Climate Change, Fiscal Fragility and Child Health in Lower Middle Income in Sub-Sahara Africa Countries

Popoola Wumi Mathew, Adeyemo Dayo Omodele

Ajayi Crowther University, Oyo, Nigeria

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ABSTRACT

Good health and well-being are one of the sustainable development goals by United Nation. The aim is to ensure healthy lives and promote well-being for everyone, at all ages. However, the immediate challenges of climate change and fiscal fragility have jeopardized citizens' well-being.

Despite government's endeavor to mitigate these issues, it has proven inadequate. Invariably Its prompt inquiry in to how climate change and fiscal fragility impact child health. Therefore, this study investigates the effect of climate change and fiscal fragility on child health in the lower and middle – income Sub Saharan African countries.

It was centered on the social determinants of health theory and included data spanning from 2000 to 2022. It includes indicators like under five mortality, maternal mortality rate, Carbon dioxide emissions, debt-to-GDP ratio, current health expenditure, inflation Consumer Price Index, Immunization (DPT % of children ages 12-23Months). To assess the impact of Climate change and fiscal fragility on child health, the study employed the Panel Fully Modified Ordinary Least Square.

The finding indicates that both climate change and fiscal fragility have adverse impact on child health, and a percentage increase in climate change worsen child heath in Lower- and Middle-Income Sub-Saharan African Countries by 0.058% to 0.075% and a percentage increase in fiscal fragility reducing child health quality by 0.010% to 0.023%. Moreover, under -five mortality and maternal mortality rates are also influenced, with climate change and fiscal fragility leading to percentage increases in under-five mortality ranging from 0.571% to 0.729% and 0.005% to 0.069%, and in maternal mortality rates from 0.405% to 0.466% and 0.052% to 0.093% respectively.

Following from the above findings, the study concluded that climate change and fiscal fragility has detrimental effect on child health. Consequently, the study recommended that policy makers should prioritize climate resilience measures and enhance financial stability including prudent financial management and investments in healthcare infrastructure.

INTRODUCTION

Sensitive issues like climate change needs an urgent attention as the aftermath is disastrous. The adverse effects of climate change include extreme weather events, shifting disease patterns, and environmental degradation; have posed substantial threats to health, particularly in lower middle-income regions. Concurrently, the issue of fiscal fragility, characterized by mounting external debts and unstable fiscal policies, has compounded the challenges faced in providing effective healthcare systems and ensuring the delivery of essential health services. These intertwined issues of climate change and fiscal fragility present has posed challenges in achieving optimal health outcomes worldwide (Veenema, et al, 2023; Chersich, et al, 2023).

Climate change is regarded as a long-term shift in temperature and weather pattern united nation (2023). From all indication the activities of man have been the main pivot of this climate change and which including burning of fossil fuels like oil and gas as well as coal (UN 2023). Throughout history, humanity has heavily depended on the environment for its survival and well-being.

The intricate relationship between humans and their surroundings has shaped the way people live, with the activities of mankind playing a pivotal role in this interaction. Notably, a consequential global phenomenon stemming from this interplay is climate change. Climate change has surged to the forefront of discussions and deliberations among scholars and experts, establishing itself as one of the paramount subjects on the global agenda today. According to Obianyo, Kelechi, &Onwualu, 2023, the mounting body of scientific evidence underscores the comprehensive nature of the threat posed by climate change. It is widely recognized as the most severe ecological challenge, casting a shadow over the continued survival and sustainable progress of humanity.

At the heart of global health and sustainable development efforts lies the aspiration to enhance health outcomes, as stressed by various United Nations Sustainable Development Goals (SDGs). Key among these health indicators are life expectancy, maternal mortality, and infant mortality. These metrics serve as fundamental gauges of the overall well-being and healthcare quality of populations (Adegoke, George, & Mbonigaba, 2022). Life expectancy reflects the anticipated number of years a person is expected to live, offering insights into the general health status and healthcare services of a nation. In the context of maternal mortality, it is a poignant measure of maternal health, revealing the extent to which pregnancy and childbirth-related complications impact women's lives. Similarly, infant mortality, which assesses the rate of infant deaths before the age of five, underscores the effectiveness of healthcare systems in safeguarding the lives of the most vulnerable members of society. In the pursuit of equitable and sustainable health, these critical health indicators collectively reflect the overall health profile of a nation, making them central to the global health discourse (Zhou, et al, 2023).

However, the evolving challenges posed by climate change and fiscal fragility have raised questions about the stability and sustainability of these vital health outcomes in the sub–Shara African region. Africa is highly susceptible to the effects of climate change due to its reliance on rain-fed agriculture, coastal vulnerability, and dependence on natural resources. Rising temperatures, changing rainfall patterns, and increased frequency of extreme weather events pose significant risks to agricultural productivity, food security, and livelihoods in these countries. Such climatic shifts can exacerbate poverty, disrupt economic stability, and lead to displacement and conflicts, all of which contribute to fiscal fragility. Climate change has emerged as one of the most pressing global challenges, with far-reaching implications for both developed and developing countries. Its impacts are particularly acute in regions with limited resources and vulnerable populations, such as the Lower Middle-Income sub-Saharan African countries. This region, include the likes of Ghana, Nigeria, Senegal, and Cote d'Ivoire, are characterized by economic fragility, inadequate healthcare infrastructure, and a high prevalence of child health issues (Adebayo, Babatunde, Olaniyi & Olamigoke, 2021).

Many of Lower Middle-Income sub-Saharan African countries face fiscal challenges due to factors like volatile commodity prices, weak revenue collection, corruption, and limited diversification of economies. These issues hinder their ability to allocate resources to vital sectors such as healthcare, education, and social services. Fiscal deficits and high levels of public debt can constrain their capacity to respond effectively to climate change impacts, as well as to invest in adaptive measures to safeguard child health. Children are particularly susceptible to the impacts of climate change and economic fragility. Inadequate nutrition, increased prevalence of waterborne diseases due to erratic rainfall patterns, reduced access to healthcare, and heightened risk of displacement and malnutrition all contribute to child health vulnerabilities. These challenges perpetuate a cycle of poor health, hindered cognitive development, and limited educational opportunities.

The growing concern over climate change and fiscal fragility in the context of lower middle-income sub Saharan African countries presents a multifaceted challenge to the achievement of key health outcomes. These nations, including Benin, Cabo Verde, Cote d'Ivoire, Ghana, Nigeria, Sao Tome and Principe, and Senegal, are grappling with the complex interplay of environmental shifts and economic vulnerabilities, both of which have the potential to significantly impact health outcomes. The United Nations has prioritized health and well-being as part of its Sustainable Development Goals (SDGs), highlighting the importance of achieving improved health outcomes, including increased life expectancy, reduced maternal mortality, and decreased infant mortality. Nevertheless, the extent to which climate change, as measured by CO2 emissions, and fiscal fragility, quantified through the debt-to-GNI ratio, may influence these health outcomes remains inadequately understood within this specific regional context. As such, there exists a critical knowledge gap concerning the

nuanced relationships between climate change, fiscal fragility, and health outcomes in these sub Saharan African countries. This research seeks to address this knowledge deficit and offers valuable insights that can inform policy decisions aimed at safeguarding the health and well-being of populations in the face of evolving climate and fiscal challenges.

Emanating from the problem statement, this research question is formulated and will be addressed; what is the effect of climate change and fiscal fragility on under five mortality in the lower middle – income sub Saharan African countries?

The main objective of the work is to determine the effect of climate change and fiscal fragility on under five mortality in the lower middle – income sub Saharan African countries.

The significance of this study is underscored by the fact that existing research primarily focuses on either the impact of climate change or fragility on child health, rather than exploring the intricate interplay between these two complex factors. Additionally, most studies often concentrate their investigations on individual countries, failing to provide a holistic understanding of the collective challenges faced by the entire region.

By taking this unprecedented approach, the study offers a unique opportunity to generate insights that transcend the limitations of past research endeavors. The absence of studies that comprehensively investigate the joint effect of both climate change and fragility on child health in lower middle-income sub Saharan African countries highlights the urgency and necessity of this research.

The study will examine the effect of climate change and fiscal fragility on child mortality in Lower Middle – Income Sub Saharan African countries for the period of 2000 to 2022. This period encompasses the onset of significant global attention to climate change issues and its evolving impacts on the West African’s climate patterns, as well as the concurrent socio-economic trends that have shaped the country's development trajectory.

LITERATURE REVIEW

Climate Change

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).The effects of climate change extend beyond just temperature rise. They encompass shifts in precipitation patterns, sea level rise, more frequent and intense extreme weather events (such as hurricanes, droughts, and heat waves), disruptions to ecosystems and biodiversity, and alterations in ocean currents and ice cover. These changes can have far-reaching impacts on agriculture, water resources, public health, economies, and overall human well-being (Helldén, et al, 2021).

Fiscal 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, 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.

Stylized fact

Under-Five Mortality Rate:

The under-five mortality rate is a critical indicator of child health and well-being, reflecting the likelihood of a child dying before reaching the age of five. A lower rate indicates better child survival and overall healthcare access. Table 2.1 shows the Under – five mortality rates. Benin's under-five mortality rate has decreased over the years. Starting at 136.8 deaths per 1000 live births in 2000, it reduces to 82.63 deaths per 1000 live births in 2021. This significant reduction signifies improvements in child health services, access to clean water, and overall healthcare. Cape Verde demonstrates a consistent decline in under-five mortality. The rate starts at 38.1 deaths per 1000 live births in 2000 and drops to 13.43 deaths per 1000 live births in 2021. This remarkable reduction reflects effective healthcare interventions and improved living conditions .Cote d'Ivoire, although starting at a high rate of 143.3 deaths per 1000 live births in 2000, also shows a steady decline, reaching 71.64 deaths per 1000 live births in 2021. This reduction implies progress in healthcare access, immunization, and child nutrition .Ghana's under-five mortality rate starts at 99.7 deaths per 1000 live births in 2000 and decreases to 43 deaths per 1000 live births in 2021. The substantial decline indicates successful implementation of child health interventions and improvement in healthcare infrastructure .Nigeria's under-five mortality rate begins at a high of 182.9 deaths per 1000 live births in 2000 and experiences a substantial drop to 106.11 deaths per 1000 live births in 2021. The decline, though notable, indicates that efforts are needed to further improve child health outcomes. Senegal demonstrates consistent progress in reducing under-five mortality. The rate starts at 129.5 deaths per 1000 live births in 2000 and declines to 23.30 deaths per 1000 live births in 2021. This remarkable reduction suggests successful child health initiatives .Sao Tome and Principe exhibit a sharp decrease in under-five mortality, starting at 82 deaths per 1000 live births in 2000 and reaching 15.06 deaths per 1000 live births in 2021. This substantial drop highlights the impact of improved healthcare services.

Comparing the countries, it's evident that while all nations have made progress in reducing under-five mortality, Cape Verde and Senegal stand out with the lowest rates in recent years. Nigeria and Cote d'Ivoire, while experiencing significant reductions, still have higher rates compared to other countries. These variations underscore the importance of effective healthcare systems, access to clean water, nutrition, and vaccination programs in ensuring child survival and well-being. The trends also emphasize the need for continued efforts to sustain progress and achieve further reductions in under-five mortality across Sub Saharan Africa.

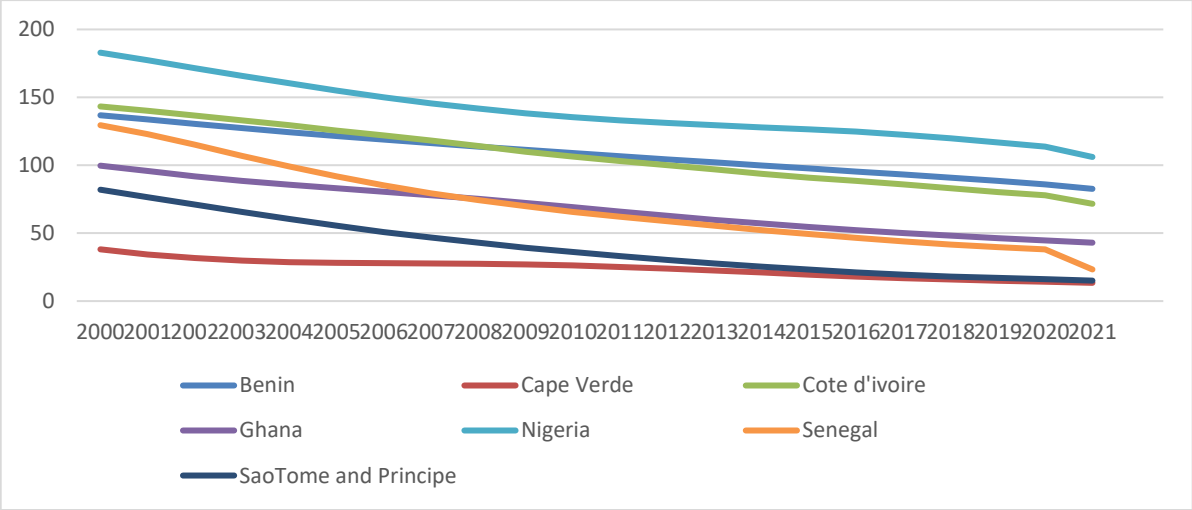
Table 2.1: Under five Mortality rate per 1000 live births

Table 2.1: Under five Mortality rate per 1000 live births							
Year	Benin	Cape Verde	Cote d'ivoire	Ghana	Nigeria	Senegal	SaoTome and Principe
2000	136.8	38.1	143.3	99.7	182.9	129.5	82
2001	133.7	34.4	140.1	95.7	177.3	122.9	76.5

2002	130.5	31.6	136.7	91.9	171.5	115.1	71
2003	127.4	29.8	133.1	88.5	165.9	107	65.6
2004	124.4	28.6	129.5	85.6	160.3	99.1	60.4
2005	121.5	28.1	125.6	83	155	91.8	55.5
2006	118.8	27.9	122	80.6	150.1	85.2	50.9
2007	116.2	27.8	118.2	78	145.6	79.4	46.7
2008	113.7	27.5	114.2	75.3	141.7	74.3	42.9
2009	111.3	27	109.9	72.3	138.3	69.8	39.3
2010	109	26.3	106.3	69.1	135.5	65.7	36.1
2011	106.7	25.2	103.1	65.9	133.1	62.1	33
2012	104.4	24	100.1	62.7	131.1	58.7	30.2
2013	102.1	22.5	97	59.8	129.4	55.4	27.7
2014	99.8	21	93.6	57.1	127.9	52.3	25.3
2015	97.6	19.5	90.8	54.6	126.4	49.4	23.1
2016	95.4	18.1	88.4	52.2	124.7	46.5	21.2
2017	93.2	16.8	86	50.1	122.5	44	19.5
2018	90.9	15.8	83.2	48.1	119.9	41.7	18.1
2019	88.4	14.9	80.3	46.4	116.9	39.7	17
2020	85.9	14.2	77.9	44.7	113.8	38.1	16.1
2021	82.63	13.43	71.64	43	106.11	23.30	15.06

Source: WDI, 2022

Trend of Under Five Mortality



Resilience Theory

This theory draws upon the works of various scholars and has been developed over time, with contributions from researchers like C.S. Holling and Lance Gunderson. The concept gained prominence in the fields of

ecology and social sciences during the 1970s and onwards. The theory centers on the capacity of systems, communities, and individuals to withstand shocks, adapt to changes, and recover from disruptions while maintaining essential functions and structures. It emphasizes the dynamic and interconnected nature of social, ecological, and economic systems and the need to build adaptive capacity to manage and even thrive in the face of uncertainties.

In the context of climate change and fragility's impact on child health in sub saharan Africa, resilience theory takes on significant relevance. The theory highlights the importance of developing adaptive strategies that bolster community capacity to cope with climate-related challenges like extreme weather events, food scarcity, and displacement. Enhancing the resilience of healthcare systems, social networks, and local economies can mitigate the adverse effects on child health and well-being.

Resilience Theory offers a holistic approach by emphasizing interconnectedness and adaptive capacity, which is crucial in the context of climate change and fragility's impact on child health in sub Saharan Africa. Its strength lies in promoting comprehensive solutions, empowering local communities, and fostering sustainable development. However, the theory's complexity can hinder precise indicators and strategies, and it may involve trade-offs with short-term gains. The inherent unpredictability of future challenges and potential for unintentional disparities in resilience efforts are additional weaknesses.

Al Wazni, Chapman, Ansong, and Tawfik (2023), examined the interrelationship among climate change, 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-Pressure-State-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 analyzed using multilevel hierarchical model. Their result shows that climate change and 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 modifications by these variables were not significant.

Ramadan et al. (2022), assessed the quality of care within fragile and conflict-affected situations (FCS) as a crucial strategy for sustainable development goals and universal health coverage. The study emphasizes the increased mortality burden in such settings due to inadequate routine services. It also highlights the scarcity of research on conflict's impact on care quality in fragile states, including service delivery disparities. The study aims to fill this research gap by analyzing the quality of primary healthcare services in four conflict-affected fragile states using proxy indicators. Utilizing secondary analysis of publicly available data from sources like the Demographic Health Survey and the Uppsala Conflict Data Program, the researchers computed equity measures to assess quality disparities based on the intensity of organized violence events at the neighborhood level. The findings reveal poor primary healthcare service quality across the studied countries, with variations observed across sub national regions. Interestingly, inadequate quality was not limited to areas with conflict intensity, as even low or no conflict areas exhibited subpart care quality.

Saha et al. (2021) undertakes a comprehensive exploration of the intricate interplay among climate change, fragility, and child health in the South Asian context through a rigorous systematic review. Their study, encompassing research published from 2000 to 2020, illuminates the intricate connections between these pivotal factors. The authors discern a concerning synergy wherein climate change and fragility amplify the existing challenges to child health in the region. Their findings unveil the exacerbation of crucial child health concerns including malnutrition, water and sanitation-linked diseases, and vector-borne illnesses. They

recommended that there is a pressing need to comprehend and address the intersections of climate change and fragility, ultimately paving the way for informed interventions that safeguard the well-being of the most vulnerable—children—in the complex landscape of South Asia.

Hellden et al. (2021) address the often-overlooked impact of climate change on child health and well-being, highlighting the need for a comprehensive understanding in this domain. While existing research has lacked a systematic focus solely on children under the age of 18, this Scoping Review offers a crucial examination of climate change's effects on child health. Conducting a thorough literature search spanning from January 2000 to June 2019, the authors identify and analyze 371 relevant studies that explicitly establish connections between altered exposures to risk factors for child health and climate change or variability. By adopting an expanded analytical framework, their investigation unveils the multifaceted nature of climate change's influence on child health, operating through both direct and indirect pathways. The implications extend beyond the realm of child health determinants to encompass the prevalence and severity of various diseases, ultimately highlighting the intricate interplay between climate change and the health and well-being of children.

MATERIALS AND METHOD

The dataset necessary for this research encompasses seven sub saharan African countries falling within the Lower Middle-Income category: Benin, Cote d'Ivoire, Cape Verde, Ghana, Nigeria, Senegal, and Sao Tome and Principe. The variable is Mortality rate, under-5 (per 1,000 live births). And the data is from World Bank indicators. The study's aim is to investigate the impact of climate change and fiscal fragility on under-five mortality. To achieve this objective, we utilized a model derived from the framework introduced by Fekadu, Kibret, and Loha (2021), with minor adjustments. The functional form of the model is outlined below:

$U5M = f(CO_2e, extd, cpi, che, imun)$ 3.20

Where:

U5M = Under -five mortality of country i in period t

CO_2e = CO_2 emission of country i in period t

extd = external debt – GDP ratio of country i in period t

cpi = Consumer price inflation of country i in period t

che = Current health expenditure of country i in period t

imun = Immunization, DPT (% of children ages 12-23 months) of country i in period t

Equation 3.20 is respecified in econometric form as

$$U5M_{it} = \beta_0 + \beta_1 CO_2e_{it} + \beta_2 extd_{it} + \beta_3 cpi_{it} + \beta_4 che_{it} + \beta_5 imun_{it} + \varepsilon_t \quad 3.21$$

Where:

β_0 = Constant

$\beta_1 - \beta_5$ = Coefficients of the independent variables

ε_t= Error Term

Equation 3.21 is transformed into its logarithmic form as follows:

$$logU5M_{it} = \beta_0 + \beta_1 logCO_2e_{it} + \beta_2 logextd_{it} + \beta_3 logcpi_{it} + \beta_4 logche_{it} + \beta_5 logimun_{it} + \varepsilon_t \quad 3.22$$

On apriori we expect $\beta_1 > 0, \beta_2 > 0, \beta_3 > 0, \beta_4 < 0, and\ \beta_5 < 0$

Estimation Techniques

The study initiated by conducting a comprehensive analysis of the descriptive statistics for the variables under investigation, providing valuable insights into their characteristics. Subsequently, the stationarity properties of the variables were assessed through the Panel Unit Root Test, a crucial step to ensure reliable modeling. To further strengthen the analysis, various pre-estimation tests were performed, including correlation analysis, tests for cross-sectional dependence, and the Westerlund cointegration test. These procedures were essential for understanding the interrelationships and dependencies among the variables. The study then applied the Panel Fully Modified OLS and Panel Dynamic OLS models to address the objective, to understand the intricate dynamics between climate change, fiscal fragility, and health outcomes measured by under-five mortality. Following the estimation, the study employed a Normality test to assess the distribution of residuals in the post-estimation phase. Moreover, tests for serial correlation and heteroscedasticity were conducted to verify the statistical robustness and reliability of the findings.

RESULTS AND DISCUSSION

Table 4.1 provides descriptive statistics for various key variables in the study. For under – five mortalities per 1000 live births. The mean values across countries vary, with Nigeria having the highest average at 138.647, indicating a relatively higher under five mortality rates, while Cabo Verde displays the lowest mean at 23.801, suggesting a lower rate. The minimum and maximum values illustrate the range of under-five mortality across these countries, with Benin having the minimum value of 81, and Nigeria having the maximum value of 182.4. In this context, Nigeria experiences the highest under five mortality rates, whereas Cabo Verde maintains the lowest, with Benin following as the next lowest, showcasing variations in under five mortality rates among the selected countries.

Table 4.1: Descriptive Statistics of Variables used in the study

Table 4.1: Descriptive Statistics of Variables used in the study				
	Mean	Std Deviation	Minimum	Maximum
Mortality rate, under – 5(per 1000 live births)				
Benin	107.6	16.656	81	136.8
Cabo Verde	23.801	7.015	12.733	38.1
Cote d'Ivoire	105.36	22.367	72.3	142.9
Ghana	67.889	18.052	42.366	100.1
Nigeria	138.647	21.544	107.8	182.4
Sao Tome and Principe	38.83	21.32	14.6	82.4
Senegal	70.482	28.523	37.1	129.7
Panel	78.944	42.705	12.733	182.4
CO2 Emissions (kt)				
Benin	4848.277	2144.322	1424.5	8251.233
Cabo Verde	506.556	88.337	305.8	627.4
Cote d'Ivoire	7938.283	2137.617	5307.6	11006.9

Ghana	11810.35	5223.034	4949.5	22125.28
Nigeria	101091	11603.67	76947.4	119544.1
Sao Tome and Principe	103.813	30.988	53.5	145
Senegal	7685.284	2494.207	4063.7	12297.8
Panel	19140.5	34143.62	53.5	119544.1
External debt Stock (% of GNI)				
Benin	24.065	10.747	9.426	43.752
Cabo Verde	73.293	25.119	35.938	124.579
Cote d'Ivoire	58.113	30.885	20.457	123.827
Ghana	53.316	38.217	16.52	139.438
Nigeria	17.331	15.347	4.95	52.944
Sao Tome and Principe	138.68	123.776	22.451	423.545
Senegal	54.973	28.404	16.644	116.545
Panel	59.967	63.7	4.95	423.545
Current Health Expenditure				
Benin	2.869	0.27	2.32	3.414
Cabo Verde	4.951	0.962	3.583	7.928
Cote d'Ivoire	4.405	0.926	3.118	6.126
Ghana	3.787	0.682	2.763	5.188
Nigeria	3.634	0.579	2.4906	5.053
Sao Tome and Principe	7.653	2.514	3.921	12.617
Senegal	4.29	0.716	3.414	6.462
Panel	4.513	1.826	2.32	12.617
Inflation, Consumer prices (annual %)				
Benin	2.22	2.282	-0.794	7.947
Cabo Verde	1.645	2.247	-2.477	6.774
Cote d'Ivoire	2.368	1.106	-1.106	6.308
Ghana	16.668	9.804	7.143	41.509
Nigeria	12.625	3.809	5.388	18.873
Sao Tome and Principe	12.334	6.397	5.245	31.99
Senegal	1.994	2.629	-2.248	9.696

Panel	7.122	7.733	-2.477	41.509
Immunization, DPT (% of children, ages 12-23 months)				
Benin	67.869	21.102	15	82
Cabo Verde	86.478	20.001	38	99
Cote d'Ivoire	69.057	20.746	8	87
Ghana	90.144	7.107	78	99
Nigeria	40.326	16.086	14	63
Sao Tome and Principe	84.478	21.146	41	99
Senegal	81.739	15.869	52	96
Panel	74.299	23.877	8	99

Source: Researcher's computation from WDI data

Effect of Climate Change and Fiscal Fragility on Under -Five Mortality: Group Specific Results

Table 4.2 offers a comprehensive analysis of the influence of climate change and fiscal fragility on under-five mortality in the selected lower-middle-income sub saharan African countries. The results unveil a notable and statistically significant impact of CO2 emissions on under-five mortality. Specifically, a 1% increase in CO2 emissions is associated with an increase in under-five mortality rates, ranging from 0.571% to 0.729% across the studied nations. The statistical significance of these findings, represented by $\rho<0.05$, draw attention to the urgency of addressing environmental pollution and greenhouse gas emissions to enhance child health within these countries. These results align with the conclusions drawn in previous studies by Mlambo,et al (2023) and Aderinto, (2023).

The findings further reveal a positive impact of debt to GNI on under-five mortality in the context of Low-Middle Income sub Saharan African countries. Precisely, a 1% increase in debt to GNI is associated with an increase in under-five mortality rates, spanning from 0.005% to 0.069%. However, it's noteworthy that the results did not achieve statistical significance, as indicated by $\rho<0.05$. This implies that, while an elevated debt-to-GNI ratio is linked to higher under-five mortality, it may not be a pivotal determinant of under-five mortality in the chosen lower-middle-income African nations. This nuanced relationship underscores the multifaceted nature of the factors influencing child mortality rates and suggests that other variables may have more substantial roles in shaping the health outcomes of young children in these countries. The study agreed with the outcome by (Mohammadi-Nasrabadi et al, 2023; Amegbor& Addae, 2023).

Across both models, a discernible pattern emerges, indicating that inflation, as gauged by the Consumer Price Index (CPI), exerts a detrimental impact on under-five mortality in the selected nations. Specifically, a 1% point rise in the inflation rate is associated with an increase in under-five mortality rates, spanning from 0.011% to 0.161%. Importantly, these findings are statistically significant, denoting a significant role for inflation as a determinant of under-five mortality within the chosen lower-middle-income African countries ($p<0.05$). The implications of these results are substantial and underscore the need for comprehensive strategies to mitigate the adverse effects of inflation on child health in these regions. The study supported the outcomes by Ipinnimo, et al (2023)

The empirical results consistently demonstrate an inverse correlation between current health expenditure and under-five mortality in all the models, in line with theoretical predictions. This implies that a 1% increase in current health expenditure leads to a significant decrease in under-five mortality, ranging from 0.187% to 0.221%, within the lower-middle-income African countries under examination. Crucially, these findings achieve statistical significance, with $\rho<0.05$, emphasizing the considerable economic implications of this

association. It underscores that current health expenditure plays a central role in shaping under-five mortality rates in the chosen countries, pointing out the need for enhanced investments in healthcare to improve child health and overall well-being.

The results uncovered a noteworthy and statistically significant inverse connection between immunization rates and under-five mortality in the selected lower-middle-income African nations, in harmony with theoretical predictions. The data indicates that a 1% increase in immunization rates leads to a significant decrease in under-five mortality, spanning from 0.116% to 0.543%. The significance of these findings, indicated by $\rho<0.05$, holds profound economic implications for the region, underscoring the pivotal role that immunization plays in advancing and maintaining the health and well-being of the population in these countries. This highlights the urgent need for continued and enhanced immunization programs to ensure the health and survival of children in these regions.

The findings indicate that the independent variables account for approximately 90% to 95% of the variability in under five mortalities.

Table 4.2: Regression Result on effect of climate change and fragility on Under-Five mortality

Table 4.2: Regression Result on effect of climate change and fragility on Under-Five mortality				
	PFMOLS		PDOLS	
	Coefficient	ρ	Coefficient	ρ
CO2	0.729***	0.000	0.571***	0.000
Extd	0.005***	0.903	0.069***	0.293
Cpi	0.011	0.043	0.161	0.155
Che	-0.187***	0.004	0.221*	0.397
Imun	-0.116***	0.013	0.543***	0.037
R2	0.90		0.95	

Source: Author's computation, 2024

CONCLUSION AND POLICY IMPLICATION

The study has extensively examined the impact of climate change and fiscal fragility on health outcomes in lower and middle-income Sub Saharan African countries over the period from 2000 to 2022. Seven countries, including Benin, Cabo Verde, Cote d'Ivoire, Ghana, Nigeria, Sao Tome and Principe, and Senegal, were scrutinized. By employing Panel Fully Modified OLS and Panel Dynamic OLS methodologies, the research has unveiled a series of significant findings. Notably, the existence of cross-sectional dependence among the variables calls for cautious consideration. Climate change, represented by CO2 emissions, was found to exert a detrimental influence on health outcomes. Specifically, it elevate under-five mortality rates. Fiscal fragility, measured through the debt-to-GNI ratio, emerged as another crucial factor, contributing to higher under-five mortality rates. Inflation exhibited a consistent adverse impact, resulting in increased under-five mortality rates. Conversely, current health expenditure played a positive role, leading to a reduction in under-five mortality rates. Furthermore, immunization programs demonstrated their importance, contributing to decreased mortality rates among both maternal and infant populations. Based on the conclusion, the following recommendations are suggested. Governments in this region should prioritize climate action by implementing comprehensive environmental policies aimed at reducing CO2 emissions. These policies should include sustainable energy practices, afforestation initiatives, and efforts to limit pollution, ultimately mitigating the detrimental effects of climate change on health. Measures should be taken to manage external debt effectively and improve budgetary allocations for healthcare and social safety nets. Policymaker should focus on reducing

fiscal fragility, enhancing fiscal responsibility, and ensuring a judicious allocation of resources. Significant investments should be made in healthcare infrastructure to enhance the capacity and quality of healthcare services. This should include expanding access to healthcare facilities and services, especially in rural and underserved areas. Immunization campaigns should be intensified and expanded, ensuring that a larger percentage of the population, especially vulnerable groups such as infants and pregnant women, are covered.

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