Modeling The Influence of Weather on The Covid-19 Pandemic Outbreak in Nigeria

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***Abstract*: - From an epidemiological perspective, a virus's ability to survive and disseminate is influenced by the weather. Weather-related events alter the ecosystem and endanger the growth of the social, economic, and environmental spheres. The impact of wind speed, wind pressure, relative humidity, and temperature on daily confirmed COVID-19 cases in Nigeria was thoroughly researched. The research spans twelve (12) months (June, 2020 – May 2021). The analysis made use of a regression analysis. A significant contribution to confirmed instances of COVID 19 in Nigeria was found to be made by average temperature, relative humidity, and wind pressure, but not by average wind speed.**

***Keywords:* COVID – 19, Temperature, Relative Humidity, Wind Speed**

I. INTRODUCTION

The coronavirus disease 2019 (COVID-19), which was first identified in Wuhan, China in December 2019 (Liu et al. 2020), was deemed a global pandemic by the World Health Organization (WHO) on March 11, 2020. Consequently, it has emerged as a global public health issue (WHO 2020). On February 27, 2020, the first case of Covid 19 in Nigeria was found. There are numerous signs of COVID-19 infection, including fever, coughing, sore throat, diarrhoea, tiredness, breathing issues, kidney failure, and even death (WHO 2020; Linton et al. 2020). WHO statistics show that as of August 5, 2020, there have been over 18,354,342 confirmed cases and 696,147 fatalities worldwide (WHO 2020). As of July 2021, Nigeria had 169,329 confirmed cases in total.

Numerous nations adopted various programs for disease suppression and mitigation due to the disease's fast spread. As an immediate response to the outbreak, various combinations of measures were implemented, including closing international borders, partial or total lockdown of a nation or a city, a ban on social gatherings, frequent hand washing with soap under running water, physical distancing, quarantine, and isolation. Additional precautions were subsequently or concurrently implemented, including testing, contact tracing and treatment, and the requirement to wear a face mask in public.

Nigeria, country located on the western coast of Africa. Nigeria has a diverse geography, with climates ranging from arid to humid equatorial. However, Nigeria's most diverse feature is its people. Hundreds of languages are spoken in the country, including Yoruba, Igbo,Fula, Hausa, Edo, Ibibio, Tiv, and English. The country has abundant natural resources, notably large deposits of petroleum and natural gas.

According to location, Nigeria has a tropical climate with varying wet and dry seasons. In the southeast, it is hot and humid for the most of the year, but dry in the southwest and further inland. In the north and west, a savanna climate with distinct wet and dry seasons is predominant, whereas the far north has a steppe environment with limited precipitation.

In general, the rainy season gets shorter as it moves northward. While the rainy season only lasts from mid-May to September in the far north, it lasts from March to November in the south. The south experiences a notable break in the rainy season in August, which leads to a brief dry season known as the "August break." In the south, particularly in the southeast, where it rains more than 120 inches (3,000 mm) annually, compared to roughly 70 inches (1,800 mm) in the southwest, precipitation is heavier. Away from the shore, rainfall gradually declines; in the extreme north, it doesn't exceed 20 inches (500 mm) each year.

In contrast to the north, where seasons fluctuate greatly and where there is a large daily temperature variation during the northern dry season, temperature and humidity in the south are largely stable throughout the year. At Lagos and Port Harcourt, the mean monthly maximum temperatures stay constant at roughly 90 °F (32 °C) and 91 °F (33 °C), respectively, throughout the year. In Lagos, the average monthly minimum temperature is about 72 °F (22 °C), while in Port Harcourt, it is about 68 °F (20 °C). In general, mean minimum temperatures are lower and mean maximum temperatures are greater in the north. In the hot months of April and May, for instance, the mean monthly maximum temperature in Maiduguri, in northeastern Nigeria, may approach 100 °F (38 °C), while during the same period frosts may form at night. The harmattan (the hot, dry northeast trade wind), which blows for more than three months in the north but seldom for longer than two weeks along the coast, causes a drop in humidity, despite the north's normally high humidity levels.

This study fits a model to the effect of weather on confirmed cases of COVID -19. The daily record of data on confirmed cases of COVID -19 pandemic and the average weather (temperature, relative humidity, wind pressure and wind speed in Nigeria was observed over the study period of one year.

II. REVIEW OF LITERATURE

An overview of linked literature on various meteorological studies in relation to the COVID-19 pandemic is provided in this section. Meo et al. (2020) looked into how the weather affected the COVID-19 pandemic's incidence and mortality in Africa, and the results revealed a substantial inverse relationship between temperature, relative humidity, and the number of cases and deaths. According to Hammed et al. (2020), there is a marginally negative correlation between temperature and the spread of this illness and the associated mortality. Increased temperatures may slow the spread of disease. The lack of a correlation between ambient temperature and COVID-19 incidence and death raises the possibility that, unlike SARS or influenza, the disease has little to no seasonal variation, at least in areas with weather circumstances similar to those used in this study. A positive linear relationship between wind speed, atmospheric pressure, and the spread of COVID -19 was found by Aidoo et al. in their explanation of the effects of weather on the spread of COVID -19 evidence from Ghana. However, they also explained that there is no nonlinear relationship between temperature and COVID -19 spread. Numerous studies on preventive, control, and intervention strategies have been conducted in an effort to limit the global spread of COVID-19. As a result, a wide range of problems were addressed using different modelling techniques (such as statistical, mathematical, and computational ones). For instance, Kucharski et al. (2020) studied the severe acute respiratory syndrome corona virus type 2 (SARS-CoV-2) and assessed the growth rate of human-to-human transmission based on reported cases. When a typical case is presented to a population, the estimate is used to determine how human-to-human transmission varies among cities. It will be challenging to estimate the reproduction when SARS-CoV-2 cases are not being reported. Semi-Mechanistic Bayesian Model was used to examine the effects of non-pharmaceutical therapies (such as case isolation, school closure, social estrangement, and absolute lockdown, among others) across 11 European countries. According to Flaxman et al. (2020), daily reported deaths in Italy are consistent with interventions. To stop the spread of COVID-19 from imported cases, a stochastic model for evaluating case isolation and contact tracking was created Hellewell et al (2020). The findings indicated that if the transmission is stopped within 12 weeks or before 5000 cases are reached, the outbreak may probably be contained. The propagation of COVID-19 has been extensively studied using a computational technique called Agent-based model (ABM). This method involves allowing the involved agents to interact with one another in accordance with some preset rules, leading to the creation of emerging patterns. An individual-based model was used to examine how non-pharmaceutical interventions affected COVID-19 mortality and healthcare demand. Ferguson (2020) discovered the usefulness of social estrangement. Similar to this, ABM was used to evaluate and compare a number of COVID-19 intervention options in Australia. Blakely (2021); as a result, the outcomes are consistent with those of Ferguson (2020). Platforms like Google Trends and Correlates were developed to provide artificial data based on people's online searches. Jun (2018). (2018). These platforms have contributed to data analytics and the modelling of emerging phenomena in the absence of sufficient data (2019). For instance, the Google Trends time series model was used to perform the COVID-19 predictability study. Effenberger (2020). (2020). In terms of the relationship between Google Trends patterns and COVID-19 cases, the findings were determined to be significant. This result is in line with certain earlier investigations. Lu (2018) with the knowledge that online real-time data are essential components for spotting and predicting outbreaks. Additionally, can help public health policy makers address important concerns. In a different study, Husnayain et al. (2020) investigated the possibility of using Google Trends to track public unease around COVID-19 infection in Taiwan.

III. METHODOLOGY

From 1st June 2020 to 31st May 2021, information about patients who tested positive for COVID-19 was retrieved from the Nigeria Centre for Disease Control website (www.ncdc.gov.ng). Time and Date at (https://www.timeanddate.com/weather/) provided meteorological information, such as atmospheric temperature, relative humidity, wind pressure, and wind speed, during the time periods matching to COVID-19 incidents.

Excel was used to import the data for trendline analysis. The data were then analyzed for descriptive and inferential statistics using SPSS 20.0 statistical software. Regression analysis was used to examine the link between meteorological factors (atmospheric temperature, relative humidity, wind pressure, and wind speed) and the incidence of testing positive for COVID-19.

A statistical software was utilized to model this work utilizing the general linear model (GLM). The general linear model is given as:

$$\hat{Y} = \lambda_0 + \lambda_1 X_1 + \lambda_2 X_2 + \cdots . \lambda_P X_P + \varepsilon_i \quad (1)$$

IV. RESULTS AND DISCUSSION

Inferential Statistics

Figure 1: Trend Line of Covid-19, Average Temperature, Relative Humidity, Wind Pressure and Wind Speed

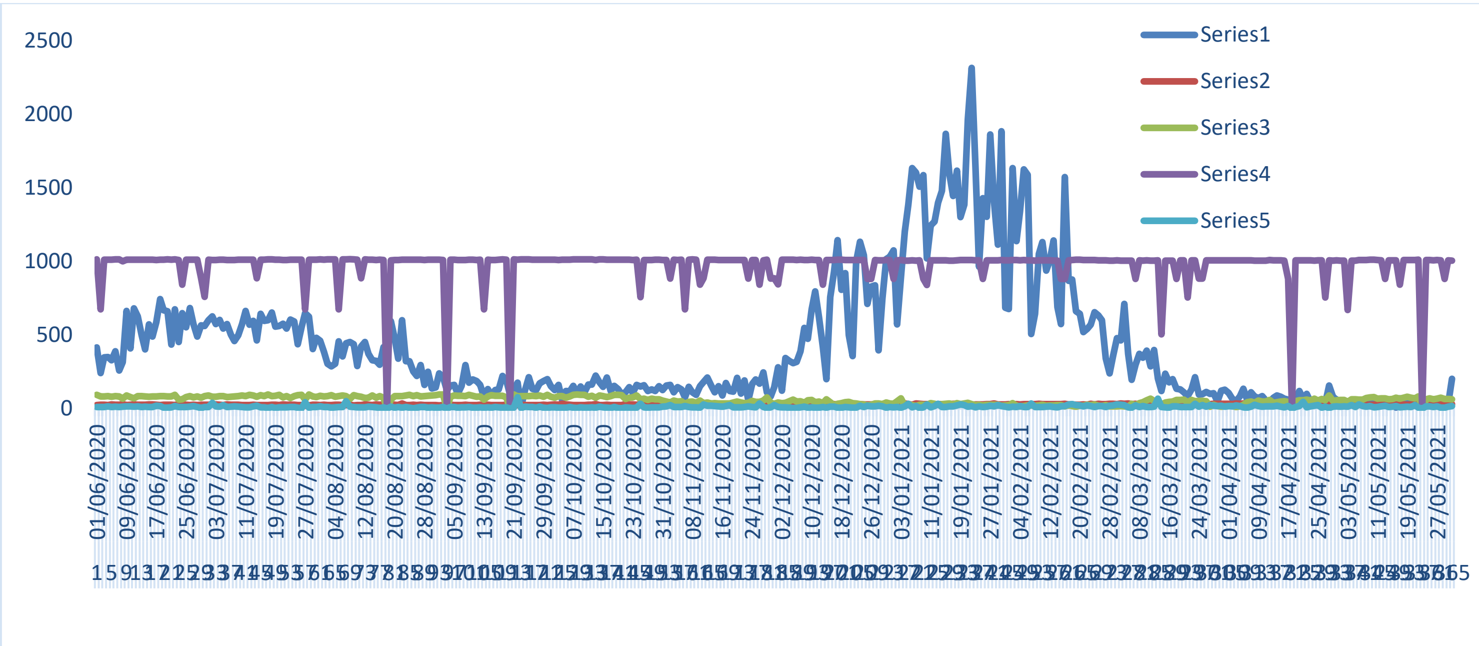

Table1: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.457[a]	.209	.200	385.171

a. Predictors: (Constant), Wind Speed, Wind Pressure, Relative Humidity, Temperature

The multiple correlation value, R = 0.457, indicates a moderate level of prediction, and the R2 coefficient, 0.209, indicates that our independent variable accounts for 20.9% of the variability of our dependent variable.

Table2: Anova[a]

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	14105736.984	4	3526434.246	23.770	.000[b]
Residual	53408292.648	360	148356.368		
Total	67514029.633	364			

a. Dependent Variable: COVID confirmed cases

b. Predictors: (Constant), Wind Speed, Wind Pressure, Relative Humidity, Temperature

The independent factors statistically and substantially predicted the dependent variable, as shown by the F ratio in the ANOVA table, F(4,360) = 23.770, P 0.000, which demonstrates that the regression model is a good match for the data.

Table3: Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	355.676	160.047		2.222	.027	40.932	670.420
Temperature	-28.052	7.506	-.284	-3.737	.000	-42.813	-13.291
Relative Humidity	-9.354	1.014	-.565	-9.225	.000	-11.348	-7.360
Wind Pressure	1.428	.246	.440	5.798	.000	.944	1.912
Wind Speed	-.365	2.597	-.007	-.141	.888	-5.473	4.743

a. Dependent Variable: COVID confirmed cases

The average temperature, relative humidity, and wind pressure contribute significantly to verified instances of COVID 19 in Nigeria, while the average wind speed does not, according to the coefficient table's Sig column.

The model is given as

$$Y = 355.676 - 28.052Temp - 9.354Rel.Humidity + 1.428Windpressure - 0.365Windspeed \quad (2)$$

This suggests that for every unit increase in temperature, there is a decrease in the number of Covid 19 confirmed cases of 28.052; for every unit increase in relative humidity, there is a decrease in the number of Covid 19 confirmed cases of 9.354; for every unit increase in wind pressure, there is an increase in the number of Covid 19 confirmed cases of 1.428; and for every unit increase in wind speed, there is a decrease in the number of Covid confirmed cases of 0.365.

VI. CONCLUSION

From an epidemiological perspective, a virus's ability to survive and disseminate is influenced by the weather. Weather-related events alter the ecosystem and endanger the growth of the social, economic, and environmental spheres. The impact of wind speed, wind pressure, relative humidity, and temperature on daily confirmed COVID-19 cases in Nigeria was thoroughly researched. The research spans twelve (12) months (June, 2020 – May 2021). The analysis made use of a regression analysis. A significant contribution to confirmed instances of COVID 19 in Nigeria was found to be made by average temperature, relative humidity, and wind pressure, but not by average wind speed. Table3 suggests that for every unit increase in temperature, there is a decrease in the number of Covid 19 confirmed cases of 28.052; for every unit increase in relative humidity, there is a decrease in the number of Covid 19 confirmed cases of 9.354; for every unit increase in wind pressure, there is an increase in the number of Covid 19 confirmed cases of 1.428; and for every unit increase in wind speed, there is a decrease in the number of Covid confirmed cases of 0.365 as seen in equation (2)

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