COVID-19 Pandemic and Its Early Transmission Dynamics in Nigeria

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Abstract
The novel coronavirus COVID-19 originally identified in December 2019, based on the data issued by March 30, 2020 daily report, the epidemic of SARS-CoV-2 so far has caused 693224 cases and resulted in 33106 deaths in more than 200 countries. Referring to the data reported, World Health Organization declared the outbreak a pandemic. Several Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2 or COVID-19), showed high transmission capacity and morbidity. In this way, WHO suggests that the most efficient method for controlling transmission is social isolation/quarantine to the population. New cases of the pandemic arose everyday but Nigeria recorded its first death in 23rd March, 2020. The study used a secondary data culled from Worldometer from March 23, 2020 – May 5, 2020. The study examined the polynomial relationship between day and new cases of coronavirus in Nigeria and also check whether new cases will be predicted. Though, linear regression model was fitted to check the model that best fit the data. Result showedthat days had a positive effect on new cases and was found significant at P-value < 0.01 (1% significance level) for both linear and non-linear regression model. It was also revealed that nonlinear regression model best fit the model with an improved adjusted R square. It was established that there is a statistically significant relationship between days and new cases.However, government should take proper measures to reduce the spread of coronavirus and law enforcement the measures should be put into consideration.
Keywords: Coronavirus, relationship, New cases, New death, Model
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1.0`Introduction

The COVID-19 outbreak is highly similar to the severe acute respiratory syndrome (SARS) outbreak that occurred in 2003; both outbreaks were caused by new coronaviruses during time periods overlapping with the Chinese Spring Festival.On December 31, 2019, the Wuhan Municipal Health Committee reported 27 cases of pneumonia with an unknown cause, and many cases were traced to the Wuhan Southern China Seafood Market, which was subsequently closed on January 1, 2020. On January 7, 2020, laboratory tests showed that the pathogen causing the previously unexplained pneumonia was a new type of coronavirus; this pneumonia was then officially named COVID-19 by the World Health Organization. The COVID-19 outbreak started in Wuhan and spread rapidly to other provinces and countries. As of January 30, 2020, a total of 34 provinces and regions in China had reported 9692 cases, and nearly all imported cases were derived from Wuhan in Hubei province. According to the daily report of the World Health Organization, the epidemic of SARS-CoV-2 so far registered 118 319 cases and 4292 deaths to 113 countries that reported by March 11, 2020 and the World Health Organization declared the outbreak a pandemic (https://www.who.int/docs/default-source/coronav)On March 30 reported 693,224 confirmed cases, including 33 106 deaths in more than 200 countries (9). COVID-19 has been defined as a class B infectious disease but has been managed as a class A infectious disease by the Chinese government. Daily case reports are being released, and any omission or concealment is punishable by law. Currently, the number of cases is still increasing, and the epidemic has not yet reached its peak; however, the situation differs from province to province. Information on the temporal and spatial distributions of cases is important for developing targeted treatment and prevention strategies. Because the return peak of Spring Festival travel is approaching, information on the possible changes in the incidence of COVID-19 in different cities will help in better preparation for disease prevention and management.

The spread of COVID-19 is accelerating across the world. In Africa, most countries have now confirmed cases and the number of fatalities is rising. If allowed to spread unmanaged, the impact on African citizens and economies will be substantial. At the time of publication (30 March 2020), cases in Africa remain low compared to other regions. According to the data available, this can be attributed to both the average age of African citizens, which is the lowest globally, and factors relating to the continent's climate – although this has been recently challenged by some experts. However, Africa may yet be worst hit by this invisible disease.

Africa's already fragile health systems, coupled with a high burden of respiratory and diabetic diseases and densely packed urban agglomerations, are likely to increase the vulnerability of the continent and the lethality of the virus. According to DrTedrosAdhanomGhebreyesus of the World Health Organization (WHO), Africa should "wake up" to the COVID-19 threat and prepare for a worst-case scenario. The speed with which countries can detect report and respond to outbreaks can be a reflection of their wider institutional capacity. Epidemics are a reality test for public governance and leadership, not only at country level, but also at regional and continental levels, as well as in connection with the wider network of multilateral actors and partners.

Home to over a billion people, public health systems across the continent will quickly be overwhelmed if the virus takes hold. The COVID-19 pandemic is a wake-up call for improving Africa's still weak health structures and related institutional capacity, such as education, infrastructure or national security. It also highlights the urgent need to strengthen data and statistical capacity, notably in relation to health and civil registration. The paper focuses on the current health landscape and related challenges, while considering the road ahead. COVID-19's global outreach will have a huge economic and wider impact on the entire African continent. Occurring later, it will isolate Africa from recovering other regions. On the continent, the pandemic will wideninequalities within and between countries, worsen already existing fragilities, restrict employment and investment prospects, and potentially fuel additional domestic unrest and conflicts. This requires immediate attention, and calls for adequate, coordinated responses.

2.0 Review of Related Literature

Statistical analysis, embracing modelling, parameter estimation, hypothesis testing and the design of studies, plays an essential role in connecting the gap between the mathematical theory and public health practice, and it is this aspect that motivates the present discussion. In other words, the world attempts to promote the use of statistical analyses that provide practical insight and guidance for the disease control, with emphasis on identifying issues that have not been addressed sufficiently (12).BrhaneBerhe*et al* (2020). They identified 360 records, of which 50 studies met the inclusion criteria [2]. They synthesized the data from the included records and dig out the deep insights of them and pooled into this review. The burden of the outbreak is worsening due to overcrowding, presence of asymptomatic carriers, scarcity of test kits, the immune escaping ability of the virus and lack of awareness. Due to the fast-spreading nature of COVID-19 the prevention and control strategies become challenging. It is imposing social, psychological, and socio-economic impacts. We recommended that following social distancing, isolation suspects, using personal protective equipment, health education and introducing hand-washing practices, avoiding contact with animals, vaccine development and treatment for controlling and prevention.Xiao-li Xiong*et al* (2020), revealed that 34 out of 193 symptomatic children had GI symptoms. They had lower median age and weight, a higher rate of fever, a longer length of stay and morehematological and biochemical abnormalities than patients without GI symptoms. There was no significant difference in chest CT findings or stool SARS-CoV-2 test positive percentages between the two groups. The number of patients admitted with GI symptoms showed an overall downward trend with time. At the time of writing, 242 patients were discharged, one died, and one critically ill patient was still in the intensive care unit[1]. COVID-19 infected children with GI symptoms are prone to presenting with more clinical and laboratory abnormalities than patients without GI symptoms. More attention and timely hospital admission are needed for these patients.Patients with COVID-19 with co-morbid neurological diseases had an advanced age, a high rate of severe illness, and a high mortality rate. Among the neurological symptoms, altered mental status was more common in patients withsevere COVID-19 with co-morbid neurological diseases.

Governments are rapidly mobilizing to minimize transmission of coronavirus disease 2019 (COVID-19) through social distancing and travel restrictions to reduce fatalities and outstripping of healthcare capacity. The pandemic's progression and impact are strongly related to the demographic composition of the population, specifically, population age structure. Demographic science can provide new insights into how the pandemic may unfold and the intensity and type of measures needed to slow it down. Currently, COVID-19 mortality risk is highly concentrated at older ages, particularly those aged 80+ y. In China, case fatality rate (CFR) estimates range from 0.4% for those 40 y to 49 y jumping to 14.8% for those 65+ y (1). This age pattern has been even more stark in Italy, where, as of March 30, 2020, the reported CFR is 0.7% for those 40 y to 49+ y, and 27.7% for those >65 y, with 96.9% of deaths occurring in those aged 60+ y and over (3). Current CFRs are likely overestimated due to underascertainment of cases. In South Korea, with broader testing and strong health care capacity (only 158 deaths), the current CFR for those 80+ y is still an alarming 18.31% (5) Population age structure may explain the remarkable variation in fatalities across countries and the vulnerability of Italy. Many Nigerian prefer to live close to the extended family Intergenerational interactions, co-residence, and commuting may have accelerated the outbreak in Nigeria through social networks that increased the proximity of elderly to initial cases.

The age structure of initial cases, along with early detection and treatment, likely explains the low numbers of fatalities in South Korea and Germany. The Korean outbreak was concentrated among the young Shincheonji religious group (5), with only 4.5% of cases thus far falling into the >80-y group (10). This contributed to a low overall CFR in South Korea relative to Italy (1.6% vs. 10.6%). Germany has, likewise, few deaths (583 out of

61,923 cases to date), with the median age of confirmed cases at 48 y compared to 62 y in Italy (9). COVID-19 transmission chains that begin in younger populations may go undetected longer (10), with countries slow to raise the alarm. The initial low CFR in England may have reflected the relatively young age structure of early infections, including Greater London, which has a small fraction of residents over 65 y compared to more rural areas (11). COVID-19 was only detected in King County, WA, once it reached the Life Care Center in Kirkland, where 19 out of 22 of the state's first reported COVID-19 deaths occurred, with virus genetic sequence estimates suggesting it circulated for several weeks prior (14). Once community transmission is established, countries with high intergenerational contacts may see faster transmissions to high-fatality age groups, as seen in Italy and Spain, leading to higher average CFR (15). The overall burden of serious cases and mortality reflects linkages between the age distribution of early cases, age structure of the population, and intergenerational connections.

Demographically informed projections will better predict the COVID-19 burden and inform governments. While population age structure is crucial for understanding those at the highest risk of mortality both across and within countries[1], it is also vital for understanding social distancing measures to reduce critical cases that overload the health system—aka "flattening the curve." Our investigations show that countries with older populations must take aggressive protective measures. For these to be effective, special attention should be devoted to high-risk population groups and intergenerational contact. Within countries, mapping of age-related spatial clustering can improve hospital and critical care forecasts (157). Consideration of population age structure also necessitates understanding the interlink age of policy measures and how policies might create unintended consequences. While schools may be a hub of virus transmission, school closures may inadvertently bring grandparents and children into contact if grandparents become the default careers[2]. In aged populations with close intergenerational ties, governments need to facilitate childcare solutions that reduce contact. In a pending decree, the Italian government introduced a special leave for parents with children at home from school, and a voucher for babysitting.

The age structure of populations also suggests that the squeezed "sandwich" generation of adults who care for both the old and young are important for mitigating transmission. Beyond introducing sick pay for those who need to self-isolate or care for family members, joint government and industry emergency policy measures should seek to counter family economic crises, particularly for vulnerable and precarious workers who are less able to comply with policies that allow social distancing. The rapid spread of COVID-19 has revealed the need to understand how population dynamics interact with pandemics[1]. Population aging is currently more pronounced in wealthier countries, which, mercifully, may lessen the impact of this pandemic in lower-income countries with weaker health systems but younger age structures. It is plausible that poor general health status and co-infections such as HIV and tuberculosis will increase the danger of COVID-19 in these countries, along with intergenerational proximity and challenges to physical distancing. Thus far, the lower than expected number of cases detected in Africa (despite extensive trade and travel links with China) suggests that the young age structure may be protective of severe and thus detectable cases[16]. Beyond age structure, demography can shed light on the large sex differences in COVID-19 mortality that need to be understood—with men at higher risk. Distributions of underlying comorbidities such as diabetes, hypertension, and chronic obstructive pulmonary disease will likewise refine risk estimates. Until more data are available, the concentration of mortality risk in the oldest old ages remains one of the best tools to predict the burden of critical cases and produce more precise planning of availability of hospital beds, staff, and other resources. Few countries are routinely releasing their COVID-19 data with key demographic information such age, sex, or comorbidities.

3.0 Material and Method.

Data Source.

The new cases and new death cases used was obtained from worldometer from 23 March, 2020 – 5 May, 2020. Worldometer is organized by international team of developers, researchers and volunteers who aim is to make data available worldwide. The site is published and managed by digit media company in the United State of America. it is rated by American Library Association as one of the best free reference website.

Statistical Model.

Polynomial regression is a special case of linear regression. Linear regression is a polynomial regression of degree 1. New cases on coronavirus were fitted based on polynomial equation with a curvilinear regression. The data established the relationship between new cases and the time of occurrence (days). The regression analysis is modelled at nth days. That is,

$$\begin{bmatrix} new\ cases_1 \\ \vdots \\ new\ cases_n \end{bmatrix} = \begin{bmatrix} 1 & day_1 \ldots & day_1^m \\ \vdots & \vdots \quad \ddots & \vdots \\ 1 & day_n \ldots & day_n^m \end{bmatrix} \begin{bmatrix} \beta_o \\ \vdots \\ \beta_n \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \vdots \\ \varepsilon_n \end{bmatrix};$$

where new $cases_1$ indicates the cases of coronavirus recorded as at March 23, 2020 when death was recorded on coronavirus in Nigeria;

New $cases_n$ indicates the cases of coronavirus as at May 5, 2020.
day is the regarded as the time (t);
$\beta_0, \beta_1, \ldots, \beta_n$ is the coefficient of the number of days
$\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_n$ is the error tern or the random error.
Also, the linear regression of the new cases of coronavirus is thus model as;

$$new\ cases = constant + \beta days(t) + \varepsilon_i$$

New case(s) is referred to as the dependent variable; days is referred to as the independent variable at time t; β is the coefficient of the independent variable (days(t)) and ε is the random error or error term.

4.0 Results

The graphical representation of new cases and death of coronavirus in Nigeria is shown in Figure 1. The graph showed an increase in the pandemic from March 23, 2020 when Nigeria recorded first death. In March 13, 2020, Nigeria recorded the first death of coronavirus in Nigeria. The graph shows that the number of patients in march 23, 2020 was higher than that of 24. The result shows a variation in the number of patients (that is, the new cases discovered from March 23, 2020 – 05/05/2020). In May 4, 2020, Nigeria recorded has highest number of new cases than ever and the cases decreases in may 5, 2020. Result also revealed that the number of new deaths in Nigeria remain constant for over days from March 23, 2020 – April 22, 2020. This is as a result of one (1) death being recorded every day. In May 2, 2020, Nigeria recorded highest number of deaths when compared with the former death being recorded. Though there has been an increase in the number if death from April 23, 2020. Thus, May 3, 2020 showed a decrease in thenumber of new deaths in Nigeria till may 5, 2020. Similar result was shown in Figure 2, 3 and 4. However, result showed in Figure 4 showed a spiral presentation of the graph. It shows an increase in the new cases over time and new death was stable over time. Moreover, a little increase occurred in the new death from may 2, 2020.

Table 1 presents the result of the box plots which include the minimum, 1st quartile, median, 3rd quartile and maximum. The summary of the fitted linear and loglinear model of residual was shown in Table 1. It was shown that loglinear model had the lowest minimum value of -1.76699; 1st quartile of -0.35940; median (-0.00118); 3rd quartile (0.43807) and maximum (1.23418) when compared with fitted linear model. It was shown that the log of the newcases was normally distributed when compared with the fitted linear model.

Result from Table 2 explored the relationship the new cases and the days at time (t) using polynomial regression analysis. The adjusted R squared revealed that 72% of the days are explained in newcases which indicates the proportion days being explained in the model fitted. The result intends to predict the new cases that might occur as the time increases. Result of the model showed that days had a positive effect on new cases with the coefficient of (4.8241). Days was found to be significant at 1% significance level (approximately 99% confidence level). This indicates that as the days increase coronavirus pandemic will also increase in Nigeria with a standard error of 0.4565. The null hypothesis states that there is no statistically significant relationship between day(s) and new cases was reject at P-value < 0.01 (1% level of significance). This implied that there was a statistically significant relationship between days and new cases. Also, it is revealed that days predicted the likely cases that might occur in Nigeria as the time occur in Nigeria. Model 1 showed the prediction of the fitted linear regression for new cases of coronavirus.

Model 1: $\hat{y} = 4.8241(t) - 41.7323$; where $\hat{y}$ is the estimated new cases.

Log linear regression model is also used as part of the polynomial regression to establish the relationship and predict the new cases of coronavirus in Nigeria as shown in Table 3. Result of the log linear model revealed that 77% of the days (represented with time t) is being explained in the new cases. This showed the proportion or total variance of days being explained in new cases. The findings revealed that days show a positive effect on the new cases and it is significant (P-value = 1.42e-15 ***) with an estimated coefficient of (0.086095). The null hypothesis of the model was tested and the result showed that there is a statistically significant relationship between days and new cases. Also, log linear model predicted the new cases that might occur in Nigeria as shown in Model 2.

Model 2a: $\exp(\hat{y}) = 0.086095(t) + 1.568430$
The log transformation is given as:
Model 2b: $\hat{y} = 1.08991(t) + 4.799108$; where $\hat{y}$ is the estimated new cases.

Comparing the model fitted with linear and non-linear regression model using an adjusted r square, result showed that non-linear regression model showed a good fit of the response variable (new cases). The graphical representation of the good fit is shown in Figure 5

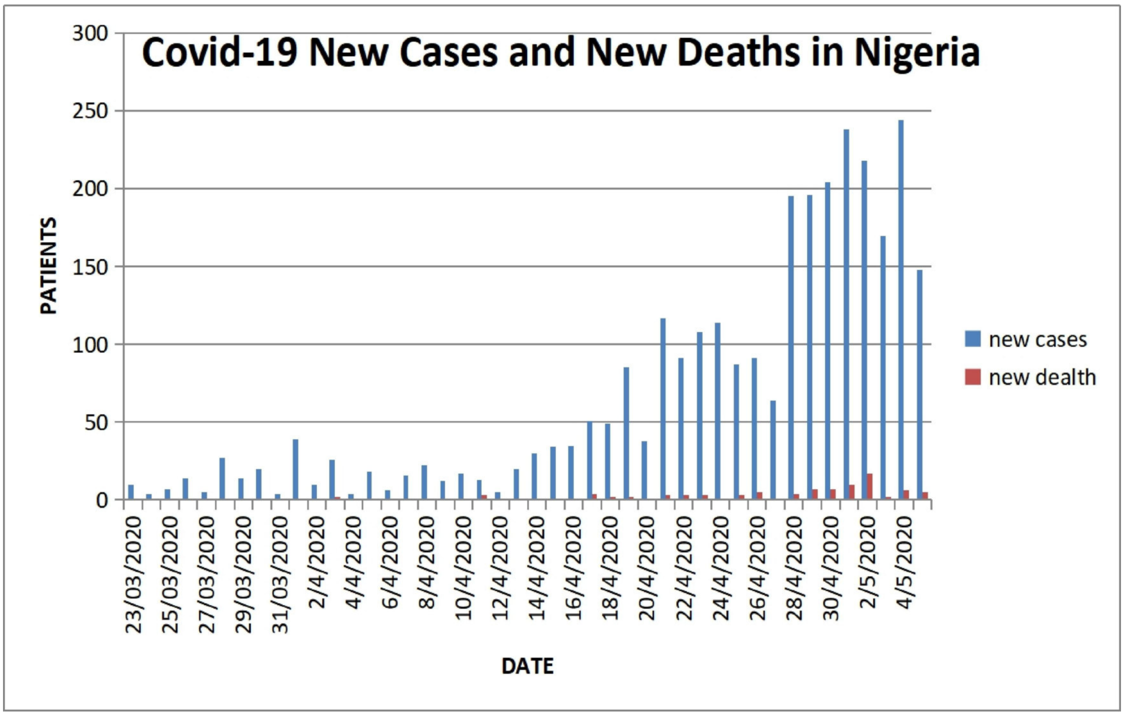

Figure 1: Covid'19 New cases and New death in Nigeria

From fig 1 above, we can deduce that new cases are increasing with time and new death is relative low.

Table 1: Box Plot Analysis

	Minimum	(1Q, 3Q)	Median	Maximum
Fitted Linear regression	-67.936	(-33,102, 32.491)	-4.639	86.768
Loglinear regression model	-1.76699	(-0.35940, 0.43807)	-0.00118	1.23418

Table 2: Fitted Linear Regression

	Estimate	Std.Error	t-value	Pr(>|t|)
Intercept	-41.7323	12.0586	-3.461	0.00123**
Days	4.8241	0.4565	10.567	1.58e-13 ***
Residual Standard error	39.77			
Multiple R-squared	0.722		Adjusted R-squared	0.7155
F-statistic	111.7		P-value	1.577e-13
DF	(1,43)			

Table 2: Loglinear Regression Model

	Estimate	Std.Error	t-value	Pr(>|t|)
Intercept	1.568430	0.186172	8.425	1.20e-10 ***
Days	0.086095	0.007048	12.215	1.42e-15 ***
Residual Standard error	0.6141			
Multiple R-squared	0.7763		Adjusted R-squared	0.7711
F-statistic	149.2		P-value	1.424e-15***
DF	(1,43)			

Where *** indicates P-value < 0.01 (1% level of significance), ** indicates P-value < 0.05 (5% level of significance and P-value – probability value.

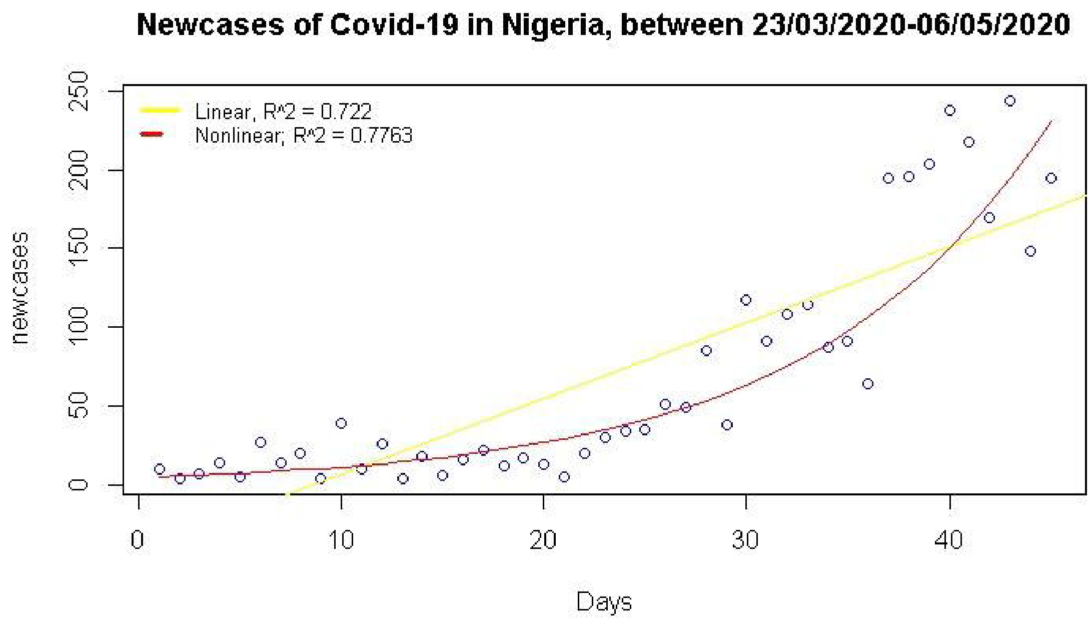

Figure 2: Linear and non-linear of new cases of coronavirus pandemic

From fig 2 above, we can say that there is an upward trend in the number of new cases of Covid-19 with advancing in days (Time) and Non-linear model captures the dynamic pattern of the diseases relatively well (R^2 =78%) as compared to Linear model (R^2 =72%)

5.0 CONCLUSION

Two different models were used to established the relationship. The two model found a significant relationship between new cases and days (measured at time t) recorded in Nigeria. Several measures have been observed to reduce the disease pandemic worldwide. This study examines the effect of days (time) on new cases. It was found that days (time)had a positive effect on the new cases. The longer the epidemic is withheld the greater will be the catastrophe, provided that the population continues to increase, and the threshold density remains unchanged. Such a prolonged delay may lead to almost complete extinction of the population. As time increases in Nigeria, new cases of Covid'19 increases and new death also increases meaning that proper measures had to be taken in other to reduce the rate of corona virus in Nigeria. The governments and health facilities should work together and also ensure that any patient visiting the hospital should be test on covid'19. People should take a proper measure by washing their hands, covering their nose, avoid contact with the available affect person and government should be more active on contact tracing.

References

1. Akomolafe A.A., Awogbemi C.A. ; Oladimeji A.O. ;Akomolafe M.A. and Yusuf T.O. (2020). Covid-19 Pandemic and its Economic Shocks in Nigeria. Researcher Vol. 12(6), 66-77. ISSN 1553-9865(Print) ISSN 2163-8950(Online)
2. Adejumo, T.J., Akomolafe A.A., Owolabi, A.T., OIadapo, O.J., Idowu, J.I. and Gbolagade S.D (2020): Modelling Fertility Rate of Covid-19 in Nigeria using Multiple Linear Regression Analysis. Global Scientific Journal 8(8), 439-448.
3. Morens DM, Folkers GK, Fauci AS. The challenge of emerging and re-emerging infectious diseases. Nature 2004;430:242–249. doi: 10.1038/nature02759. [PMC free article] [PubMed] [Google Scholar]
5. Suwantarat N, Apisarnthanarak A. Risks to healthcare workers with emerging diseases:lessons from MERS-CoV, Ebola, SARS, and avian flu. CurrOpin Infect Dis 2015;28:349–361. [PubMed] [Google Scholar]
6. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020;382:727–733. doi: 10.1056/NEJMoa2001017. [PMC free article] [PubMed] [Google Scholar]
7. Carlos WG, Dela Cruz CS, Cao B, Pasnick S, Jamil S. Novel Wuhan (2019-nCoV)coronavirus. Am J RespirCrit Care Med 2020;201:7–8. doi: 10.1164/rccm.2014P7. [PubMed] [Google Scholar]
8. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early transmission dynamics in Wuhan, China, of novel

coronavirus-infected pneumonia. N Engl J Med 2020. doi: 10.1056/NEJMoa2001316 [Epub ahead of print]. [PMC free article] [PubMed] [Google Scholar]
9.A. Salmon , *Why are Korea's COVID-19 death rates so low? Asia Times, 11 March 2020.https://asiatimes.com/2020/03/why-are-koreas-covid-19-death-rates-so-low/. Accessed 23 March 2020.*
10. Mossong et al., *Social contacts and mixing patterns relevant to the spread of infectious diseases. PLoS Med. 5, e74 (2008).*O penUrlCrossRefPubMedGoogle Scholar
11. Arbana, S., Jafet, M., Drita, K., Arben, S. &Albulena, S. (n.d.). Types of financial crisis. *Asian Journal of Business and Management Sciences* Vol. 2, No. 12 (31-39) ISSN 2047-2528
12. Borge, B. (2020). Great recession showed countries can't fight the coronavirus economic crisis alone. April 3, 2020. Retrieved from www.weforum.org
13. Carlsson-Slezak, P., Reeves, M., & Swartz, P. (2020). Understanding the economic shock of coronavirus. *Harvard Business Review* March 27, 2020. Retrieved from www.hbr.org
14. Coulton, B. (ed.) (2020). Deep global recession in 2020 as coronavirus crisis escalates. *Fitch Ratings,* April 2, retrieved from www.fitchratings.com
15. Greg, C. (2009). Recession, recovery and reinvestment: The role of local economic leadership in a global crisis. *OECD*
16. Jiri, M., & Elena, M. (2013). The evaluation of economic recession Magnitude introduction and application. *Prague economic papers*, 2. DOI 10.1826/jpep.447
17. National Bureau of Statistic Nigeria (2016). GDP Q22016finalreport26-08-2016.pf. Abuja
18. Ogungbola O. O., **Akomolafe A. A,** and Musa Z. A: Accelerated Failure Time Model with Application to Data on Tuberculosis/HIV co-infected Patients in Nigeria(2018) . *American Journal of Epidemiology and Public Health* 1, 21-26.
19 . Paulus, Z. (2011). The impact of global recession on developing countries. Pontification Academy of Social sciences, Acta 16.
20. Sebastian, D., Detlef, J. K., Alejandro, M. & Jan, P. (2010). *The financial and economic crisis of 2008-2009 and developing countries*, United Nations NY and Geneva.
21. Shambaugh, J. (2020). We are already in a recession: Can we make it a short one? *Brookings,* April 3, retrieved from www.brookings.edu
22. Wen-jen (2011). The Global Economic Recession and Industrial Structure : Evidence from four Asian Dragons. *ADBI working paper* series No 315.

Appendix

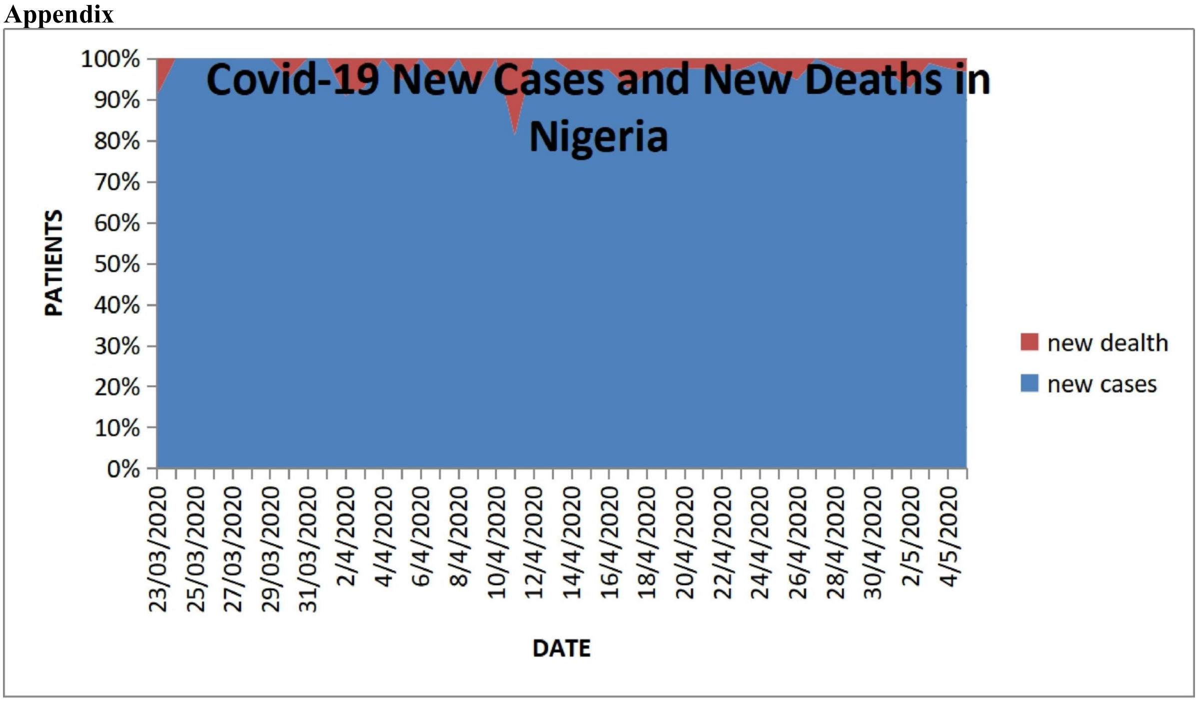

Figure 3: Percentage distribution of new cases and new death in Nigeria

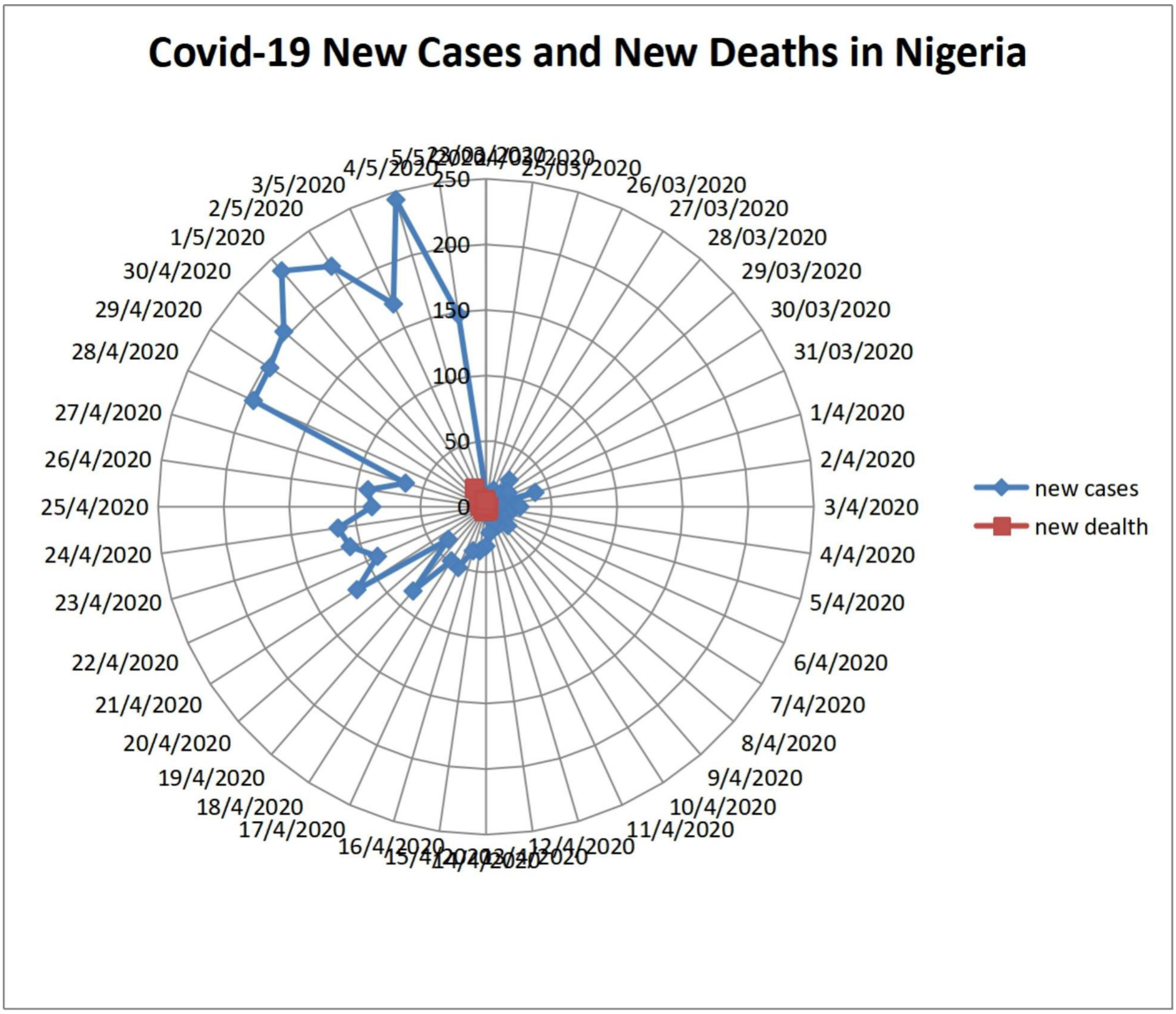

Figure 4: Sporadic fluctuation of new cases and new death(s) in Nigeria.