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CLIMATE CHANGE AND PUBLIC HEALTH CARE EXPENDITURE IN NIGERIA

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Abstract

Despite the existence of various studies examining the effect of public health expenditure on health outcomes in Nigeria and other countries, as well as the relationship between public spending and CO2 emissions in other nations, this particular research focuses on the effects of climate change on public healthcare expenditure in Nigeria from 1990 to 2022. The study utilizes the Ordinary Least Squares and Error Correction Model (ECM) for estimation purposes. Unit root tests are conducted on variables such as carbon dioxide (greenhouse gas) emissions and population, which exhibit order zero I(0), while public healthcare expenditure per capita, gross domestic product per capita, and consumer price index exhibit order one I(1). To establish the long-term relationship between these variables, the Johansen co-integration test is employed. The results of the error correction model indicate a significant negative relationship between climate change and government healthcare expenditure, while population and gross domestic product per capita exhibit a significant positive relationship with government healthcare expenditure in Nigeria. Based on these findings, the study recommends that governments at all levels should strive to increase healthcare expenditure in the country, particularly during periods of climate change that affect people's health.

Key words: *Government healthcare expenditure, Climate change, OLS, ECM, Nigeria.*
JEL Classification: H50, H51, I18, J13

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INTRODUCTION

Health plays a crucial role in our overall well-being, happiness, and quality of life. It is not only important for individual well-being but also for economic progress and productivity. Various factors can influence a person's health, including their income, race, gender, age, existing medical conditions or genetics, occupation, and geographical location. Public health focuses on protecting and improving the health of individuals and communities. It involves the science and art of preventing illnesses, promoting health, and extending life through organized efforts and informed decisions made by society and both public and private organizations. This includes promoting healthy lifestyles, studying disease

prevention and injury prevention, and effectively responding to infectious diseases diseases (Gatseva & Argirova, 2011). Understanding the determinants of health and the challenges faced by different populations is essential in the field of public health. The scope of public health can range from a small group of individuals to a large community or even across continents during a pandemic Central for Disease Control, 2017). Health expenditure encompasses all costs related to health services, family planning, nutrition activities, and emergency assistance, excluding drinking water and sanitation (World Health Organization, 2024). Funding for health is a significant aspect of healthcare systems. The proportion of general government health expenditure (GGHE) in relation to total government spending reflects the level of investment in public health. This indicator not only includes funds allocated through government budgets but also resources directed towards health by government bodies and compulsory health insurance programs (WHO, 2024).

According to a study conducted by Ilori, Olalere, & Babatola (2017) and Reeves, Basu, Mckee, Meissner, & Stuckler (2013), investing in healthcare has significant benefits in both the short and long term. Good health is considered a fundamental aspect of human capital, which is crucial for sustainable development (Karaman, Urek, Demir, Ugurluoglu, & Isik, 2020). The neoclassical growth model suggests that a healthy and educated workforce increases per capita income for individuals and their families, thus enhancing the value of human life (Karim, 2016; Romer, 2012; Sen, 2014). Schultz's (1999) theory further emphasizes that children in good health have better learning abilities, leading to improved educational outcomes, higher school completion rates, and increased human capital formation within households and individuals. By investing in healthcare, we can improve health facilities and promote the development of human capital, ultimately boosting economic performance and productivity (Raghupathi & Ragupathi, 2020; Albulescu, Oros, & Tiwari, 2017).

According to Central Bank of Nigeria (2022) the total government recurrent expenditure on healthcare in 1981 was ₦0.08 billion, in 1990 was ₦0.50 billion, in 2000 it increases to ₦15.22 billion, in 2010 it rise again to ₦99.10 billion and in 2020 it was ₦423.36 billion. In 2021, the expenditure fell to ₦386.24 billion and rises in 2022 to ₦437. 52. The total government current expenditure on healthcare in 1981 was ₦1.30 billion; in 1990 it was ₦2.10 billion; in 2000 it rises to ₦27.97 billion, in 2010 it increases again to ₦151.77 billion and in 2019 there was also an increased ₦264.69 billion and fell to ₦186.74 in 2020. In 2021 and 2020, the current expenditure on healthcare increased to ₦303.66 billion and ₦377.26 billion respectively. The Nigeria total healthcare expenditure per capital in 2000 was $18, in 2005 it went up to $54 and in 2010 it was $74. In 2015, it further rises to $96 and fell in 2019, 2020 to date to $70. Between 2014 and 2020, health expenditure per capital in Nigeria was decreasing on average by 4.75% each year, although before that, it grew from $18 in 2002 to $106 in 2014. Estimating

the healthcare expenditure as a percentage to GDP, in 2000 it was 3.20%, in 2005 it rises to 4.47% and fell in 2010 to 3.30%. It went up again 2015 to 3.58% and in 2020 it fell to 3.38% (World Bank, 2020). In a historic move for Nigeria, the healthcare funding for 2023 witnessed a remarkable increase, surpassing a trillion naira. The proposed 2023 budget allocated a staggering ₦1.17 trillion to the health sector, out of the total ₦20.5 trillion for the fiscal year. This allocation comprised ₦404.08 billion for capital expenditure and N580.82 billion for general expenditure. Additionally, it included ₦2.5 billion for Aids & Grants and a provision of ₦62 billion for retained independent revenue, which could greatly support the activities of health agencies (Tambe, 2022). Furthermore, the service-wide votes granted the health sector an additional ₦81.47 billion. This allocation encompassed ₦69.57 billion for GAVI/immunization, ₦7.4 billion for counterpart funding, including global funds and health refund to GAVI, and ₦4.4 billion for military retirees under the National Health Insurance Scheme (NHIS). Comparing it to previous years, the 2023 budget showcases a significant increase from the ₦826.9 billion allocated in 2022 and the ₦547 billion in 2021. Notably, the capital expenditure witnessed a remarkable surge of 94.83 percent from the 2022 budget, while the recurrent health budget experienced a 25.54 percent increase. Over the past eight years, the health budget has witnessed a substantial rise, escalating from ₦278.31 billion in 2015 to ₦1.17 trillion in the 2023 budget (Tambe, 2022).

Nigeria's healthcare system is falling behind its neighboring African countries in terms of both expenditure and access. For instance, Nigeria's public spending on healthcare only accounts for 3.89 percent of its $495 billion GDP, whereas South Africa spends 8.25 percent and Kenya spends 5.17 percent (World Bank, 2021). Over the past five years, Nigeria's healthcare expenditure as a percentage of GDP has consistently remained below 4 percent. Unfortunately, the country's healthcare services have been consistently inadequate, worsened by a growing population and increasing health disparities. The sector suffers from a lack of sufficient health infrastructure, outdated facilities, and insufficient funding to equip and staff hospitals. To meet the global average of 2.7 beds per thousand people, Nigeria would require 386,000 beds and an investment of $82 billion in healthcare real estate assets. Additionally, Nigeria's population of 206 million is projected to double by 2050, making it the third most populous country in the world according to the U.N. Therefore, it is crucial for governments at all levels, including national and sub-national, to prioritize an equitable and inclusive healthcare system. Adequate and appropriate financing of healthcare is imperative for the future of the nation. According to the Nigeria Medical Association, the doctor-to-patient ratio in Nigeria is approximately one doctor for every 4,000 to 5,000 patients, which falls significantly short of the World Health Organization's recommended ratio of one doctor for every 6,000 patients.

Private health expenditure, mainly out of pocket, makes up around 69% of the total health expenditure. This figure is quite significant in a nation where 133 million individuals, roughly 63% of the population, are considered multidimensional poor. As per Alabi, Chime, Adu, & Aiglomudu (2010), the health sector in Nigeria only received about 2% of government funding from oil extraction, with less than 1% of the country's GDP allocated to healthcare services. With the majority of Nigerians being impoverished and having to pay for their medical expenses themselves, the lack of substantial financial support would inevitably result in unequal access to healthcare services.

Conversely, climate change refers to the notable shift in average weather conditions over several decades or longer, such as growing warmer, wetter, or drier. What sets climate change apart from natural weather variability is the longer-term tendency. The earth's climate is changing, and it is anticipated that it will do so for the rest of this century and beyond. The amount of greenhouse (heat-trapping) gases released into the atmosphere on a worldwide scale and the degree of uncertainty around the Earth's climate's sensitivity to these emissions will mostly determine the extent of climate change that occurs beyond the next few decades. Either directly through the emission of gases or particles or indirectly through atmospheric chemistry human activity alters the composition of the atmosphere (World Bank, 2022, Intergovernmental Panel on Climate, Change, 2013; IPPC 2014). Temperature increases and rainfall variability (with an increase in coastal areas and a decrease in continental parts) are clear indicators of climate change in Nigeria. According to Alaniyi, Olutimehin, & Funmilayo (2019), it is also represented in drought, desertification, increasing sea levels, erosion, floods, thunderstorms, bush fires, landslides, land degradation, more frequent extreme weather events, and biodiversity loss. All of which still has a detrimental impact on Nigeria's ecosystems, as well as the lives of humans and animals (Dada & Muhammad, 2014).

The effects of climate change include rising sea levels, increased frequency or intensity of some extreme weather events, changes in precipitation patterns, warming temperatures, and more. These effects have an impact on the food we eat, the water we drink, the air we breathe, and the weather we experience, all of which pose a health risk. The degree of these health risks will vary depending on a number of characteristics, including individual behavior, age, gender, and economic status, as well as the capacity of public health and safety agencies to handle or anticipate these evolving dangers. The effects will differ according to an individual's location, health risks they are susceptible to, amount of exposure to climate change effects, and community's capacity for adaptation. (US Environment Protection Agency, 2014). Even in prosperous nations like the United States, there are serious health hazards associated with climate change. The most susceptible people in the world may be those living in poor nations like Nigeria and other African countries. Risks are higher for specific groups, including

children, expectant mothers, older adults, those with low incomes, those with chronic illnesses, and those with impairments (US EPA, 2014). Omoruyi & Onafalujo (2011) stated that skin cancer, high blood pressure, malaria, cholera, cerebral-spinal meningitis, cardiovascular respiratory disorders in the elderly ones and problems with infant and maternal health are some of the direct effects of climate change in Nigeria. Vulnerabilities to different health hazards across age groups are anticipated to influence the effect on climate-related medical costs, since health expenditures vary significantly by age.

Climate change poses a significant danger to the well-being of the Nigerian population. It has the potential to impact human health in two distinct ways. Firstly, it can alter the severity or frequency of health issues that are already influenced by climate or weather factors. Secondly, it can give rise to unforeseen health problems or threats in regions or seasons where they have not previously occurred. While every Nigerian is susceptible to the health consequences associated with climate change, certain groups will be particularly affected. These include infants and young children (aged 0-5 years), pregnant women, the elderly, individuals living in poverty, vulnerable communities and villages, people with disabilities, and those with pre-existing medical conditions (US EPA, 2014).

After explaining all of this, it is important to highlight that several researchers, including Oladosu, Chanimbe, and Anaduaka (2022), Anwar, Hyder, Nor, and Younis (2023), Awoyemi, Makaju, Mpapalika, and Ekpeyo (2023), Olusanya and Odishika (2020), and Imoughele and Ismaila (2013), have examined the factors that influence public health care spending in Nigeria as well as government health expenditures and health outcomes in Nigeria, Ghana, and other OECD countries. Some of them discovered that the population under the age of 14 and the health spending portion of GDP are the main determinants, that the demand for health is price inelastic, and that there is a long-term relationship between total government health expenditure and other variables. Some researchers discovered a positive correlation on health outcome (life expectancy) and a negative correlation between health expenditure and death rates. A small number of research, including Frankovic (2017), Sherman, Lee, and Mossburg (2024), Dritsaki and Dritsaki (2023), and Socol, Luga, Socol and Luga (2023), examined the effects of climate change on healthcare costs, health expenditures, and health quality, but none of them were conducted in Nigeria. They discovered that the impact of climate change on overall health care demand is significantly shaped by age-specific vulnerabilities, and that rising temperatures and CO2 emissions are major contributors to rising health care costs. Because of this, this study uses the Ordinary Least Square (OLS) and Error Correction Model (ECM) to examine how government healthcare spending in Nigeria is affected by climate change, namely the greenhouse effect and CO2 emissions, from 1990 to 2022. GDP per capital, average age dependence ratio to working age

population, government health spending per capital, CO2 emissions, and consumer price index are among the variables used in this study.

Theoretical Literatures

Theories on Public Expenditure

- **Wagner's Law:** German economist Adolph Wagner (1835–1917) postulated that there are predetermined tendencies for the three levels of government's operations to develop in both intensity and scope. Wagner's law, also referred to as the law of growing state activity, states that when national income rises, so do public expenditures. Historical facts form the basis of Wagner's theory. He asserts that an increase in national income results in an increase in governmental spending. Public spending in this case relates to spending on medical care and supplies. For rising economies, public spending is endogenous and is observed to expand in proportion to income growth. This legislation is criticized because it fails to account for unforeseen economic events such as wars and pandemics
- **Peacock-Wiseman Theory:** By applying the Peacock Wiseman Hypothesis to address the problem, Peacock and Wiseman's analysis of the increase of public expenditures in Great Britain between 1890 and 1955 advanced the field's understanding of public spending growth. Wiseman - Peacock concentrated on the pattern of public spending and came to the conclusion that it increases in a jerky or step-like manner rather than continuously or smoothly. Thus, a pattern of public spending served as the foundation for their study's hypothesis.

Theories on Climate Change

Green House Theory of Climate Change:

The physics of climate change is based on the greenhouse effect, which was discovered by Irish physicist John Tyndall. He began publishing a series of studies on greenhouse gases, including carbon dioxide, in 1859. According to the greenhouse theory of climate change, cooling the stratosphere and warming the surface-troposphere system restores balance. The anticipated changes over the next few decades may significantly outweigh those that have historically happened organically. The globe will warm as a result of significantly increasing the amount of carbon dioxide and, as important, other trace gases in the atmosphere. The greenhouse effect is the accumulation of some of a planet's surface heat in its atmosphere due to greenhouse gas concentrations in the atmosphere. This hypothesis applies to this study because greenhouse covers can alter the direction of the sun's rays, spreading them evenly across the entire surface, preventing direct contact with the plants and benefiting the entire greenhouse.

- **Carbon-Dioxide Theory:** In-depth discussion of the geological consequences of the carbon dioxide theory was provided by Chamberlin (1987, 1988, 1989). The carbon

dioxide idea was abandoned when it was found that water vapor absorbs all of the long wave radiation that CO2 absorbs. According to the carbon dioxide theory, the atmosphere gets more opaque over a wider frequency range as carbon dioxide concentration rises. This enhances the effectiveness of absorbing outgoing radiation close to the Earth's surface and raises warmth. The fact that carbon dioxide is a greenhouse gas and helps to trap heat in our atmosphere is a key advantage of this idea. Without it, there is no question that our world would be inhospitable.

Empirical Literature

Ezeruigbo and Ezeoha (2023) conducted a study comprising 49 African countries to examine the impact of healthcare finance burdens on households in Africa between 2000 and 2019. Using random effect regression analysis, the study demonstrates that the amount of out-of-pocket health expenditure in Africa is positively and significantly impacted by climate change. A 1% increase in greenhouse (CO2) emissions is estimated to result in a 0.423% increase in OPHE.

Ilevbare (2019) looked into how Nigerian health hazards were affected by climate change. The results showed that factors associated to climate change, such as rising sea levels, temperature increases, increases in precipitation, extreme weather events, and particularly elevated health risks, are what are causing the impacts of climate change in Nigeria. Risks to health including meningitis of the brain and spinal cord, cardiovascular disease, respiratory disorders in the elderly, skin cancer, malaria, hypertension, and morbidity have been linked directly to climate change.

The link between per capita GDP, per capita CO2 emissions, and per capita healthcare expenditure in G7 nations was studied by Dritsaki and Dritsaki (2023). The augmented mean group (AMG) and long-run panel co-integration coefficients were employed in the study's analysis. The findings demonstrate that the long-run coefficients, which were calculated using the AMG technique, are shown to be positively and statistically significant for GDP per capital and negatively significant for greenhouse gas emissions per capital.

Socol, Luga, Socol, and Luga (2023) examined how healthcare spending in EU member states changed between 2000 and 2020 in relation to climate change, as measured by temperature and CO2 emissions. The study used panel VAR Granger causality, Generalized Method of Moments (GMM) methodologies, and control variables like governance, macroeconomic indicators (inflation and GDP), and the human development index. The results showed that rising temperatures and CO2 emissions are associated with increased healthcare costs, as are advancements in economic growth, governance, inflation, and human development.

Frankovic (2017) investigated how endogenous mortality and a realistic demographic were combined with a continuous time OLG economy to examine the effects of climate change on health spending. Two conflicting forces affect the demand for health care, according to the study. While the demand for medical care rises due to climate-induced mortality, health spending tends to decline with lower income, especially among the elderly. Additionally, they discovered that the influence on the overall demand for health care is significantly shaped by age-specific vulnerability to climate change

Using an Error Correction Mechanism Approach, Imoughele and Ismaila (2013) calculated the public health care spending in Nigeria between 1986 and 2010. The findings demonstrate Nigeria's price-inelastic demand for health care. Additionally, the total population in Nigeria under the age of 14, as well as the GDP share allocated to health care, are the main factors influencing health spending in the country; GDP per capita, the unemployment rate, the population per physician, the consumer price index, and political instability are not as important.

The determining government health expenditure in Nigeria from 1980 to 2018 was studied by Olusanya and Odishika (2020). For estimate, the study used a parsimonious error correction model and Johansen Co-integration analysis. The outcome demonstrates that all of the explanatory variables and the overall amount of government health spending have a long-term relationship.

In Nigeria, Awoyemi, Makanju, Mpapalika, and Ekpeyo (2023) examined the relationships between government spending and health outcomes (birth weight and death rate) between 1995 and 2018. The study used Autoregressive Distributed Lag methodologies, and the findings indicate that health spending and death rate have a negative association, but adjustments in health spending have a beneficial impact on life expectancy at birt

Anwar, Hyder, Nor, and Youins (2023) looked into how health spending affected health outcomes in the OECD nations between 1996 and 2020. The system generalized methods of moments (GMM) for thirty OCED countries using panel data were adopted by the study. The results showed that while health spending increases life expectancy, it has a detrimental effect on infant mortality. In addition, factors like air pollution, GDP, and the number of doctors have a negative impact on infant mortality but a favorable impact on life expectancy in the countries under study.

Oladosu, Chanimbe, and Anaduaka (2022) investigated the relationship between public health spending and health outcomes (HIV/AIDS mortality and malaria) in Ghana and Nigeria. The Abuja Declaration of 2000, the 1990 United Nations General Assembly's commitment to health spending, and linear regression analysis were all used in the study. The results showed that both nations had low public health spending, even though Nigeria showed a positive association and Ghana showed a negative one that was essentially inconsequential.

From 2000 to 2017, Ganda (2021) examined the relationship between health spending and carbon emissions in the BRICS (Brazil, Russia, India, China, and South Africa) nations. The Fully Modified Ordinary Least Square (FM-OLS), Granger causality, Vector Error Correction Model (VECM), and Dumitrescu-Hurlin tests of causality were all utilized by the study. The findings indicate that there is a negative correlation between current health spending and carbon emissions. While spending on domestic general and external health is positively correlated with emissions, spending on public health is also negatively correlated with emissions.

In India's populous economy, Sajid, Khan, Sun, and Yu (2022) examined the long-term interdependencies between the development of communicable diseases, economic prosperity, greenhouse gas emissions, and government health spending. Variance error correction, or VEC, was used in the study from 1981 until 2021. The impulse response and variance decomposition studies' findings demonstrated that there is a substantial relationship between economic prosperity (GNI) and the rates of infectious disease transmission, greenhouse gas emissions, and public health spending.

Research Hypotheses

H_0: There is no statistical significant effect of climate change on public healthcare expenditure in Nigeria.

H_1: There is statistical significant effect of climate change on public healthcare expenditure in Nigeria

RESEARCH METHOD

A statistical technique for estimating the association between one or more independent variables and dependent variables is called ordinary least square (OLS) regression. OLS will be used in this study within the framework of a multivariate model with two or more independent variables. The multiple regression model generally has the following form.

$$Y_t = \beta_1 X_{it} + \beta_2 X_{2t} + \beta_3 X_{3t} + ... + \beta_k X_{kt} + \mu_t \quad (1)$$

Where β is a *k x1* vector of unknown parameters; the μ_t are unobserved scalar random variables (errors) which account for influences upon the responses Y_{it} from sources other than explanators X_{it} and X_{it} is a column vector of the *ith* observations of all the explanatory variables.

Model Specification: To investigate the effect of climate change on public health care expenditure in Nigeria.

$$GHEPC = f(C02, GDPPC, POP, CPI) \quad \textbf{(2)}$$

Where GHEPC = Government healthcare expenditure per capital, CO2 = Carbon-dioxide greenhouse emission proxy for climate change, GDPPC = Gross domestic product per capital, POP = Population (age dependent ratio % working age), CPI = Consumer price index

The econometric specification as follows

$$GHEPC_t = \beta_1 + \beta_2 C02_t + \beta_3 GDPPC_t + \beta_4 POP_t + \beta_5 CPI_t + \mu_t \quad (3)$$

Diagnostic/Estimation Techniques

Unit root test: To completely eliminate autocorrelation, Dicky and Fuller suggest adding additional lagged components of the dependent variable to their test approach. The equation that can be utilized to ascertain the potential form of the ADF is as follows.

$$\Delta y_t = a_0 + \lambda y_{t-1} + a_{2t} + \sum_{i=1}^{p} \beta_i \Delta y_{t-1} + \mu_t \quad (4)$$

Co-integration test: The co-integration test, which confirms the existence of an underlying long-run stationary steady state link between the dependent and explanatory variables, will be conducted using the Johansen procedure. A lack of co-integration indicates the absence of a long-term link for such a variable. The co-integration rank *r*, or the number of independent co-integration vectors, is found using the maximum eigenvalue and trace statistics. Consequently, the general can be stated as follows.

$$Z_t = A_1 Z_{t-1} + A_2 Z_{t-2} + ... + A_k Z_{t-k} + \mu_t \quad \textbf{(5)}$$

Error Correction Model (ECM)

The reason for the ECM is to decide the speed of change from the short-run disequilibrium to the long run equilibrium state. If then, Y_t and X_t are co-integrated by definition $\mu_t \sim I(0)$. Thus, we can express the relationship between Y_t and X_t with an ECM specification as

$$\Delta Y_t = \alpha_0 + \beta_1 \Delta X_t - \Pi \mu_{t-1} + Y_t$$

RESULTS AND DISCUSSION OF FINDING

Table 1: Descriptive Statistics

	GHEPC	CO2	GDPPC	POP	CPI
Mean	7.593019	33.78951	1455.624	43.92906	17.99596
Median	10.18706	36.27342	1656.425	43.95100	12.87658
Maximum	15.83451	67.06026	3098.986	44.75259	72.83550
Minimum	0.000000	10.22222	270.2240	43.04461	5.388088
Std. Dev.	5.836891	13.82700	915.2264	0.427281	16.11163
Skewness	-0.260874	0.360406	0.141190	-0.088965	2.214176
Kurtosis	1.466992	3.349644	1.526418	2.073018	6.869507
Jarque-Bera	3.605711	0.882503	3.095375	1.225062	47.55216

Probability	0.164828	0.643231	0.212739	0.541977	0.000000

Eviews 10

From the result of the descriptive statistics above, the government health expenditure per capital, CO2 emission, gross domestic product per capital and population have a normally distributed curve since the J-B is below 5 and the probability is above 0.05 (5%) , here we cannot reject the null hypotheses. But in consumer price index, it does not has a normally distributed curve because the J-B is higher than 5 and the probability is below 0.05 (5%), here we reject the null hypotheses.

Table 2: Unit root test

The below table will shows the Augmented Dickey Fuller unit root test and will carried by 5%.

Variables	ADF t-Stat	1% level	5% level	10% level	Prob	Order of integration
GHEPC	-4.795464	-4.284580	-3.562882	-3.215267	0.0029	I(1)
CO2	-3.6019387	-4.273277	-3.557759	-3.212361	0.0456	I(0)
GDPPC	-3.807845	-4.562882	-3.215267	-3.215267	0.0296	I(1)
POP	-5.016039	-4.374307	-3.603202	-3.238054	0.0024	I(0)
CPI	-9.375021	-4.339330	-3.587527	-3.229230	0.0000	I(1)

Eviews 10

The levels of government health expenditure per capital (GHEPC), gross domestic product per capital (GDPPC), and consumer price index (CPI) are evident from the above unit test that they strongly suggest the existence of a unit root. The series are integrated of order one I(1), according to the result obtained from first differencing the series, which robustly rejects the null hypothesis of the existence of a unit root. However, the population's (0–14 dependence) and C02 emission levels show no evidence of a unit root, which would indicate a level of rejection of the null hypothesis. Inferring that the series are integrated of order zero I(0) as a result. We can now do the Johansen co-integration test for long-term relationships and error correction model

Table 3: Johansen Co-integration test.

Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob
r0	0.880615	135.7071	69.81889	0.0000
r1	0.715324	69.81981	47.85613	0.0001
r2	0.498019	30.87131	29.79707	0.0375
r3	0.259142	9.506320	15.49471	0.3206
r4	0.006687	0.207986	3.841466	0.6483

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob
r0	0.880615	65.88732	33.87687	0.0000

r1	0.715324	38.94850	27.58434	0.0012
r2	0.498019	21.36499	21.1362	0.0464
r3	0.259142	9.298334	14.26360	0.2622
r4	0.006687	0.207986	3.841466	0.6483

Eviews 10

Both the Trace test and the Max-eigenvalue test statistics indicate three (3) co-integration equations at the 5% (0.05) level. These results indicate that there is a long-run relationship between the dependent variable and the independent variables.

Table 4: Error Correction Model
Dependent variable: GHEPC

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.09287	4.047141	-2.493826	0.0193
C02	-0.000489	0.000158	-3.089752	0.0047
GDPPC	0.003807	0.000799	4.762652	0.0001
POP	3.13E-07	1.05E-07	2.969452	0.0063
CPI	-0.030442	0.023577	-1.291182	0.2080
ECM(-1)	0.668964	0.152309	4.392134	0.0002
R-squared	0.915325	Mean dependent var		7.830301
Adjusted R-squared	0.899041	S.D. dependent var		5.766315
S.E. of regression	1.832191	Akaike info criterion		4.216263
Sum squared resid	87.28004	Schwarz criterion		4.491088
Log likelihood	-61.46021	Hannan-Quinn criter.		4.307360
F-statistic	56.21108	Durbin-Watson stat		2.001024
Prob(F-statistic)	0.000000			

Eviews 10

From the result of the error correction model above, it seen that carbon-dioxide (C02) emission is negatively statistically significant to government healthcare expenditure per capital (GHEPC), while gross domestic product per capital (GDPPC) and population (POP) are seen to be positively statistically significant to government healthcare expenditure per capital (GHEPC). Consumer price index is not statistically significant to government healthcare expenditure per capital (GHEPC). From the estimate above, one percentage change in CO2 emission brought about 0.049% negative change (decrease) to government health expenditure per capital. Also one percentage change in gross domestic product per capital (GDPPC) and population (POP) brought about 0.38% and 0.00003% positive change (increase) to government health expenditure per capital (GHPC) in Nigeria respectively. It can also be seen that the error correction model (ECM) is statistically significant and with the result of the Durbin –Watson statistics which is 2.001024 shows that the result is free of the presences of auto correlation or serial correction. The overall result which is the Adjusted A-square shows about 90% goodness of fit which

shows a high correlation among the variables. F-statistics shows a significant result of 56.21108 because the value is more than 5.

Discussions of Results

Based on the study's findings, it can be seen that the government's (public) healthcare expenditure proxy, measured by government healthcare expenditure per capital (GHEPC), has a statistically significant negative relationship with the climate change proxy, carbon dioxide (C02) emissions. That is to say, if the country's health is negatively impacted by climate change, rather than the government spending more money to address health issues, particularly for the poor,pregnant women the young, the unemployed, the elderly, or those in the dependency age group, the government will spend less money and force people to pay for their healthcare out-of-pocket with little that they have. The studies that conform to this result are as follows Dritsaki and Dristsaki (2023), Frankovic (2017), Imougehel and Ismaila (2013), Awoyemi, Makanju, Mpapalika and Ekpeyo (2023), Anwar, Hyder, Nor and Youins (2023), Ganda, (2021) and Oladosu, Chanimbe, and Anaduaka (2022). Also studies that do not agree with this study are as follows Ezeruigbo and Ezeoha (2023), Ilevbare (2019), Socol, Luga, Socol, and Luga (2023) and Olusanya and Odishika (2020).

Conclusions and Policy Recommendations

This study investigated climate change (CO2 green house emission) on public healthcare expenditure in Nigeria used a yearly data and the Ordinary Lease Square and Error correction model (ECM) for estimation. The study used data from the Central Bank of Nigeria (2022) statistical bulletin and World Bank Development Indicator (2022). The study found that correlation between climate change and public healthcare expenditure with the help of Johansen co-integration test and found that climate change is negatively significant to public healthcare expenditure in Nigeria. It can be concluded from the findings that an increase in climate change in Nigeria reduces or decreases public healthcare expenditure which is not suppose to be so.

Base on the findings, the study recommends that;

(1) The government at all levels should try to increase the healthcare expenditure in the country more especially when there is a climate change that affect people’s health.
(2) The government should also take care of the health expenditure of the dependent (0-14) citizens, unemployed, and age people (60 and above) that are vulnerable to climate change.

The government should review the health expenditure sub-policy programs in order to effectively manage carbon emissions, and promote a healthy environment.

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