagos State, one in FCT Abuja, one in Osun State and one in Edo State [12, 13]. At this time, these laboratories were only available to those who had travelled to the high risk countries or had contact with those that were confirmed or were suspected to have contracted the virus, making the testing frequency to be very low.

1.2 Economic Zones and Movement of Industrialists and Business Men

Economic activities involve actions that lead to production, distribution and consumption of goods and services involved to carry them out. A country's economic activities involve: manufacturing, banking, transportation, agriculture, tourism, trading and distribution of both visible and invisible items [14].

The economic activities can be classified as follows: the primary sector which involves raw materials, the secondary sector which involves conversion of raw materials to finished or semi-finished goods, the tertiary sector which involves services, the quaternary sector which involves knowledge and finally the quinary sector which involves policies and decision making.

The major economic zones in Nigeria are noted for their multi-functions of industry, commerce, trade and tourism. They include the six free trade zones in Lagos State, Ogun State, Delta State and FCT Abuja [15]. The ones noted for trading and commerce are Lagos Municipal in Lagos State, Kano Municipal in Kano State, Onitsha in Anambra State, Ibadan in Oyo State, Aba in Abia State, and Port Harcourt in Rivers State [16].

These areas are highly noted for the exchange of goods and services and also of import and export based goods. They are highly populated and are connected to other areas of the country with good access roads for easy flow of people, goods and services.

1.3 Transportation within Nigeria

The occurrence of Covid-19 in Nigeria was initially concentrated in Lagos (the economic capital of the country), and Ogun State, as

shown in Fig. 1.0. Ogun State is an industrial State adjacent to Lagos State and it uses the Murtala Mohammed International Airport for its connection to its overseas industrial partners. The FCT Abuja (the political capital of Nigeria) later joined in the queue. Contact with the industrial zones is by road and air. Transport service is essential for the success of any industrial activity and this involves the movement of workers, marketers and distributors [11]. The marketers move their products from the factory and the major distributors move theirs to the market centres from where the minor distributors come to buy. Covid -19 can thus be contracted in the movement of people using shared transport system and in the overcrowded market squares where the distancing protocols are not obeyed [17].

The introduction of Covid-19 to Nigeria was by the industrialists and businessmen who travelled from the high risk areas abroad, such as China, Italy, Spain and Germany, to their industries in Nigeria. After infecting people in a community, the disease will continue to spread inside the community through contact to other places by movement of people [18].

1.4 Efforts of the State and Federal Governments to Curb Covid-19

Upon the detection of the first index case, the NCDC activated a multi-sectional National Emergency Operation Centre (EOC) to oversee the national response to Covid-19 occurrence [9]. Subsequently, the Presidential Task Force (PTF) for coronavirus control was inaugurated on March 9, 2020. The PTF immediately announced that travelers from 13 Covid-19 high risk countries had been restricted from entering Nigeria, and the Port Health Services and NCDC started to monitor the self-isolation of returnees from the affected countries from then onward [19].

To curb the spread of Covid-19 therefore, the State and Federal Governments started to take certain decisive actions. From March 18, 2020, the State Governments and the FCT Abuja started the protocol of sensitization and the encouragement of personal hygiene which included hand washing with soap and running water, shutting down of schools and banning of large gatherings. Mallam Aminu Kano International Airport, Kano; Akanu Ibiam International Airport, Enugu; and Port Harcourt International Airport, Omagwa were closed down

effective from March 21, 2020. The Murtala Mohammed International Airport, Lagos and the Nnamdi Azikwe International airport, Abuja were also closed to international flights effective from March 23, 2020. In addition, all domestic flights were suspended on this day.

At the same time, the high risk regions in the country were under lockdown by the Federal Government from March 30, 2020. The citizens of these states were mandated to stay at home. All non-essential businesses were fully closed. The operations of passenger aircrafts, both commercial and private in the country were suspended, but special permits were allowed on needs basis. All seaports remained operational subject to thorough screening of the vehicles and drivers by the Ports Health Authority.

On March 23, 2020, the Borno State Government imposed a four week ban on visitors to the internally displaced camps in the State and set up an isolation centre to prepare for the pandemic response.

The general restriction intervention included: isolation of confirmed index cases, closure of schools and universities, wide scale social distancing, banning of large gathering and both local and national lockdowns.

These efforts were supplemented by similar initiatives by several other States by imposing restrictions on entry into and exit out of the States as well as restrictions on movement within the State. However, these restrictions were not strictly obeyed.

The House of Representatives on March 24, 2020 passed the Emergency Economic Stimulus Bill to provide a 50% tax rebate for employers and business owners who agree not to make staff cuts during the pandemic period.

The aim of this study therefore is to investigate the contribution which the economic zones and movement of people into the country and from city to city and State to State within the country have on the spread of Covid-19 in Nigeria.

2. DATA COLLECTION

The data of Covid-19 in Nigeria used for this study was obtained from the daily update of the Covid-19 occurrence in Nigeria as given by the NCDC Covid-19 Situation Report [9]. Their data collection was done by trained NCDC staff. The infected subjects were identified when they started showing symptoms and they were taken to the nearest test centres where the blood

samples were taken and sent to the laboratory. The age range of subjects that were tested positive were between 30 to 60 years for the males and 30 to 50 years for the females. We assembled the data of the daily update of the Covid-19 occurrence in Nigeria from February 27, 2020 when the first Covid-19 index case was reported in Ogun State as given by the NCDC Covid-19 Situation Report. The date of the first index in each State between February 27, 2020 and March 30, 2020, was compiled. The breakdown of new confirmed cases for each day depending on whether they were from foreign travel, or community contact were also made.

3. RESULTS

Table 1 is divided into Economic Zones in terms of the States that are close to the one containing an international airport as the airport will be feeding all the economic businesses in those States. Thus Lagos State, Ogun State, Oyo State, Osun State and Ekiti State which are close to the Murtala Mohammed International Airport are grouped into the Economic Zone 1;

FCT Abuja, Bauchi State, Kaduna State which are close to the Nnamdi Azikwe International Airport, Abuja are grouped into the Economic Zone 2; and so on .

Table 1 shows the time of arrival of the first index in each State. These States are grouped in terms of their proximity to the State with an international airport in it. It may be seen in Table 1 that the first index in an economic zone is through an international airport. More undetected cases of the disease may still occur in that same State, leading to community contacts and infection. The disease will then spread from that State to the surrounding States. It spreads in the Economic Zone 1 where the international airport is situated in Lagos, from Lagos State to the surrounding States of Ogun, Ekiti, Oyo and Osun; in the Economic Zone 2 where the international airport is situated in the FCT, Abuja, from the FCT to the neighbouring States of Bauchi, Kaduna and Benue; and in the Economic Zone 4, where the international airport is situated in PH, from the Rivers State to Enugu State.

Table 2 shows that international airports contribute immensely to the arrival of new daily index cases in Nigeria. For example, out of the 5 new confirmed index cases of March 18, 4 were located at the airport and out of the 10 new confirmed index cases of March 23, 8 were located at the airport.

Table 1. Date of the first index in a State in Nigeria (February 27 – March 28, 2020)

S/N	Economic zones	State	Date of first appearance	Number of indexes at first appearance	Number with Foreign Travel	Number with Local Travel	Community contact
1		Ogun State	27-02-20	1	1	-	
2		Lagos State	16-03-20	1	1	-	
3	1	Ekiti State	18-03-20	1		1	
4		Oyo State	22-03-20	1		1	
5		Osun State	25-03-20	1		1	
6		FCT Abuja	21-03-20	3	1	2	
7		Bauchi State	24-03-20	1		1	
8	2	Kaduna State	28-03-20	1		1	
9		Benue State	28-03-20	1		1	
10	3	Edo State	23-03-20	1	1		
11	4	Rivers State	25-03-20	1	1		
12		Enugu State	28-03-20	2		2	

Source of data: NCDC COVID-19 Situation Reports [9]

Table 2. Breakdown of daily new confirmed cases of Covid-19 pandemic in Nigeria (February 27-March 23, 2020)

Date (2020)	Cumulative confirmed cases in Nigeria as at date	New confirmed cases as at date	Breakdown of New confirmed cases					
			From airport	From sea port	From land border crossings	Interstate movement	Community contact	Unknown source
Feb 27	1	1	1					
Mar 09	2	1					1	
Mar 16	3	1	1					
Mar 18	7	5	4				1	
Mar 19	12	4	2				1	1
Mar 21	25	3	2				1	
Mar 22	30	5	4				1	
Mar 23	40	10	8				2	

Source of data: NCDC COVID-19 Situation Reports [9]

4. DISCUSSION

The international flight restriction into Nigeria due to Covid-19 as from March 21, 2020 was a welcome one as it prevented more people from the high risk regions of the world from flooding into the country. Table 1 confirms the influence of passengers with foreign travel history on the spread of Covid-19 in the country. The disease got to Ogun and Lagos States before getting to the adjoining States of Oyo, Ekiti, Osun and Edo. It got to FCT Abuja first before getting to its adjoining States of Bauchi, Kaduna and Benue. Similarly, it got to Rivers State through the international airport in Port Harcourt before getting to the adjoining State of Enugu. Further spread of the disease was worsened by the continued operation of the domestic flights up to March 23, 2020, making it possible for the quick spread of the disease to far flung places in the country. This Nigerian experience was supported by the work of Zhao et al. [20] which quantized the association between domestic travel and exportation of Covid-19.

Before the first lockdown of March 30, 2020, people were travelling about and even from State to State, using commercial vehicles without minding the effect of human mobility and domestic travel on Covid-19 [18, 20]. These vehicles were not hindered in any way by the law enforcement officers. Although the open markets in the big cities were under partial lockdown, those in the small towns and villages were open and were unrestricted.

Fig. 1 shows a pictorial view of how Covid-19 was spreading at the beginning of the pandemic in March, 2020 from State to State in Nigeria. The disease first got to Ogun State on February 27 through the Murtala Mohammed International Airport, Ikeja Lagos. By March 18, another index who arrived at the same airport travelled straight to Ekiti State by road. On March 21, another index who arrived by air at the Nnamdi Azikwe International Airport was located at the FCT Abuja.

A similarity may be seen between the map showing the Covid-19 distribution on March 24, 2020 and the map showing the molecular laboratories distribution on the same day. It may be inferred from these two maps that the confirmed index cases were not too far from the

laboratories, suggesting a need to have more laboratories well distributed all over the country. This will help to know how the disease is spreading spatially [21, 22].

The work done in this study is strictly on when Covid-19 got to Nigeria and how it spread from State to State in the early part of the pandemic. The work thus provides a good pedestal for responding to future health emergencies. The report also indicates a need for a national policy on responding to and managing unforeseen public health crisis. The policy will state what needs to be done or put in place to help the management of the disease. The limitation to this policy can only come if the test is not made free and compulsory as any imposed fee will drive people away from the exercise.

From the experience of Covid-19 in many countries and especially in Nigeria, testing to cover a large population at every point of influx and efflux of people is very important to discover how the disease is imported into the community or is spreading in it, as it is possible to contract the disease in transit if Covid-19 protocols are not obeyed.

This brings in the need to provide sufficient testing kits, laboratories and quick training of a large number of health personnel to make this possible. On March 5, 2020, there were only 5 laboratories in Nigeria and on March 28, there were still 5 laboratories in a country of about 200 million people with six international airports operated by the Federal Airports Authority of Nigeria (FAAN) and with some other local airports. In addition, it is also unfortunate that the result of testing always took a long time to come out in a condition of fast spreading disease like Covid-19.

The first drive should be to find a way of making reliable rapid tests by providing very many sufficient test kits and laboratories that can be easily reached to carry out the test within minutes instead of waiting for days for results to be out. This will help in cutting down the response time that medical personnel need to commence treatment. With this, it will be possible to reach a large population and distant communities within a short time. Testing should be made free to encourage people to easily come forward for it.

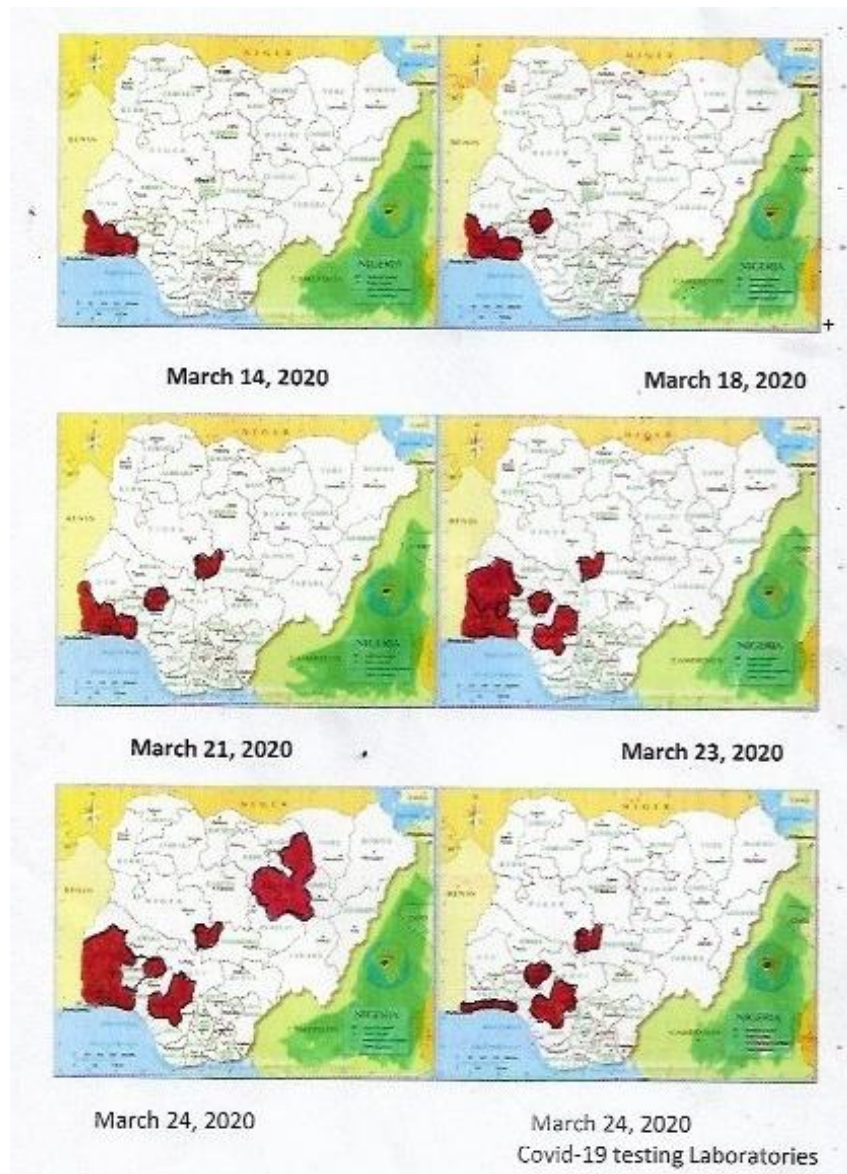


Fig. 1. Map of Nigeria showing confirmed COVID-19 distribution and NCDC Molecular Lab Network in March 2020 (NCDC COVID-19 Situation Reports (NCDC, 2020a))

Key to Fig. 1: The red colour shows the States infected by Covid-19

March 14: Lagos and Ogun States; March 18: Lagos, Ogun and Ekiti States; March 21: Lagos, Ogun, Ekiti States and FCT Abuja; March 23: Lagos, Ogun, Ekiti, Oyo, Osun, Edo States and FCT Abuja; March 24: Lagos, Ogun, Ekiti, Oyo, Osun, Edo, Bauchi States and FCT Abuja. March 24: The red colour shows the 5 molecular laboratory networks in Lagos (2), Abuja (1), Edo (1), Osun (1)

5.CONCLUSIONAND RECOMMENDATION

This study also provides knowledge for curtailing/reducing the spread of the second wave of Covid-19 by understanding how human flow through transportation and human mingling in the economic zones affect the spread of the disease.

The following recommendations are made in case of future occurrence of similar pandemic disease attack.

Aggressive country-wide-large scale test to cover almost everyone should be started very early before the spread is everywhere, to know the regions the disease has reached and the region

it has not reached. Then strict transport restrictions should be enforced for at least two weeks (the period of manifestation of the symptoms) to prevent people from any infected region from travelling to the disease free regions so that the disease free regions can continue to be free from infection.

The tests should be made free and mandatory to encourage and force people to come out for the testing. Any levy of payment will limit the test to those who can afford it. Making it mandatory will cut to minimum those who would go into hiding, to run away from the test. This process is initially expensive, but if it is done, it will preempt the later indirect costs and productivity losses due to hospital admission or quarantine that will later occur.

Visit to high risk countries, especially the economic trade-centres, should be avoided. The closure of the country's borders, airports, especially the international airports should be enforced very early to prevent additional import of the disease from the high risk regions of the world. When the airports are later re-opened, it should be to the countries which are not suffering from the second wave of the pandemic.

The spread of the disease within each community can be better managed by having internal enforcement / monitoring team to monitor the enforcement of the restriction protocols until the disease has totally disappeared.

From this study, it is observed that businesses aid the early spread of Covid-19 via transportation and mingling of customers. It is therefore necessary to see that the transport system obey the covid-19 restriction protocols and that transportation between states and the economic zones are strictly controlled with regard to the protocols.

There is a need for a national policy on responding to and managing unforeseen public health crisis to be on ground before the occurrence of any contagious pandemic disease. This policy will help the government to know what to start doing quickly when there is any occurrence of a pandemic like Covid-19. Government should also look inward to mobilize the scientists inside the country by providing research grants purposely to combat the pandemic. Such grants will enable our scientists to make their contribution in addition to the ones made by the scientists outside the country to curb or solve the pandemic problem.

All these recommendations may be valuable in the future on the occurrence of another pandemic disease.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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