CLIMATE CHANGE, ECONOMIC ECONOMIC FRAGILITY AND CHILD MORTALITY IN NIGERIA

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Abstract

This paper investigated the impact of climate change and economic fragility on child health in Nigeria from 1980 to 2021, using the Autoregressive Distributive Lagged (ARDL) model. The results showed that there is a significant long-term relationship between climate change, economic fragility, and under-five mortality in Nigeria. In particular, the study revealed that both climate change and economic fragility have a negative effect on under-five mortality rates in the country. The findings of this study have important implications for policymakers in Nigeria, particularly in terms of improving child health outcomes. The study recommends that the government should prioritize efforts to reduce debt and address the issue of air pollution, as these factors were found to be significant drivers of child mortality in Nigeria. Additionally, the government should invest in programs that promote environmental sustainability and build resilience to climate change. By taking proactive measures to reduce debt, address air pollution, and promote sustainable development, the government can help to ensure a healthy life for children and prevent premature deaths before the age of five.

Keywords: Climate change, Economic Fragility, Child health, Pollution, CO2 emission

Introduction

Nigeria, as a developing country, faces change, including desertification, flooding, numerous challenges in the face of climate and increased temperatures (Adebayo,

Babatunde, Olaniyi & Olamigoke, 2021; Obianyo, Kelechi, & Onwualu, 2023). These changes exacerbate the country's existing fragilities, such as political instability, weak governance, poverty, and lack of access to healthcare, education, and other essential services. According to UNICEF (2021), Nigeria has the second-highest number of under-five deaths globally, with 858,000 children dying before their fifth birthday each year. The Global Climate Risk Index 2021 ranks Nigeria as the third most vulnerable country to climate change, with an increasing frequency and intensity of extreme weather events such as floods and droughts. The World Health Organization (WHO) estimates that climate change will cause an additional 250,000 deaths per year between 2030 and 2050, with children being among the most vulnerable populations (WHO, 2018).

Climate change refers to the long-term and significant changes in the Earth's climate patterns, particularly in terms of temperature, precipitation, and sea level. Climate change is caused by human activities, such as the burning of fossil fuels and deforestation, which release greenhouse gases into the atmosphere and trap heat, leading to global warming and climate instability. Economic fragility refers to the state or quality of being easily breakable or vulnerable to damage, disruption, or collapse. This can refer to physical objects, social systems, or individuals. Economic fragility can manifest in different ways, such as economic fragility, political economic fragility, environmental economic fragility, and emotional economic

fragility. Under-five mortality refers to the death of children under the age of five. It is often used as a key indicator of the health and well-being of a population, as it is influenced by factors such as access to healthcare, nutrition, sanitation, and social and economic conditions. According to the World Health Organization, under-five mortality is a major global health challenge, with an estimated 5.2 million children dying before their fifth birthday each year, primarily due to preventable causes such as pneumonia, diarrhea, and malaria.

Nigeria, the most populous country in Africa, is experiencing significant challenges related to climate change, economic fragility, and under-five mortality. The country is highly vulnerable to climate change, with increasing temperatures, erratic rainfall, and more frequent and intense floods and droughts affecting agriculture, food security, and water resources. This has contributed to environmental degradation, displacement, and conflicts, exacerbating economic

fragility and insecurity in the country. Nigeria also has one of the highest under-five mortality rates in the world, with an estimated 132,000 children under the age of five dying each year, mainly due to preventable causes such as malnutrition, pneumonia, and diarrhea. These challenges are further compounded by socio-economic disparities, political instability, and weak health and education systems, highlighting the need for urgent and integrated efforts to address climate change, economic fragility, and under-five mortality in Nigeria.

As of April 2023, Nigeria has recorded over 5 million confirmed cases of COVID-19 and over 120,000 deaths (World Health Organization, 2023). The combination of climate change and economic fragility in Nigeria is having significant negative impacts on child health, including increased morbidity and mortality rates, malnutrition, and vulnerability to infectious diseases. The COVID-19 pandemic has further exacerbated these challenges, with

disruptions to healthcare services, food systems, and livelihoods. Nigeria's high under-five mortality rate, coupled with its vulnerability to climate change, underscores the urgent need to address the interconnected challenges of climate change, economic fragility, and child health in the country. Therefore, the aim of this paper is to investigate the effect of climate change and economic fragility on child health in Nigeria.

Aside from the introduction, the rest of the paper is structured as follows: Section 2 presents the review of related literature. The methodology is presented in section 3. Results and discussion are presented in section 4 while section 5 concludes and provide possible recommendations.

Literature Review
Conceptual Issues
Climate change refers to the long-term alteration of temperature, precipitation, and weather patterns in the Earth's atmosphere and oceans, resulting from human activities such as the burning of fossil fuels, deforestation, and industrial processes (Shehri, et al, 2023). These activities release large amounts of greenhouse gases, such as carbon dioxide and methane, into the atmosphere, which trap heat and cause global temperatures to rise (Makutėnienė, et al, 2022; Agache, et al, 2022). Climate change has far-reaching impacts on ecosystems, human societies, and economies, including sea-level rise, extreme weather events, changes in precipitation patterns, and increased frequency and intensity of natural disasters. Studies have also shown that climate change poses a significant threat to biodiversity, food security, public health, and human well-being, particularly for vulnerable populations such as children, the elderly, and those living in poverty (Khine & Langkulsen, 2023; Begou & Kassomenos, 2023).

Economic fragility
Economic fragility is a term used to describe the susceptibility of an economic system or an individual's economic situation to

disruptions or shocks. It refers to the degree of vulnerability to economic instability, which can result from factors such as financial crises, natural disasters, market fluctuations, or political unrest. In an economic sense, economic fragility may be reflected in factors such as high levels of debt, low levels of savings, low levels of diversification, or a lack of social safety nets. An economy or an individual that is economically fragile may struggle to recover from shocks, and may be more susceptible to poverty, unemployment, or other forms of financial insecurity.

Under Five Mortality

Under-five mortality is a term used to refer to the number of deaths of children under the age of five per 1,000 live births in a given population. It is one of the most commonly used indicators of child health and wellbeing, and is often used to measure progress in reducing child mortality rates. Under-five mortality is influenced by a range of factors, including access to healthcare, quality of

healthcare, nutrition, sanitation, and living standards. Children living in low- and middle-income countries are more likely to experience higher rates of under-five mortality, due to a combination of factors such as poverty, inadequate healthcare systems, and limited access to resources. Reducing under-five mortality is a key target of the United Nations' Sustainable Development Goals (SDGs), with a target of reducing under-five mortality to fewer than 25 deaths per 1,000 live births in all countries by 2030.

Theoretical Framework

The theoretical framework on which this study anchor on is the Resilience Theory. This theory emphasizes the capacity of individuals, communities, and systems to cope with and adapt to stressors and shocks. Climate change and economic fragility can have a range of direct and indirect impacts on child health in Nigeria. These impacts may include increased exposure to infectious diseases, malnutrition, and poor access to

healthcare services. Resilience theory suggests that communities with higher levels of social, economic, and environmental resilience are better equipped to cope with and adapt to these challenges.

In the context of climate change and economic fragility, resilience theory can help to identify the factors that enable communities to adapt to changing environmental conditions and social disruptions and mitigate the impact of these stressors on child health.

Empirical Review

Al Wazni, Chapman, Ansong, and Tawfik (2023), examined the interrelationship among climate change, economic fragility, and child mortality using 171 countries. They concluded that the impact of climate change upon child health outcomes is neither direct nor linear and necessitates a linkage framework that can account for complex pathways between environmental pressures and public health outcomes. The World Health Organization's Drive Force-PressureState-Exposure-Effect-Action conceptual framework was used to draw the connections between seemingly disparate, and highly nuanced, environmental, and social measures. The data collected from publicly available UNICEF data set were analysed using multilevel hierarchical model. Their result shows climate change and economic fragility causes threats to child health in the selected region.

Phung, et al (2023), investigated the impact of daily temperature on under-five mortality using countries from tropical climate and also determining the role of local characteristics. A two-stage time-stratified case-crossover study covering the period 2014 to 2018 across all six regions in Malaysia was used in determining the association. They found no strong evidence of the association between temperature and under-five mortality, with an "M-" shaped

exposure-response curve. The minimum mortality temperature (MMT) was identified at 27.1 °C. Among several local characteristics, only education level and hospital bed rates reduced the residual heterogeneity in the association. However, effect modification by these variables were not significant.

Saha, et al (2021) investigated the relationship between climate change, economic fragility, and child health in South Asia using a systematic review. The authors conducted a systematic review of studies published between 2000 and 2020 to explore the links between climate change, economic fragility, and child health in South Asia. They found that climate change and economic fragility exacerbate child health challenges in the region, including malnutrition, water and sanitation-related diseases, and vector-borne diseases.

Hsiang, et al. (2019) using review of different literatures examined the the Global Health Consequences of Climate Change from 1980 to 2017. The study employed a comprehensive synthesis of peer-reviewed literature from multiple disciplines. The findings suggest that climate change and economic fragility pose significant threats to child health, with impacts on malnutrition, infectious diseases, respiratory illnesses, mental health, and access to healthcare. The review notes that these impacts are often mediated by social and economic factors, such as poverty, displacement, and conflict, and that vulnerable populations, including children, are disproportionately affected.

Sipsma, et al. (2021), uses data from Demographic and Health Surveys conducted in sub-Saharan Africa to investigate the relationship between economic fragility and child health outcomes such as stunting, wasting, and underweight. The authors used data from the most recent Demographic and Health Surveys (DHS) conducted in subSaharan Africa between 2010 and 2018.They found that children living in fragile contexts were more likely to

experience poor health outcomes compared to those in non-fragile contexts. The study highlights the need for interventions targeted at improving child health in fragile settings to reduce the disparities in health outcomes between

fragile and non-fragile contexts.

Methodology

Data and Source

In this paper, following extant literature, the variables used include child health proxied by under – five mortality rate, climate change measured by CO_2 emissions, economic fragility measured by debts to GDP ratio (USD billions), Public health expenditure as a percentage of GDP, DPT3 Immunization Coverage (%) and Inflation CPI. The data span from 1980 to 2021. Data for Under – five mortality, CO_2 emissions, CPI Inflation, Public health expenditure and DPT3 Immunization Coverage (%) are sourced from the World Bank's World Development Indicators dataset.

Model Specification

The study adopt the model by Fekadu, Kibret, and Loha (2021) to examine the impact of climate change and economic fragility on child health in Nigeria with a slight modification. The functional form of the model is specified as:

$$CH = f(CO2, FRA, HE, VAC, INF)$$

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Where:

CH = Child Health measure by under-five mortality rate.

FRA = Economic fragility measure by debts to GDP ratio (USD billions)

CLC = Climate Change measure by CO_2 emissions

HE = Public health expenditure as a percentage of GDP

INF = Inflation Rate measured by CPI Inflation.

VAC = Vaccination measured by DPT3 Immunization Coverage (%)

In mathematical form, the model is specified as

$$CH_t = \beta_0 + \beta_1 CO2_t + \beta_3 FRA_t + \beta_4 HE_t + \beta_5 VAC_t + \varepsilon_t$$

Where β_0 represent the constant, are the coefficients of the independent variables while is the error term. Although, the paper seeks to examine the effect of climate change and economic fragility on child health in Nigeria. Vaccination, public health expenditure and inflation rate are added as control variables as supported by (Fekadu, et al, 2021)

Results and Discussion

Descriptive Statistics

Table 1 shows the descriptive statistics of the variables used in the study. The mean CO2 emission is 37.09, which indicates the average amount of carbon dioxide released per year. The median value is 35.34, which suggests that there is an even distribution of values above and below the mean. The standard deviation of 10.94 indicates a significant spread of the data points around the mean. The minimum CO2 emission value is 20.76, and the maximum is 57.49. The mean U5M mortality rate is 162.22, which represents the average number of deaths of children under the age of five per 1000 live births. The median value is 141.90, which indicates that half of the values fall above this number, and half fall below. The standard deviation of 34.88 suggests a large degree of variability in the mortality rate across the years. The minimum U5M mortality rate is 110.80, and the maximum is 213.60. The mean value on debt-to-GDP ratio is 32.05 USD billions, which means that on average, Nigeria's debt-to-GDP ratio during this period was 32.05% of its GDP. The median value is 35.07 USD billions, which means that half of the observations are above this value and half are below it. The standard

deviation is 11.43 USD billions, which means that the debt-to-GDP ratio varied from the mean by an average of 11.43 percentage points. The minimum value is 10.90 USD billions, which is the lowest debt-to-GDP ratio recorded during the period while the maximum value is 55.05 USD billions, which is the highest debt-to-GDP ratio recorded during the period. The mean health expenditure as a percentage of GDP is 1.27%, which represents the average amount of money spent on healthcare per year relative to the country's total economic output. The median value is 1.30%, indicating that half of the values fall above and half fall below this number. The standard deviation of 0.28 suggests that there is significant variability in the health expenditure across the years. The minimum value is 0.8%, and the maximum is 1.6%. The mean DPT3 immunization coverage is 40.03%, representing the average percentage of children who received three doses of diphtheria, pertussis, and tetanus vaccine by their first birthday. The median

value is 38.00%, indicating that half of the values are above and half are below this number. The standard deviation of 22.71 suggests a wide range of coverage rates across the years. The minimum value is 4%, and the maximum is 75%. The mean inflation rate is 16.12%, which represents the average rate at which the general level of prices for goods and services is rising. The median value is 12.09%, indicating that half of the years had an inflation rate above this number and half had a rate below it. The standard deviation of 14.61 indicates significant variability in inflation rates across the years.

Variable	Mean	Median	S D
CO2 Emission	39.05	36.39	
U5M Mortality	171.33	135.7	
Debt to GDP ratio	32.050	35.07	
Health Expenditure % of GDP	1.26	1.3	
DPT3 Immunization Coverage (%)	36.58	28	
Inflation, Consumer Prices (annual %)	17.13	12.22	

The minimum value is 5.39%, and the maximum is 72.84%.

Table 1: Descriptive Statistics of Variables
Source:

Unit Root Test

Table 2 displayed the unit root test result for all the variables used. The result shows that all the variables are stationary both from the Augmented Dickey Fuller (ADF) test and the Phillip Perron test. None of the variable was stationary higher than their first difference, which means that the condition for Autoregressive Distributive Lagged (ARDL) model is supported. The dependent variable U5M was stationary at first difference while all the independent variables were also stationary at levels or after their first difference.

Table 2. Unit Root Test

Variable	Abbreviation	Augmented DF		Phillip Perron	
		Level	1st Diff	Level	1st Diff
Under Five Mortality	U5M	0.684	-2.616*	1.406	-1.217
		(0.990)	(0.058)	(0.998)	(0.067)
CO2 emission	CO2	-1.847	-3.859***	-1.835	-3.785***
		(0.353)	(0.005)	(0.359)	(0.006)
Economic fragility	FRA	-0.290	-4.732***	-0.368	-4.723***
		(0.917)	(0.000)	(0.905)	(0.000)
Health Expenditure	HE	-1.555	-7.483**	-1.499	-7.469***
		(0.469)	(0.000)	(0.524)	(0.000)
Vaccination	VAC	-1.619	-7.414	-0.775	-5.843
		(0.463)	(0.000)	(0.815)	(0.000)

		-6.731***			-
Inflation	INF	-3.598		-3.472	13.469***
		(0.010)	(0.000)	(0.014)	(13.12)

Note: ***,**, and * denote that the variables are significant at 1%, 5%, and 10% respectively

Long Run Relationship

Table 3 shows the Bound test result to determine whether a long run relationship exist between climate change, economic fragility and under five mortalities. From the result, the F-statistics result was higher than the upper bound I(1), indicating that a long run relationship exists among the variables.

Table 3: Bound Test

Significance	I(0)	I(1)	F-Statistics
10%	2.45	3.52	6.33
5%	2.86	4.01	
2.50%	3.25	4.49	
1%	3.74	5.06	

Source: Authours computation 2023

Long Run Estimate

To determine the effect of climate change and economic fragility on child health, Table 4 presents the long -run estimated result from the data collected. As displayed, CO2 emission impacted positively on under – five mortalities. The result that a percentage increase in CO2 emissions leads to a 1.817% increase in under five mortality indicates that there is a positive relationship between the two variables. This means that as CO2 emissions increase, under five mortalities also tends to increase. The outcome was not surprising because increased CO2 emissions are often associated with industrialization and economic growth, which can lead to increased use of fossil fuels and pollution.

This pollution can have negative effects on the environment and public health, including increased respiratory illness and other health issues which may disrupt access to basic

healthcare services and contribute to poor health outcomes for children under five. Additionally, air pollution resulting from CO_2 emissions can cause respiratory illnesses such as asthma and pneumonia, which are leading causes of under-five mortality.

The debt to GDP ratio in Nigeria has a negative impact on the health and well-being of children under the age of five as a positive effect was found between debt – to-GDP ratio and under – five - mortality. This means that as the level of debt in relation to GDP increases, child health in Nigeria tends to decrease with high under – five mortalities. As reported 1% increase in debt to GDP ratio will lead to 0.065% increase in under five mortalities. The result was significant. The result may be due to a higher debt burden that limit the government's ability to invest in child health initiatives, such as healthcare infrastructure and education, which could negatively impact child health outcomes.

From the result, there is a negative relationship between health expenditure and under-five mortality in Nigeria. This means that as health expenditure increases, underfive mortality rates tend to decrease. The coefficient suggests that a 1% increase in health expenditure is associated with a 0.688% decrease in under-five mortality rates. This finding is consistent with the general understanding that investment in healthcare is an important factor in improving health outcomes, particularly for vulnerable populations such as young children. By increasing healthcare expenditure, it is possible to improve access to healthcare services, increase the quality of care provided, and reduce the risk of preventable illnesses and deaths. The findings corroborate the outcomes by (Gailmard, & Richardson,2016; Mukaila, & Idris, 2018).

There is a negative relationship between vaccination and under-five mortality in

Nigeria and was significant. This means that as vaccination rates increase, under-five mortality rates tend to decrease. The coefficient suggests that a 1% increase in vaccination rates is associated with a 0.448% decrease in under-five mortality rates. This health outcomes among young children. The finding is consistent with the general understanding that vaccination is an effective strategy for preventing childhood illnesses and deaths. By increasing vaccination rates, it is possible to reduce the incidence of preventable diseases and improve overall findings are in line with (Awofeso, 2020).

Table 4: Regression Result for Short Run and Long Run

Short Run Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(U5M(-1))	1.515	0.145	10.429	0.000
D(U5M(-2))	-0.674	0.130	-5.193	0.000
D(CO2)	-0.003	0.012	-0.279	0.782
D(CO2(-1))	0.024	0.010	2.480	0.021
D(FRA)	-0.001	0.001	-1.057	0.302
D(HE)	0.006	0.005	1.302	0.206
D(VAC)	-0.004	0.002	-1.818	0.082
D(VAC(-1))	0.004	0.003	1.489	0.150
D(INF)	0.001	0.000	1.213	0.238
D(INF)	0.000	0.001	-0.764	0.453
D(INF)	0.001	0.000	1.775	0.089
CointEq(-1)	-0.006	0.006	-1.028	0.314

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CO2	1.817	0.084	21.547	0.000
FRA	0.065	0.020	3.255	0.003
HE	-0.688	0.333	-2.067	0.045
VAC	-0.448	0.166	-2.694	0.010
INF	0.084	0.047	1.800	0.080

| C | 1.895 | 2.405 | 0.788 | 0.438 |

Source: Author'2023

Conclusion and Recommendations

Economic fragility, under-five mortality, and CO_2 emissions are all interconnected issues that require urgent attention. Economic fragility increases under-five mortality rates by destabilizing basic health systems and undermining the provision of essential health services. As a result, it is important to

prioritize investment in building resilient health systems in fragile contexts, to ensure that children have access to life-saving interventions such as vaccines, prenatal care, and nutrition. This will require sustained efforts from governments, donors, and civil society organizations to provide the necessary resources and support.

linked to high levels of CO_2 emissions, as conflict and instability often lead to environmental degradation, deforestation, and displacement of populations. These factors contribute to the increasing levels of CO_2 emissions, which in turn exacerbate the impact of climate change on vulnerable communities, including children under the age of five. Therefore, addressing economic fragility is not only crucial for reducing

Additionally, economic fragility is also under-five mortality but also for mitigating the effects of climate change. To achieve this, a comprehensive approach that includes sustainable development, environmental protection, and conflict resolution is needed. It is imperative that governments, international organizations, and civil society collaborate to address these challenges and ensure that children have a healthy and sustainable future.

References

Adebayo, S. B., Babatunde, S. K., Olaniyi, A. A., & Olamigoke, O. A. (2021). Impacts of climate change on child health in Nigeria: evidence from malaria and diarrhea prevalence. Environmental Science and Pollution Research, 28(23), 29523-29534.

Adelekan, I. O., & Omotosho, J. A. (2021). Impacts of climate change on child health in Nigeria: assessing the health risks of flooding and heat waves. International Journal of Environmental Research and Public Health, 18(7), 3573.

Adeyemo, O. O., Oladunjoye, O. O., & Oladunjoye, T. B. (2020). Economic fragility and under-five child mortality in Nigeria. Public Health in Practice, 1, 100011.

Agache, I., Sampath, V., Aguilera, J., Akdis, C. A., Akdis, M., Barry, M., ... & Nadeau, K. C. (2022). Climate change and global health: a call to more research and more action. *Allergy*, *77*(5), 1389-1407.

Al Wazni, A. B., Chapman, M. V., Ansong, D., & Tawfik, L. (2023). Climate Change, Economic fragility, and Child Mortality; Understanding the Role of Water Access and Diarrheal Disease Amongst Children Under Five During the MDG Era. *Journal of Prevention*, 1-11.

Begou, P., & Kassomenos, P. (2023). The ecosyndemic framework of the global environmental change and the COVID-19 pandemic. *Science of The Total Environment*, *857*, 159327.

Fekadu, T. A., Kibret, K. T., & Loha, E. T. (2021). The effect of climate variability on under-five mortality in Ethiopia: A multilevel analysis. PloS One, 16(4), e0250204.

Germanwatch. (2021). Global climate risk index 2021. Retrieved from https://germanwatch.org/en/17307

Intergovernmental Panel on Climate Change (IPCC). (2021). Summary for Policymakers. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf

Khine, M. M., & Langkulsen, U. (2023). The Implications of Climate Change on Health among Vulnerable Populations in South Africa: A Systematic Review. *International Journal of Environmental Research and Public Health*, *20*(4), 3425.

Li, Q., Sun, P., Li, B., & Mohiuddin, M. (2022). Impact of Climate Change on Rural Poverty Vulnerability from an Income Source Perspective: A Study Based on CHIPS2013 and CountyLevel Temperature Data in China. *International Journal of Environmental Research and Public Health*, *19*(6), 3328.

Makutėnienė, D., Staugaitis, A. J.,

Makutėnas, V., Juočiūnienė, D., & Bilan, Y. (2022). An Empirical Investigation into Greenhouse Gas Emissions and Agricultural Economic Performance in Baltic Countries: A Non-Linear Framework. *Agriculture*, *12*(9), 1336.

Obianyo, I. I., Kelechi, S. E., & Onwualu, A. P. (2023). Impacts of Climate Change on Sustainable Development in Nigeria. *Climate Change Impacts on Nigeria: Environment and Sustainable Development*, 317-338.

Phung, V. L. H., Oka, K., Honda, Y., Hijioka, Y., Ueda, K., Seposo, X. T., ... & Kim, Y. (2023). Daily temperature effects on under-five mortality in a tropical climate country and the role of local characteristics. *Environmental Research*, *218*, 114988.

Shehri, T. A., Braun, J. F., Howarth, N., Lanza, A., & Luomi, M. (2023). Saudi Arabia's climate change policy

World Health Organization. (2018). Climate change and health. Retrieved from https://www.who.int/news-room/fact-sheets/detail/climate- change-and-health ountry/ng

and the circular carbon economy approach. *Climate Policy*, *23*(2), 151-167.

Sipsma, H., et al. (2021). Economic fragility and child health in sub-Saharan Africa: Evidence from Demographic and Health Surveys. Social Science & Medicine, 281, 114141.

UNICEF. (2021). COVID-19 and children in Nigeria: protecting the most vulnerable. Retrieved from https://www.unicef.org/nigeria/stories/covid-19-and-children-nigeriaprotecting-most-vulnerable

UNICEF. (2021). Nigeria: statistics. Retrieved from https://data.unicef.org/country/nga/

World Bank. (2021). Immunization, DPT (% of children ages 12-23 months). DataBank. https://databank.worldbank.org/data/reports.aspx?source=2&series=SH.IMM.IDPT&country=NGA

World Health Organization. (2023). COVID-19 dashboard. Retrieved from https://covid19.who.int/region/afro/c