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Trend and Epidemiological Analysis of Coronavirus in Nigeria

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Abstract: Nigeria is the most populous country in Africa and it's among the countries where the novel corona virus is highly endemic. World Health Organization listed Nigeria among other 13 African countries identified as high-risk for the spread of the virus. Hence the need to observe the six geopolitical zones in Nigeria, in other to study the trend of the virus and also look at some the epidemiological measures based on the case records of adult patients above 16 years with Corona virus admitted between February 2020 and February 2021. The research work tries to analyze the epidemiological measures of the COVID-19 using the Case Fatality Rate (CFR), Infection Fatality Rate (IFR), Mortality Rate (MR) and Incidence Rate (IR) and also to analyze the trend of death across the six geopolitical zones in Nigeria. The analysis of the epidemiological measure shows a wide variation in CFR among the six geopolitical zones, it's an indication that it disproportionately affected states like Lagos and Abuja which are the most affluent. The result from IFR shows that the North-East has the highest infection rate at 4.88% while South-West has the least at 1.53%. MR shows south west with the highest population and highest death recorded of 11% while south-East has the lowest death rate. The incidence rate was lowest in North-East at 2.3% and highest in the South-West at 18.93%, studying this incidence rate of the six geopolitical zone one can conclude that the occupation and the economic activities of the zones really influenced the rates. The trend analysis of death across the six zones shows the South East has a perfect fitted polynomial series of order four model.

Keywords: Trend Analysis, Case Fatality Rate, Infection Fatality Rate, Mortality Rate and Incidence Rate

1. Introduction

Nigeria is among the countries where the novel corona virus is highly endemic. According to World Health Organisation (WHO) factsheet, in 2020 corona virus is a serious public health problem in the world as it leads to significant mortality and residual neurological sequelae. Human coronaviruses (HCoV) which cause gastrointestinal and respiratory tract infections were first introduced by the discovery of HCoV□ 229E and HCoV□OC43, from the nasal cavities of human patients with the common cold, in the 1960s [13]. On 31th of January 2020, following the developments of COVID-19 pandemic in mainland China and other countries worldwide including the federal government of Nigeria set up a Coronavirus preparedness Group to mitigate the impact of the virus if it eventually spreads to their countries. On the same day, the World Health Organization listed Nigeria among other 13 African countries identified as high-risk for the spread of the virus. Zubaida, H. et al (2020) Carried a study and found out that low BCG vaccine coverage correlated with higher COVID-19 mortality. This was further supported by the observation that high TB prevalence correlated with higher COVID-19 mortality. However, these associations were weak. [7] In her study on survival of COVID-19 patients in rivers state, Nigeria concluded that fever, comorbidity, and anosmia are the major factors that affect the survival time of COVID-19 patients in Rivers State, Nigeria. The age groups most affected by COVID-19 in Nigeria, as of June 30th 2020, were 21-50 years with a peak infection among 31-40 years [6]. [12] In their work on Exploring the emerging COVID-19 research trends and current status in the field of education, the study indicated that the majority of scientific studies on COVID-19 are focused on the field of health, and that there is limited

edition research on COVID-19-related education. Zhao, S. et al (2020) [14] Studied the estimation of exponential growth rate and basic reproduction number of the coronavirus disease 2019 (COVID-19) in Africa. The study shows that the exponential growth fitted and the trend analysis indicated a significant decrease for all variables. [11] In their investigation of the emerging COVID-19 research trends in the field of business and management, this study suggest that COVID-19 will be the catalyst of several long- and short-term policy changes and requires the theoretical and empirical attention of researchers. Trend analysis is a methodology that can be used to detect the presence of a change or any form of fluctuations over time. [5] In their research work stated that regression modeling is another tool to assess time trends. It enables modeling the effect of influential factors and it can easily deal with outliers, missing observations and irregular measure patterns. [1] In their research using the daily precipitation data obtained from five gauging stations to find the trend and prediction of precipitation for water deficit area of Wadi Shueib catchment in Jordan, from the results the future trend shows that the high level (heavy rain) is decreasing at all stations and low level (normal rain) is increasing, except in the month of December, which shows an increasing trend. The aim of the research is to find out the trend and epidemiological analysis of covid-19 cases in Nigeria, based on the six geographical zones.

2. Epidemiological Measures

Epidemiology is the study of the determinants, distribution, and frequency of health-related events and processes (i.e., disease, injuries, disability, and mortality) within defined populations. Therefore, epidemiological measurement is the process of collecting data relevant to events of interest and the application of epidemiology-specific tools to the collected data [2]. Some of the epidemiological measures include; Case Fatality Rate, infection fatality rate, Mortality rate and Incidence rate. [9] In their study, used a purely data-driven statistical method to estimate the Case Fatality Rate (CFR) in the early phase of the COVID-19 outbreak. Their early stage estimates suggest that the CFR of COVID-19 is lower than the previous coronavirus epidemics caused by SARS-COV and Middle East respiratory syndrome coronavirus (MERS-COV). John P. A. I (2020) [4] tried to estimate the infection fatality rate of coronavirus disease 2019 (COVID-19) from seroprevalence data and he concluded that the infection fatality rate of COVID-19 can vary substantially across different locations and this may reflect differences in population age structure and case-mix of infected and deceased patients and other factors. The inferred infection fatality rates tended to be much lower than estimates made earlier in the pandemic.

2.1. Case Fatality Rate (CFR)

As defined by Centers of Diseases Control and Prevention (CDC), Case fatality rate (CFR) is the proportion of the number of deaths divided by the number of confirmed patients of a disease, which has been used to assess and compare the severity of the epidemic between countries and regions. The case fatality rate is given by

$$\text{CFR} = \frac{Reported\ Covid{-}19\ DEATHS}{Reported\ death\ cases{+}recovered\ cases{=}CONFIRMED\ CASES}\ X\ 100 \quad (1)$$

2.2. Infection Fatality Rate (IFR)

The infection fatality rate is estimated based on reported deaths and serologically inferred infections. It is the risk of death per infection and it is one of the most important epidemiological parameters. To estimate IFR the number of deaths and the actually number of infected individuals are needed [3].

$$\text{IFR} = \frac{DEATH}{ACTUAL\ NUMBER\ OF\ INFECTED\ INDIVIDUAL}\ X\ 100 \quad (2)$$

Looking at the equation 3.1 and 3.2 one might ask what is the difference between case fatality rate and infection fatality rate, we need to understand that case fatality rate (CFR) is the ratio of the number of deaths divided by the number of confirmed case of disease. Infection fatality rate is the ratio of deaths divided by the number of actual infections not just confirmed cases of SARS-CoV-2.

2.3. Mortality Rate (MR)

Mortality is related to the number of deaths caused by the health event under investigation. It can be communicated as a rate or as an absolute number. Mortality usually gets represented as a rate per 1000 individuals, also called the death rate. The calculation for this rate is to divide the number of deaths in a given time for a given population by the total population. To keep these values concise and for ease of comparison to other health events, this number can be multiplied by 1000 to reflect the "per 1000" rate of the target population.

Mathematically,

$$\text{Mortality Rate (MR) is given by} = \frac{DEATH}{TARGETED\ POPULATION}\ X\ 10^n \quad (3)$$

2.4. Incidence Rate (IR)

The term incidence rate refers to the rate at which a new event occurs over a specified period of time. Put simply, the incidence rate is the number of new cases within a time period (the numerator) as a proportion of the number of people at risk for the disease (the denominator). This measure is commonly used in epidemiology as a way to denote the occurrence of disease, illness, or accident. This rate only uses new cases rather than previously diagnosed or reported ones. It can also be used to determine the probability of other events, such as financial phenomena like foreclosures. The incidence rate helps experts anticipate future incidents and make plans accordingly. The incidence rate measures how often an event, such as disease or foreclosure, is likely to occur over a particular period of time.

Mathematically,

$$\text{Incidence Rate is given by } \frac{CONFIMED\ CASES}{ESTIMATED\ POPULATION\ OF\ EACH\ STATE}\ X\ 10^n \quad (4)$$

3. Trend Analysis

Trend analysis is a statistical procedure performed to evaluate hypothesized linear and nonlinear relationships between quantitative variables. Typically, it is implemented either as an analysis of variance (ANOVA) for quantitative variables or as a regression analysis. It is commonly used in situations when data have been collected over time or at different levels of a variable. In particular, the means of a dependent variable are observed across conditions, levels, or points of the independent variable to statistically determine the form, shape, or trend of such relationship. Trend analysis is, fundamentally, a method for understanding how and why things have changed or will change over time [8]. Dwilson D. S. (2019) explained that trend forecasting is a forecasting based on tangible, concrete numbers from the past. It typically plots the numbers with the horizontal x-axis being used to plot time, such as the year, and the y-data being used to plot the information you are trying to predict. We also tried to fit four different models to that data in other to determine the model that fits the data very well. The four models investigated are:

$$\text{Linear Trend: } Y_i = a_0 + a_1 t \quad (5)$$

$$\text{Quadratic Trend: } Y_i = a_0 + a_1 t + + a_2 t^2 \quad (6)$$

$$\text{Cubic Trend: } Y_i = a_0 + a_1 t + a_2 t^2 + a_3 t^3 \quad (7)$$

$$\text{Polynomial: } Y_i = a_0 + a_1 t + a_2 t^2 + \ldots + a_k t^k \quad (8)$$

Where Y is response and t is the time period.

4. Methodology

This chapter presents the methods and procedure that was adopted in the study. The data used in this research are case records of adult patients (age ≥ 16 years) with Corona virus admitted between February 2020 and February 2021 in the six geopolitical zones in Nigeria namely North Central, North West, North East, South East, South West and South South. The factors considered in the analysis are epidemiological measures of Case Fatality Rate (CFR) as given in equation (1), Infection Fatality Rate (IFR) as given in equation (2), Mortality Rate (MR) as given in equation (3) and Incidence Rate (IR) as given in equation (4). Trend analysis was applied to see the trend in which deaths from COVID-19 follow over time in the six zones considered and also to obtain the model that best shows this trend. In the application of trend analysis we considered four different models; linear, quadratic, cubic and polynomial trend as stated in equations (5), (6), (7) and (8), where Y is the number of deaths and t is the time.

5. Results

Table 1 shows a wide variations in CFR of COVID-19 among the six geopolitical zones in Nigeria and this could be attributed to the age structure of the zones, larger proportion of young confirmed cases, by the way time lags are handled and also the differing quality of care or interventions being introduced at different stages of the illness in these zones. It also shows that the least CFR was recorded in the South-East zone with a percentage rate of 2.34% in the country (90 deaths out of 4013 confirmed cases) as at September, 2020. The severity of the disease was very high in the North-East zone with a percentage rate of 5.25% (134 deaths out of 2745 confirmed cases) compared to other zones, the South-West has CFR of 3.75%, followed by South-South with 3.69%, 3.59% and 2.94% respectively for North-West and the North-Central. Generally the confirm cases affected the entire six geopolitical since the case fatality across the zones is greater than 1.00%.

Table 1. *Case Fatality Rate.*

North Central	Death	Recovery cases	Death + Recovery case	$\frac{Death}{Death+Recovery}$ in fraction	* 100
Niger	12	229	241	0.049792531	4.979253112
Kwara	30	835	865	0.034682081	3.468208092
Kogi	2	3	5	0.4	40
Benue	10	413	423	0.023640662	2.364066194
Plateau	31	2471	2502	0.012390088	1.239008793
Nasarawa	14	376	390	0.035897436	3.58974359
FCT	86	1780	1866	0.046087889	4.608788853
North Central CFR	185	6107	6292	0.02940241577	2.94
North East					
Bauchi	14	657	671	0.020864382	2.086438152
Borno	65	680	745	0.087248322	8.724832215
Taraba	6	89	95	0.063157895	6.315789474
Adamawa	17	186	203	0.083743842	8.374384236
Gombe	24	753	777	0.030888031	3.088803089
Yobe	8	50	58	0.137931034	13.79310345
NORTH East CFR	134	2415	2549	0.05256964	5.25696352
North West					

North Central	Death	Recovery cases	Death + Recovery case	$\frac{Death}{Death+Recovery}$ in fraction	* 100
Zamfara	10	73	83	0.120481928	12.04819277
Sokoto	37	131	168	0.220238095	22.02380952
Kaduna	44	2314	2358	0.018659881	1.865988126
Kebbi	9	84	93	0.096774194	9.677419355
Katsina	28	841	869	0.032220944	3.222094361
Kano	58	1648	1706	0.033997655	3.399765533
Jigawa	15	299	314	0.047770701	4.777070064
North West CFR	201	5390	5591	0.03595063	3.59506349
South East					
Enugu	21	1143	1164	0.018041237	1.804123711
Imo	12	529	541	0.022181146	2.218114603
Ebonyi	30	1007	1037	0.028929605	2.892960463
Abia	8	882	890	0.008988764	0.898876404
Anambra	19	181	200	0.095	9.5
South East CFR	90	3742	3832	0.02348643	2.34864301
South South					
Edo	105	2458	2563	0.040967616	4.096761607
Bayelsa	22	373	395	0.055696203	5.569620253
Akwa Ibom	17	274	291	0.058419244	5.841924399
Rivers	69	2213	2282	0.030236635	3.023663453
C/Rivers	8	71	79	0.101265823	10.12658228
Delta	52	1727	1779	0.029229904	2.922990444
South-South CFR	273	7116	7389	0.03694681	3.69468128
South West					
Oyo	50	2284	2334	0.021422451	2.142245073
Ekiti	11	303	314	0.035031847	3.503184713
Osun	32	755	787	0.040660737	4.066073698
Ondo	35	1540	1575	0.022222222	2.222222222
Lagos	258	4304	4562	0.056554143	5.655414292
Ogun	33	1708	1741	0.018954624	1.895462378
South-West CFR	419	10894	11313	0.03703704	3.7037037

Table 2. *Infection fatality rate.*

North Central	Death	Number of confirmed cases	$\frac{Death}{Nuber\ of\ confirmed\ cases}$	$\frac{Death}{Number\ of\ confirmed\ cases}$x100
Niger	12	259	0.04633205	4.633205
Kwara	30	1036	0.02895753	2.895753
Kogi	2	4	0.5	50
Benue	10	472	0.02118644	2.118644
Plateau	31	3268	0.00948592	0.948592
Nasarawa	14	446	0.03139013	3.139013
FCT	86	5677	0.01514885	1.514885
North Central IFR	185	11162	0.01657409	1.657409
North East				
Bauchi	14	698	0.02005731	2.005731
Borno	65	732	0.08879781	8.879781
Taraba	6	102	0.05882353	5.882353
Adamawa	17	259	0.06563707	6.563707
Gombe	24	879	0.02730375	2.730375
Yobe	8	75	0.10666667	10.66667
North East IFR	134	2745	0.04881603	4.881603
North West				
Zamfara	10	86	0.11627907	11.62791
Sokoto	37	162	0.22839506	22.83951
Kaduna	44	2408	0.01827243	1.827243
Kebbi	9	97	0.09278351	9.278351
Katsina	28	858	0.03263403	3.263403
Kano	58	1733	0.03346797	3.346797
Jigawa	15	331	0.04531722	4.531722
North West IFR	201	5675	0.0354185	3.54185
South Eat				
Enugu	21	1289	0.0162917	1.62917
Imo	12	572	0.02097902	2.097902
Ebonyi	30	1040	0.02884615	2.884615
Abia	8	895	0.00893855	0.893855
Anambra	19	217	0.0875576	8.75576
South East IFR	90	4013	0.02242711	2.242711
South-South				
Edo	105	2623	0.0400305	4.00305

North Central	Death	Number of confirmed cases	$\frac{Death}{Nuber\ of\ confirmed\ cases}$	$\frac{Death}{Number\ of\ confirmed\ cases}$ x100
Bayelsa	22	399	0.05513784	5.513784
Akwa Ibom	17	289	0.05882353	5.882353
Rivers	69	2402	0.02872606	2.872606
C/Rivers	8	87	0.09195402	9.195402
Delta	52	1747	0.02976531	2.976531
South-South IFR	273	7547	0.03617331	3.617331
South-West				
Oyo	50	3260	0.01533742	1.533742
Ekiti	11	312	0.03525641	3.525641
Osun	32	810	0.03950617	3.950617
Ondo	35	1626	0.02152522	2.152522
Lagos	258	19480	0.01324435	1.324435
Ogun	33	1814	0.01820188	1.820188
South-West IFR	419	27301	0.01534742	1.534742

5.1. Epidemiological Measures Results

From table 2, the infection rate for the South-West which is the hub of the coronavirus in Nigeria remains low at 1.53% this in itself is good. The study reported an IFR of 1.67%, in the North – Central, 4.88% in the North – West, 2.24% in South – East, 3.62% in South – South.

Table 3. *Mortality rate.*

NORTH CENTRAL	DEATH	POPULATION	Mortality Rate
Niger	12	5,556,247	2.1597312
Kwara	30	3,192,893	9.395867635
Kogi	2	4,473,490	0.447078232
Benue	10	5,741,815	1.741609578
Plateau	31	4,200,442	7.380175705
Nasarawa	14	2,523,395	5.548081057
FCT	86	3,564,126	24.12933774
North Central (MR)	185	29,252,408	6.32
NORTH EAST			
Bauchi	14	6,537,314	2.141552326
Borno	65	5,860,183	11.09180379
Taraba	6	3,066,834	1.956414987
Adamawa	17	4,248,436	4.001472542
Gombe	24	3,256,962	7.368830217
Yobe	8	3,294,137	2.428557161
North East (MR)	134	26,263,866	5.10
NORTH WEST			
Zamfara	10	4,515,427	2.214629979
Sokoto	37	4,998,090	7.40282788
Kaduna	44	8,252,366	5.331804237
Kebbi	9	4,440,050	2.0270042
Katsina	28	7,831,319	3.575387492
Kano	58	13,076,892	4.435304658
Jigawa	15	5,828,163	2.573709761
North West (MR)	201	48,942,307	4.11
SOUTH EAST			
Enugu	21	4,411,119	4.760696776
Imo	12	5,408,756	2.218624763
Ebonyi	30	2,880,383	10.41528158
Abia	8	3,727,347	2.146298694
Anambra	19	5,527,809	3.437166516
South East (MR)	90	21,955,414	4.10
SOUTH – SOUTH			
Edo	105	4,235,595	24.78990555
Bayelsa	22	2,277,961	9.657759725
Akwa Ibom	17	5,482,177	3.100957886
Rivers	69	7,303,924	9.446976721
C/Rivers	8	3,866,269	2.069178322
Delta	52	5,663,362	9.181825213
South-South (MR)	273	28,829,288	9.50
SOUTH – WEST			
Oyo	50	7,840,864	6.376848266

NORTH CENTRAL	DEATH	POPULATION	Mortality Rate
Ekiti	11	3,270,798	3.363093655
Osun	32	4,705,589	6.800423921
Ondo	35	4,671,695	7.491927448
Lagos	258	12,550,598	20.55678941
Ogun	33	5,217,716	6.324606399
South-West (MR)	419	38,257,260	11.00

Table 3 shows south west with the highest population and highest death recorded 11%, 9.50% in south-south, 6.32% in North central, 5.10% in North-East, 4.11% and 4.1% in North-west and South East respectively. It should be noted that, these kinds of comparisons suffer from the fact that the epidemic evolves through highly clustered outbreaks and reaches different stats at different times.

Table 4. *Incidence rate.*

North Central	Confirmed cases	Population	Incidence rate as fraction	Incidence rate as per 100,000 population
Niger	881	5,556,247	0.00015856	15.85602656
Kwara	2918	3,192,893	0.000913905	91.39047253
Kogi	5	4,473,490	1.1177E-06	0.111769558
Benue	1188	5,741,815	0.000206903	20.69032179
Plateau	8894	4,200,442	0.002117396	211.7396217
Nasarawa	2197	2,523,395	0.000870652	87.06524345
FCT	19092	3,564,126	0.005356713	535.6712978
North Central (IR)	35175	29252408	0.00120247	12.0246511
North East				
Bauchi	1195	6,537,314	0.000182797	18.27967878
Borno	1272	5,860,183	0.000217058	21.7058068
Taraba	803	3,066,834	0.000261834	26.18335391
Adamawa	687	4,248,436	0.000161707	16.17065668
Gombe	2004	3,256,962	0.000615297	61.52973231
Yobe	271	3,294,137	8.22674E-05	8.226737382
North East (IR)	6232	26263866	0.00023728	2.37284184
North West				
Zamfara	217	4,515,427	4.80575E-05	4.805747053
Sokoto	744	4,998,090	0.000148857	14.88568633
Kaduna	8247	8,252,366	0.00099935	99.93497622
Kebbi	381	4,440,050	8.58098E-05	8.580984448
Katsina	2044	7,831,319	0.000261003	26.10032869
Kano	3707	13,076,892	0.000283477	28.34771443
Jigawa	496	5,828,163	8.5104E-05	8.510400275
North West (IR)	15836	48942307	0.00032356	3.23564641
South East				
Enugu	2003	4,411,119	0.00045408	45.40797925
Imo	1470	5,408,756	0.000271782	27.17815335
Ebonyi	1864	2,880,383	0.000647136	64.71361621
Abia	1525	3,727,347	0.000409138	40.91381886
Anambra	1720	5,527,809	0.000311154	31.11540214
South East (IR)	8582	21955414	0.00039088	3.90883087
South-South				
Edo	4534	4,235,595	0.001070452	107.0451731
Bayelsa	774	2,277,961	0.000339778	33.97775467
Akwa Ibom	1501	5,482,177	0.000273796	27.37963404
Rivers	6456	7,303,924	0.000883908	88.39084306
C/Rivers	262	3,866,269	6.77656E-05	6.776559003
Delta	2550	5,663,362	0.000450263	45.02625825
South-South (IR)	16077	28829288	0.00055766	5.57662055
South West				
Oyo	6732	7,840,864	0.000858579	85.85788505
Ekiti	797	3,270,798	0.000243671	24.36714221
Osun	2372	4,705,589	0.000504081	50.40814232
Ondo	2959	4,671,695	0.000633389	63.3388952
Lagos	55212	12,550,598	0.004399153	439.9152933
Ogun	4363	5,217,716	0.00083619	83.61896278
South West (IR)	72435	38257260	0.00189337	18.9336612

The table 4 on incidence rate shows that the North East has the lowest incidence of approximately 2.30% and the highest in South West. It is unique that the Incidence rate varies across the six geopolitical zones as the onset of the disease varies across these regions and the effectiveness of the stringency index and the overall population of the various zones also accounted for the variation of the incidence rate. Studying the incidence rate of the six geopolitical zone one can conclude that the occupation and the economic activities of the zones really influenced the rates.

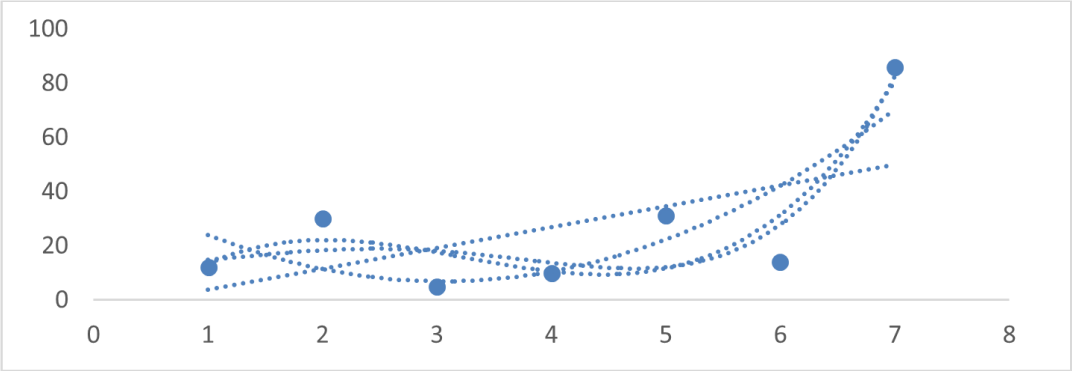

Figure 1. *Trend Analysis for Death in North Central.*

Linear Trend:$Y = -4 + 7.7143x, R^2 = 0.3566$
Quadratic Trend: $Y = 44.857 + 24.857x + 4.0714x^2, R^2 = 0.6546$
Cubic Trend: $Y = -19.143 + 48.032x - 17.262x^2 + 1.7778x^3, R^2 = 0.8007$
Polynomial Trend: $Y = 1 - 7.6999x - 9.5833x^2 - 3.1919x^3 + 0.3106x^4, R^2 = 0.81$.

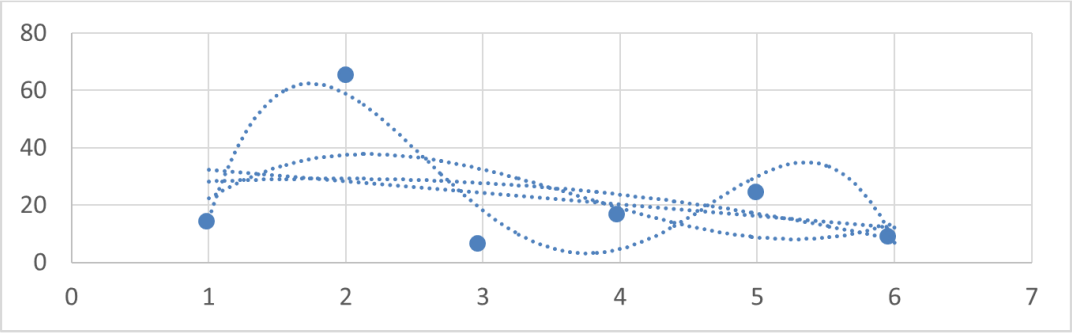

Figure 2. *Trend analysis for Death in North East.*

Linear Trend:$Y = 36.533 - 4.0571x, R^2 = 0.1204$
Quadratic Trend: $Y = 24.7 + 4.8179x - 1.2679x^2, R^2 = 0.1454$
Cubic Trend: $Y = -25 + 67.337x - 21.976x^2 + 1.9722x^3, R^2 = 0.2507$
Polynomial Trend: $Y = -323.5 + 581.42x - 298.56x^2 + 60.014x^3 - 4.1458x^4, R^2 = 0.8417$.

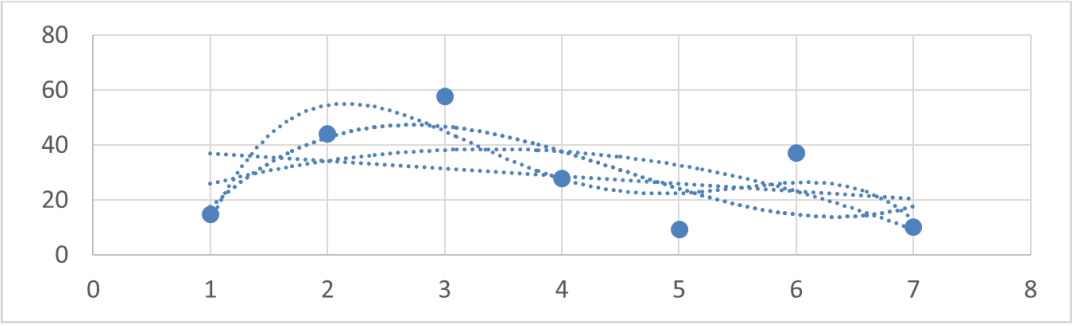

Figure 3. *Trend analysis for Death in North West.*

Linear Trend:$Y = 39.857 - 2.7857x,\ R^2 = 0.1041$
Quadratic Trend: $Y = 13 + 15.119x - 2.2381x^2, R^2 = 0.3057$
Cubic Trend: $Y = -38 + 73.202x - 19.238x^2 + 1.4167x^3,\ R^2 = 0.5133$
Polynomial Trend: $Y = -148.14 + 247.87x - 103.37x^2 + 16.992x^3 - 0.9735x^4,\ R^2 = 0.7188$.

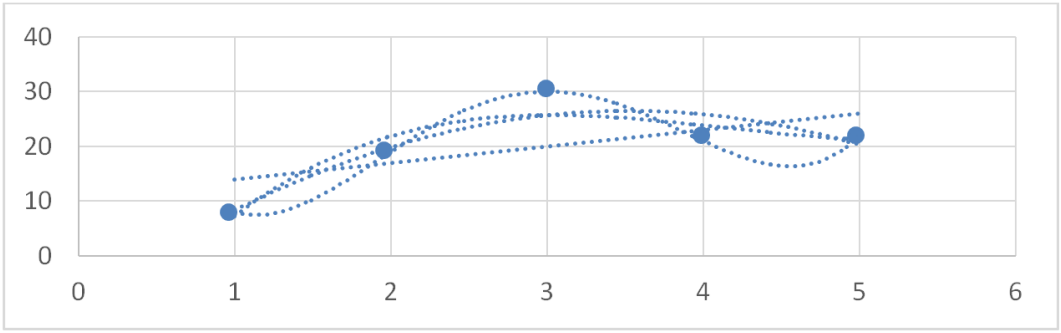

Figure 4. *Trend analysis for Death in South – East.*

Linear Trend:$Y = 11 + 3x,\ R^2 = 0.36$
Quadratic Trend: $Y = -9 + 20.143x - 2.8571x^2, R^2 = 0.8171$
Cubic Trend: $Y = -23 + 39.81x - 10.357x^2 + 0.8333x^3,\ R^2 = 0.8571$
Polynomial Trend: $Y = 67 - 129.83x + 92.917x^2 - 24.167x^3 + 2.0833x^4,\ R^2 = 1.$

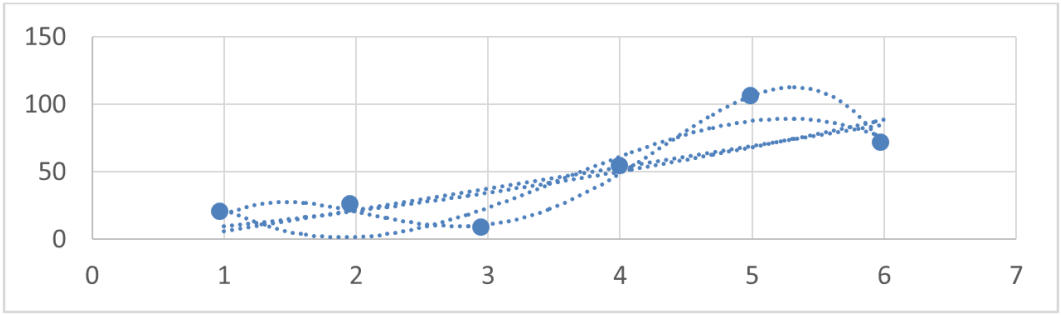

Figure 5. *Trend analysis for Death in South – South.*

Linear Trend:$Y = -9.8 + 15.8x,\ R^2 = 0.6326$
Quadratic Trend: $Y = 0.7 + 7.925x - 1.125x^2, R^2 = 0.6395$
Cubic Trend: $Y = 116.67 - 137.95x + 49.444x^2 - 4.6019x^3,\ R^2 = 0.8382$
Polynomial Trend: $Y = -145.83 + 314.13x - 193.78x^2 + 46.44x^3 - 3.6458x^4,\ R^2 = 0.9966.$

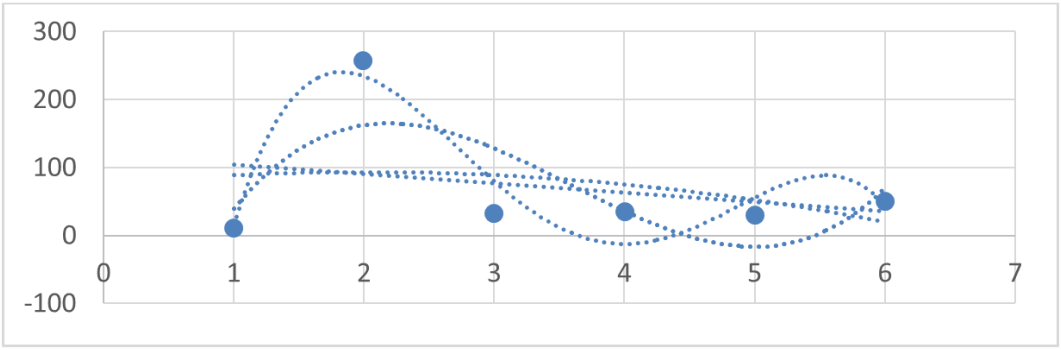

Figure 6. *Trend analysis for Death in South – West.*

Linear Trend:$Y = -117.93 + 13.743x,\ R^2 = 0.0764$
Quadratic Trend: $Y = 75.1 + 18.382x - 4.5893x^2, R^2 = 0.0946$
Cubic Trend: $Y = -337.67 + 537.62x - 176.58x^2 + 16.38x^3,\ R^2 = 0.4964$
Polynomial Trend: $Y = -1347.2 + 2276.2x - 1112x^2 + 212.67x^3 - 14.021x^4,\ R^2 = 0.8703.$

5.2. Trend Analysis Results

Studying the chats of the trend analysis of coronavirus death across the six zones shows that the South East has a perfect fitted model with an $R^2 = 1$ of polynomial series of order four, followed by the South-South with $R^2 = 0.99$, the South-West R^2 =0.87. The trend reveals that the Southern zones have a better trend than the Northern zones. The polynomial trend model best fits and reveals the fluctuations of death in all the six zones.

6. Conclusion

The novel coronavirus is not an infectious disease to be toyed with by individual, community, state or countries. From this study it can be concluded that the entire six

geopolitical zones in Nigeria are affected by the infectious coronavirus which resulted in server economic, educational and other aspect of life break down and expose the real weakness of the Nigeria health care system. The case fatality rate which can be used to assess the healthcare capacity in response to an outbreak reveals that the South-West zones has better and has well equipped healthcare system than other zones despite having a percentage of 3.70% compared to the South-East with 2.3%, the study observed that the South-West has a greater population and the virus was first discovered in the South-West zone. Also the infection fatality rate which determined the effect of the pandemic at population level also shows that 1.53% rate of infection was recorded in the South-West which is significantly lower than that of the CFR of 3.7%, this exposes the difference between CFR and IFR despite their close relationship in definition. Now it can be seen clearer that truly there is a difference in the number of confirmed cases (Preferably by testing) of Covid-19 and actual infectious of disease with/without testing. The mortality rate (MR) and the incidence rate (IR) in itself shows fluctuations in the coronavirus cases within the period under study. The MR which measures the death rate against the targeted population shows that the South-West recorded 11.00% compared to 4.10 and 4.11% in South-East and North-West respectively. But looking closing at the result in table 3 there is a fair comparison in the North-West and South-West (48,942,307 and 38,257,260: 201 and 419) population and death respectively. The IR which talks about the onset of an outbreak shows significant value in table 4 This study has been able to indicate that COVID-19 disproportionately affected the different zones in essence it affected the states like Lagos and Abuja more this could be attributed to the fact that in Nigeria both states are the most affluent.

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