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Impact of Health Expenditures on Adult Mortality Rates in Nigeria: 1992 - 2023

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Abstract

According to World Development Indicators (2024), adult mortality rates increased to 376.09 per 1000, in 2023; indicating that structural health challenges persist despite numerous government interventions. This paper seeks to examine the impact of health expenditures on adult mortality rates in Nigeria from 1992 to 2023. The paper used Descriptive analysis and the autoregressive distributive lag (ARDL) technique. The long-run result showed that capital health expenditure (CHX) has a negative and insignificant impact on adult mortality while recurrent health expenditure (RHX) has a negative and significant impact on adult mortality. In contrast, donor health expenditure (DHE) has a positive coefficient and insignificant probability value, implying that an increase in donor-funded health expenditures is associated with higher adult mortality. Meanwhile, out-of-pocket health expenditure (OPT) had a coefficient of negative value, indicating a negative, but very insignificant effect on adult mortality. The probability value shows that this variable is not statistically significant. The paper recommended that the Nigerian Federal Ministry of Health (FMoH) and National Primary Health Care Development Agency (NPHCDA) should ensure sustained and increased budgetary allocation for recurrent healthcare spending. Also, the Federal Ministry of Finance, Budget, and National Planning and the State Ministries of Health should prioritize capital health expenditure by directing funds toward critical healthcare infrastructure such as health centers, diagnostic centers, and medical equipment. The National Health Insurance Authority (NHIA) and Development Partners Coordination Unit (DPCU) of the Federal Ministry of Health should work closely with international donors, including the World Health Organization (WHO), United Nations Development Programme (UNDP), and Global Fund, to ensure better tracking, allocation, and utilization of donor funds. Donor assistance should be directed towards sustainable health programs rather than short-term interventions. Furthermore, the National Health Insurance Authority (NHIA) and State Health Insurance Schemes should expand affordable health insurance coverage under the current Basic Healthcare Provision Fund (BHCPF), particularly for low-income households, to ensure better access to quality healthcare services. Finally, the Central Bank of Nigeria (CBN) and Bank of Industry (BOI) should introduce subsidized loan schemes for healthcare financing to reduce the cost of private healthcare services.

Keywords:
Health Expenditures, Adult mortality, Health, Donor Funds, Out of Pocket expenditure

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Background to the Study

Worldwide approximately 131 million people dead between 2020 and 2021 which was as a result of covid-19 pandemic and other health challenges. Adult mortality rate looks at the probability of individuals aged 15 to 60 dying within that age bracket per 1,000 population and it serves as a critical indicator of a nation's health status. Fluctuations of global adult mortality rate are experienced by nations due to health challenges, 15.9 million deaths attributed to the pandemic which gave room for us to see the vulnerability of adult populations to emerging health threats (Schumacher *et al.* 2021). Nigeria adult mortality rate remains high which is of great concern. Despite increases in health expenditures, the nation still grapples with significant health challenges (Angell *et al*.). Health expenditures and adult mortality rate has a relationship that is dynamic that is increased government health spending has been associated with improved health outcomes, such as reduced infant mortality rates (WHO, 2017). However, the effectiveness of different types of health expenditures capital, recurrent, donor-funded, and out-of-pocket—on adult mortality rates requires further investigation.

According to World Development Indicators (2024), during the early 1990s, adult mortality rates were considerably high, exceeding 430 deaths per 1,000 adults. The peak was recorded in 1996 at 444.38 deaths per 1,000 adults and from 2000 onwards, adult mortality experienced a steady decline, dropping from 423.43 in 2000 to 381.94 in 2015. While Between 2015 and 2019, adult mortality rates remained relatively stable, hovering around 376 to 370 per 1,000 adults. Furthermore, emergence of the COVID-19 pandemic in 2020 led to a temporary increase in adult mortality, rising from 370.40 in 2019 to 386.45 in 2021 and following the pandemic, adult mortality rates saw a notable decline in 2022, reaching 364.60, the lowest recorded in the dataset. However, in 2023, there was an increase to 376.09, indicating that structural health challenges persist.

Several government policies aimed at reducing adult mortality have been put in place by different elected government like the National Health Policy (1996), the Health Sector Reform Program (2004), the National Strategic Health Development Plan (2010-2015), the Saving One Million Lives Initiative (2012), the National Health Act (2014), the Basic Health Care Provision Fund (2018), and the Second National Strategic Health Development Plan (2018-2022). Despite these efforts, there has not been significant improvement in reduction of adult mortality rates, suggesting gaps in policy implementation and effectiveness. Existing literature often focuses on the impact of health expenditures on general health outcomes, with limited emphasis on adult mortality. Additionally, there is a paucity of research examining the differential effects of various types of health expenditures on adult mortality rates in Nigeria. The cruciality of this research is that it aims to fill these existing gaps by analyzing the specific impact of different health expenditure categories on adult mortality in Nigeria. Understanding these relationships can inform more targeted and effective health policies. The primary objective of this study is to assess the impact of health capital expenditure, health recurrent expenditure, health donor expenditure, and health out-of-pocket expenditure on adult mortality rates in Nigeria.

The study hypothesizes the following:

H_{01}: Health capital expenditure has no significant impact on adult mortality in Nigeria.

H_{02}: Health recurrent expenditure has no significant impact on adult mortality in Nigeria.

H_{03}: Health donor expenditure has no significant impact on adult mortality in Nigeria.

H_{04}: Health out of pocket expenditure has no significant impact on adult mortality in Nigeria.

Literature Review

Conceptual Review

Health Expenditure

Health expenditure refers to the financial resources allocated to the healthcare sector by governments, organizations, and individuals. It includes spending on medical services, health facilities, medications, preventive healthcare, and related services which is categorized into public and private spending (out-of-pocket costs incurred by individuals and donor contributions). (World Health Organization [WHO], 2020; Akinyemi *et al*., 2022). The health expenditure includes capital expenditure, recurrent expenditure, donor expenditure, out-of-pocket expenditure (Chikezie & Ukpere, 2020; Ajayi *et al.*, 2021; Ogunyemi *et al.*, 2020; Ekpenyong *et al.*, 2021). Health expenditure is positively correlated with better health outcomes (WHO, 2020), In Nigeria, health expenditure has been a subject of discussion, as public health spending remains below the recommended threshold of 15% of national budget allocation by the Abuja Declaration (WHO, 2001). This underfunding has led to challenges in healthcare delivery, with many Nigerians resorting to out-of-pocket spending, which can lead to financial hardship, particularly for the poor (Oladosu & Ajayi, 2022). Overall, the allocation and effective utilization of health expenditure are vital for achieving sustainable healthcare development.

Capital Health Expenditure

Capital health expenditure refers to the funds used by a government or organization to acquire, maintain, or upgrade physical assets that are long term investment such as buildings, machinery, and infrastructure e.g., hospitals, clinics, acquisition of medical equipment, and development of technological infrastructures aimed at improving healthcare delivery (Ajayi *et al.,* 2021; Akinyemi *et al.*, 2022). In developing countries like Nigeria, capital expenditure in healthcare has significant implications for the accessibility and effectiveness of healthcare delivery, as limited resources often result in inadequate infrastructure to meet the needs of the population (Oladosu & Ajayi, 2022). The importance of capital expenditure in healthcare are infrastructure development which shows that capital expenditure is essential for expanding and improving healthcare infrastructure, which includes building and maintaining hospitals, clinics, laboratories, and pharmacies. The availability of modern and well-equipped healthcare facilities is crucial for providing high-quality care to the population (Ogunyemi *et al.*,

2020). Technological Advancements as capital expenditure also supports the integration of advanced technologies in healthcare. This includes purchasing medical equipment such as diagnostic machines, surgical tools, and electronic health record systems, which enhance the quality and efficiency of healthcare delivery (Ajayi *et al.,* 2021).

Recurrent Health Expenditure

Recurrent health expenditure refers to the ongoing costs incurred by governments or organizations for day-to-day operations and the maintenance of services, as opposed to capital expenditure, which focuses on long-term investments. In the context of healthcare, recurrent expenditure includes spending on salaries for healthcare workers, procurement of medical supplies, costs of maintaining health infrastructure, and funding for the operational aspects of healthcare facilities (Howdon & Rice, 2018). This type of expenditure is essential for the smooth functioning of the healthcare system, ensuring that medical personnel are compensated, healthcare facilities are adequately stocked with essential drugs and equipment, and routine healthcare services are delivered effectively.

The importance of recurrent expenditure in healthcare includes salaries and compensation as one of the largest components of recurrent expenditure in healthcare is personnel costs. This includes salaries and allowances for doctors, nurses, medical technicians, and administrative staff. Adequate payment ensures that healthcare professionals remain motivated and committed to delivering quality care (Adebayo & Akinyemi, 2022); Healthcare service delivery as Recurrent expenditure is vital for maintaining the operational capacity of healthcare services. This includes the procurement of essential medicines, medical supplies, and consumables like bandages, syringes, and diagnostic tools. Without sufficient recurrent funding, healthcare facilities may struggle to provide adequate services, leading to suboptimal health outcomes (Ajayi *et al.*, 2021); Maintenance of health facilities as recurrent expenditure also covers the cost of maintaining existing healthcare infrastructure, such as hospitals, clinics, and medical equipment. Regular maintenance ensures that healthcare facilities are functional and equipped to provide proper care to patients, minimizing the risk of service disruptions (Oladosu & Ajayi, 2022) and also is public health programs which in addition to hospital care, recurrent expenditure is used to fund various public health programs, such as vaccination campaigns, disease prevention initiatives, and health education programs. These initiatives are essential for improving the overall health of the population and preventing the spread of infectious diseases (Akinyemi *et al.*, 2022).

Donor Health Expenditure

Donor health expenditure refers to financial contributions made by foreign governments, international organizations, and non-governmental organizations (NGOs) to support health systems in developing countries. These expenditures are typically directed towards funding healthcare programs, projects, and services that are deemed critical to improving health outcomes, especially in countries with limited domestic resources for health financing. In the context of Nigeria, donor expenditure

plays a pivotal role in addressing the country's healthcare challenges, including high mortality rates, inadequate infrastructure, and the burden of infectious diseases (Ogunbameru *et al.*, 2020). The importance of donor expenditure in healthcare include filling funding gaps as donor expenditure is crucial in countries like Nigeria, where domestic healthcare funding is often insufficient to meet the needs of the population. These funds can bridge gaps in public health financing, enabling governments to implement and scale up essential healthcare services, such as vaccination campaigns, maternal and child health programs, and disease control initiatives (Jiang & Liu, 2021); support for health programs as donor funds are often channeled into specific health programs, such as HIV/AIDS treatment, malaria control, and tuberculosis management (Chima *et al.*, 2022).

Out of Pocket Health Expenditure

Out-of-Pocket (OOP) health expenditure refers to the direct payments made by individuals or households for healthcare services at the time of use, without any reimbursement or external financial support. This includes payments for medical consultations, medications, diagnostic tests, hospital stays, and other healthcare-related expenses that are not covered by insurance, government funding, or donor support (Liu *et al.*, 2020). In many low- and middle-income countries like Nigeria, out-of-pocket expenditure is a significant source of healthcare financing, particularly in the absence of comprehensive health insurance coverage and limited government funding for public healthcare systems. Out-of-pocket expenditure plays a crucial role in determining individuals' access to healthcare services. High out-of-pocket costs can create financial barriers, especially for low-income households, leading to delays in seeking care, underutilization of services, or even catastrophic health spending (Mills *et al.,* 2021). In Nigeria, where healthcare financing is predominantly dependent on personal payments, this has resulted in many individuals opting out of necessary medical treatments due to the high cost of care (Akinyemi *et al.*, 2022). The level of OOP expenditure disproportionately affects vulnerable groups in society, including low-income individuals, rural populations, and the elderly. In Nigeria, as in many other developing countries, the burden of OOP payments falls heaviest on those who can least afford it, exacerbating health inequalities (Ogunbekun *et al.,* 2021). Those unable to pay out-of-pocket for health services often experience poor health outcomes due to delayed or lack of treatment.

Adult Mortality

Adult mortality refers to the death rate among individuals aged 15-59 years within a specific population. It is a critical indicator of health outcomes in a country, reflecting not only the quality of healthcare but also the socio-economic conditions, lifestyle choices, and environmental factors that contribute to health in adulthood (World Health Organization [WHO], 2021). Adult mortality can be influenced by various factors, including chronic diseases, infectious diseases, accidents, violence, and environmental conditions (Gakidou *et al.*, 2017). The measurement of adult mortality rates provides vital insights into the effectiveness of public health interventions, healthcare systems, and

socio-economic development. Adult mortality is a key metric in understanding the health of a population because it reveals the burden of diseases and conditions that affect individuals during their working and reproductive years. A high adult mortality rate often indicates poor healthcare access, unhealthy living conditions, and a high prevalence of non-communicable diseases (NCDs) such as cardiovascular diseases, diabetes, and cancer (Sachs, 2020). In developing countries, including Nigeria, adult mortality is also strongly influenced by factors such as malnutrition, lack of access to healthcare, and limited education on health and well-being (Ogunjimi & Adebayo, 2019).

The factors influencing adult mortality include chronic diseases as Non-communicable diseases (NCDs) such as heart disease, diabetes, and stroke are major contributors to adult mortality, particularly in middle-aged populations. These diseases are often linked to lifestyle factors like poor diet, physical inactivity, and tobacco use (Bloom *et al.,* 2019). In Nigeria, the rising prevalence of NCDs is a growing concern, as these diseases are becoming the leading cause of death among adults (Okunola *et al*., 2021); Infectious Diseases as in low-income countries like Nigeria, infectious diseases such as HIV/AIDS, tuberculosis, and malaria also significantly contribute to adult mortality (Akinmoladun *et al*., 2020). Despite efforts to reduce these diseases, they continue to claim the lives of adults, particularly those in vulnerable and marginalized communities; Socioeconomic factors as socioeconomic conditions, including income, education, and employment, influence the health of adults and their likelihood of dying prematurely. Lower socio-economic status is often associated with higher mortality rates, as it may limit access to healthcare, proper nutrition, and healthier living environments (Marmot, 2020).

Theoretical Framework

The theoretical framework for this study is anchored on the grossman health theory, proposed by Michael Grossman in 1972 in his work on the health production function. Grossman's theory provides a robust foundation for understanding the relationship between health expenditure and adult mortality rates, making it a suitable framework for this research. The grossman health theory posits that individuals invest in their health as a form of human capital, with health serving as both a consumption good and an investment good. As a consumption good, health directly contributes to an individual's well-being. As an investment good, health influences productivity, earning capacity, and life expectancy. Grossman's model suggests that health is a stock variable that depreciates over time and can be replenished through investments such as healthcare spending, lifestyle choices, and preventive measures. The grossman health theory is typically expressed as: H=f(M,L,E,Z), Where: H = Health status, M = Medical care (health expenditure), L = Lifestyle factors (e.g., nutrition, exercise), E = Environmental factors, Z = Socioeconomic factors (e.g., income, education) In this framework, health expenditure is a key input that enhances the stock of health capital, leading to improved health outcomes and reduced adult mortality rates. Grossman's Health theory is particularly relevant to this study because it emphasizes the role of health expenditure in influencing adult mortality rates. The study examines health expenditure in Nigeria through the proxies of capital health expenditure, recurrent health expenditure, donor health

expenditure, and out-of-pocket health expenditure. These expenditures represent investments in healthcare infrastructure, personnel, external aid, and household spending, all of which are critical for improving healthcare delivery and reducing mortality.

Empirical Review

In the research conducted by Boundioa and Thiombiano (2024) where they analyzed the effects of public health expenditure on maternal mortality in WAEMU by using panel data from 1996 to 2018 and two-step least squares (2SLS) was used for analysis. They found a significant negative association with maternal mortality. However, private health expenditure was positively associated with maternal mortality. Following a different approach, Katsiferis *et al.* (2023) conducted a study to assess whether temporal patterns of healthcare expenditures could enhance the prediction of mortality in spousal-bereaved older adults beyond the predictive power of commonly used sociodemographic variables. This population-based cohort study involved 48,944 Danish citizens aged 65 years and older who experienced spousal bereavement between 2013 and 2016 and the findings demonstrated that temporal patterns of healthcare expenditures significantly enhance mortality predictions, offering more precise risk profiling and prognosis for bereaved older adults.

While Akintunde *et al.* (2023) examined the effect of health care expenditures on maternal mortality in Nigeria between 1991 and 2021 and by using descriptive statistics and Autoregressive Distributed Lag (ARDL) model. the study revealed that health care expenditure plays a vital role in reducing incidences of maternal mortality in Nigeria both in the short-run and long-run periods. Therefore, the study recommended that governments at all levels in Nigeria should put more resources in the health care sector especially on the area of maternal health. Kakara *et al.* (2023) examined trends in the leading causes of death from 1999 through 2020 among US adults aged ≥65 years. They used data from the National Vital Statistics System mortality files to identify the 10 leading causes of death among adults aged ≥65 years. They calculated overall and cause-specific age-adjusted death rates and then calculated the average annual percentage change (AAPC) in death rates from 1999 through 2020. The overall age-adjusted death rate decreased on average by 0.5% (95% CI, −1.0% to −0.1%) per year from 1999 through 2020. Although rates for 7 of the top 10 causes of death decreased significantly, the rates of death from Alzheimer disease (AAPC = 3.0%; 95% CI, 1.5% to 4.5%) and from unintentional injuries (AAPC = 1.2%; 95% CI, 1.0% to 1.4%), notably falls (AAPC = 4.1%; 95% CI, 3.9% to 4.3%) and poisoning (AAPC = 6.6%; 95% CI, 6.0% to 7.2%), increased significantly. Conclusion: Public health prevention strategies and improved chronic disease management may have contributed to decreased rates in the leading causes of death. However, longer survival with comorbidities may have contributed to increased rates of death from Alzheimer disease and unintentional falls.

In another studies, Oladosu *et al.* (2022) assessed public policy's role in this relationship via linear regression analysis. Their result disclosed a low public health expenditure in

both countries despite the Ghanaian case revealing a negative relationship, which was primarily insignificant whilst Nigeria indicated a positive one. Further empirical evidences accentuated the need to augment public health expenditure in both countries to boost health outcomes whilst bringing to bear the significant influence of GDP, school enrolment and residing in urban areas on health outcomes. Also, Tukur *et al.* (2021) analyzed the impact of government health expenditure on mortality in Nigeria in order to improve the health sector. The secondary data was used for analysis with VAR. They found that when health expenditure increased maternal mortality increases. So also, from the side of government expenditure and infant mortality rate, the result revealed there is significant impact on health. On the other side of life expectancy, the result reveals the government health expenditure has no impact on life expectancy of Nigerians.

Schumacher *et al.* (2021) examined Global age-sex-specific mortality, life expectancy, and population estimates in 204 countries and territories and 811 subnational locations, 1950–2021, and the impact of the COVID-19 pandemic: a comprehensive demographic analysis for the Global Burden of Disease Study 2021 22 223 with Spatiotemporal Gaussian process regression (ST-GPR) was used to generate under-5 mortality rates, which synthesised 30 763 location-years of vital registration and sample registration data and found that global adult mortality rates markedly increased during the COVID-19 pandemic in 2020 and 2021, reversing past decreasing trends. Owusu *et al.* (2021) examined the influence of health expenditure on infant and maternal deaths for the period 2000–2015 across 177 countries. Using panel Quantile Regression with bootstrapping, this study accounted for the 2007–2008 financial crisis in an empirical relationship between health outcome and health expenditure. They found a negative effect of health expenditure on mortality across all percentiles. Infant mortality rate declines between 0.19% - 1.45% while maternal mortality rate declines ranging from 0.09% - 1.91%. To attain the goal of ensuring healthy lives and wellbeing of all people (SDG 3).

Salinas-Rodríguez *et al.* (2020) conducted a study to investigate the relationship between out-of-pocket (OOP) healthcare expenditures and dependency in older adults. The study focused on a sample of 735 community-dwelling Mexican adults aged 60 and older, using cross-sectional data to estimate both direct (medical and non-medical) and indirect OOP healthcare costs. The Katz scale was employed to assess Activities of Daily Living (ADL) dependency, and the Lawton scale was used to measure Instrumental Activities of Daily Living (IADL) dependency. To analyze the association between dependency and OOP healthcare costs, the researchers utilized two-part regression models. The findings revealed a significant relationship between both ADL and IADL dependency and total yearly OOP healthcare expenditures.

Also, Bucci *et al.* (2018) conducted a study to examined the impact of various types of health expenditures on all-cause mortality rates among adults (25–64 years old) and elderly individuals (over 65 years old) in Italy. They employed Ordinary Least Squares

(OLS) regression models and Generalized Method of Moments (GMM) estimator and they found that DPS exerts the largest influence on reducing mortality rates among both adults and the elderly. Using data from a national sample of 132,116 Indian adults aged 15 years and above, Barik *et al.* (2018) examined the likelihood of death between wave 1 of the India Human Development Survey (IHDS), conducted in 2004–05 and wave 2, conducted in 2011–12. The results showed that mortality between the two waves is strongly linked to the economic status of the household at wave 1 regardless of the choice of indicator for economic status. However, negative relationship between economic status and mortality for individuals already suffering from cardiovascular and metabolic conditions varies between three markers of economic status—income, consumption, and ownership of consumer durables—reflecting two-way relationship between short- and long-term markers of economic status and morbidity.

Howdon and Rice (2018) used hospital episode statistics and English administrative data to investigate the growth in admitted patient health care expenditures and the implications of an ageing population. They used two samples of around 40,000 individuals who (a) used inpatient health care in the financial year 2005/06 and died by the end of 2011/12 and (b) died in 2011/12 and had some hospital utilisation since 2005/06. They used a panel structure to follow individuals over seven years of this administrative data, containing estimates of inpatient health care expenditures (HCE), information regarding individuals' age, time-to-death (TTD), morbidities at the time of an admission, as well as the hospital provider, year and season of admission. They showed that HCE is principally determined by proximity to death rather than age, and that proximity to death is itself a proxy for morbidity. By using longitudinal study, Hone *et al.* (2017) assessed the association between economic recession and adult mortality in Brazil between 2012 and 2017 and they utilized fixed-effect panel regression models with quarterly timepoints to analyze the association between changes in unemployment and mortality, controlling for underlying trends with Hodrick–Prescott filters. They study also found that municipalities with higher expenditures on health and social protection programs did not experience significant increases in recession-related mortality.

Another researcher, Odhiambo *et al.* (2015) investigated the persistent challenge of reducing adult mortality in Sub-Saharan Africa (SSA) and the role of health expenditures in addressing this issue. They explored regional differences in the relationship between health expenditure, corruption, and adult mortality across SSA's four regions: Western, Southern, Central, and Eastern Africa. The researchers employed a dynamic panel data model to analyze the effectiveness of health expenditures in reducing adult mortality under varying levels of corruption. Their findings revealed a nuanced interplay between health expenditures and corruption. While Zheng *et al.* (2015) investigated historical changes in both single-year-of-age adult mortality rates and variation of the single-year mortality rates around expected values within age intervals over the past two centuries in 15 developed countries. They apply an integrated hierarchical age-period-cohort—variance function regression model to data from the human mortality database. They found that recent increases in mortality variation are not due to increasing

proportions of older adults in the population, trends in mortality rates, or disproportionate delays in deaths from degenerative and man-made diseases, but rather due to increasing variations in young and middle-age adults.

Methodology

This paper employs an *ex post facto* research design to analyze secondary annual time series data from 1992 to 2023. The data for health expenditures, specifically Capital Health Expenditure (CHX), Health Recurrent Health Expenditure (RHX), Donor Health Expenditure (DHX), and Out-of-Pocket Health Expenditure (OPT), are obtained from Central Bank of Nigeria (CBN) Statistical Bulletin 2024, the National Bureau of Statistics (NBS) 2024, NPHCDA database and the World Bank's World Development Indicators 2024 and adult mortality (AMT) was sourced from the world bank's world development indicators. These sources offer robust and internationally comparable data on Adult mortality rates, reflecting changes in health outcomes over the study period. The study employed the Autoregressive Distributed Lag (ARDL) method, introduced by Pesaran and Pesaran in the late 1990s. The ARDL technique is particularly useful for analysing the dynamic relationships between variables, as it allows for the examination of both short-run and long-run effects within a single framework.

Model Specification

This paper employed the Autoregressive Distributed Lag (ARDL) methodology alignment with the theoretical framework established herein. The model is adapted from Awoyemi *et al.* (2023) where they investigated the linkages between government expenditure and health outcomes in Nigeria from 1995 to 2018 and the functional relationship model is stated as:

$$MR_t = f(PHE\_GDP_t, PRHE\_GDP_t, CHE\_GDP_t, RHE\_GDPt, RGDP_t, \varepsilon_t) \quad (1)$$

Where:
MRt denotes Mortality Rate.
PHE_GDPt is Public Health Expenditure as a percentage of GDP.
PRHE_GDPt represents Private Health Expenditure as a percentage of GDP.
CHE_GDPt is Capital Health Expenditure as a percentage of GDP.
RHE_GDPt is Recurrent Health Expenditure as a percentage of GDP.
RGDPt is Real Gross Domestic Product.
εt is the error term.

Equation (1) is modified to align with the objectives of this research and to establish the functional relationship between health expenditures variables and adult mortality rate in Nigeria. Consequently, the functional form of the model for this study, which includes health expenditures variables and adult mortality rate indicator, is expressed in the following implicit model:

$$AMT = f(CHX, RHX, DHX, OPT) \quad (2)$$

Where; AMT: Adult Mortality at time (dependent variable) and independent variable are CHX: Capital Health Expenditure at time. RHX: Recurrent Health Expenditure at time, DHX: Donor Health Expenditure at time, OPT: Out-of-Pocket Health Expenditure at time.

This research further specifies equation (2) in a stochastic (linear regression) form to gives:

$$AMT_t = \beta_0 + \beta_1 CHX_t + \beta_2 RHX_t + \beta_3 DHX_t + \beta_4 OPT_t + \varepsilon_t \quad (3)$$

Where;
The β_0: Intercept term, $\beta_1, \beta_2, \beta_3, \beta_4$: Coefficients of the independent variables, ε_t : Error term capturing unobserved factors at time t. The Autoregressive Distributed Lagged (ARDL) model that was used in this paper is specified as follows:

$$\Delta AMT_t = \beta_0 + \sum_{a=1}^{m} \beta_{1i} AMT_{t-1} + \sum_{b=1}^{m} \beta_{2i} CHX_{t-1} + \sum_{c=1}^{m} \beta_{3i} RHX_{t-1} + \sum_{d=1}^{m} \beta_{4i} DHX_{t-1} + \sum_{e=1}^{m} \beta_{5i} OPT_{t-1} \quad (4)$$
$$+ \beta_{6i} \Delta AMT_{t-1} + \beta_{7i} \Delta CHX_t + \beta_{8i} \Delta RHX_t + \beta_{9i} \Delta DHX_t + \beta_{10i} \Delta OPT_t + \varepsilon_t$$

Equation (5) was employed to assess both the short-run and long-run relationships, as well as the impact of health expenditure variables on adult mortality rate in Nigeria. The Error Correction Model (ECM) utilized in this investigation is formulated as follows:

$$\Delta AMT_t = \beta_0 + \sum_{a=1}^{p} \beta_{1i} \Delta AMT_{t-1} + \sum_{b=1}^{q} \beta_{2i} \Delta HCX_{t-1} + \sum_{c=1}^{q} \beta_{3i} \Delta HRX_{t-1}$$
$$+ \sum_{d=1}^{q} \beta_{4i} \Delta HDX_{t-1} + \sum_{e=1}^{q} \beta_{5i} \Delta OPT + ecm \quad (5)$$

Equation (5) was employed to assess both the short-run and long-run relationships, as well as the impact of health expenditure variables on adult mortality rate in Nigeria.

Variable Description, Measurements and Apriori Expectation

Table 1: Description of the Variables used for the Model

Variable	Description/Measure	Type	Source	Apriori Expectation
AMT	Adult Mortality (per 1,000 adults)	Dependent	World Bank data, 2024	Not Applicable
CHX	Capital Health Expenditure (₦' Billion)	Independent	Central Bank of Nigeria (CBN)	Negative
RHX	Recurrent Health Expenditure (₦' Billion)	Independent	Central Bank of Nigeria (CBN)	Negative
DHX	Donor Health Expenditure (₦' Billion)	Independent	Central Bank of Nigeria (CBN)	Negative
OPT	Out-of-Pocket Expenditure ((₦' Billion)	Independent	CBN Statistical Bulletin, 2024	Negative

Source: Author Compilation, 2025

The apriori expectation for this paper's coefficients for independent variables $\beta_1<0$ coefficients of capital health expenditure are expected to have negative impact on Adult mortality. $\beta_2<0$ coefficients of recurrent health expenditure are expected to have negative impact on adult mortality rate in Nigeria. $\beta_3<0$ coefficients of Donor Health Expenditure are expected to have negative impact on adult mortality rate in Nigeria. $\beta_4<0$ coefficients of Out-of-Pocket Health Expenditure is expected to have negative impact on adult mortality rate in Nigeria.

Presentation and Discussion of Results

Descriptive statistics

Table 2: Descriptive Statistics

	AMT	CHX	RHX	DHE	OPT
Mean	403.0128	24.12250	142.9200	0.517438	70.95719
Median	399.9450	20.65500	86.05500	0.162000	71.73000
Maximum	444.3800	53.87000	459.3300	4.075000	77.39000
Minimum	364.6000	0.540000	0.150000	0.000000	60.16000
Std. Dev.	25.18827	18.86885	149.4884	0.826994	4.642038
Skewness	0.227836	0.288446	0.839718	2.822186	-0.765929
Kurtosis	1.615441	1.677828	2.381945	12.01615	2.719815
Jarque-Bera	2.832854	2.774589	4.269995	150.8665	3.233459
Probability	0.242579	0.249750	0.118245	0.000000	0.198547
Sum	12896.41	771.9200	4573.440	16.55800	2270.630
Sum Sq. Dev.	19667.92	11037.04	692750.1	21.20150	668.0040
Observations	32	32	32	32	32

Source: Researcher's computation using EViews 12, 2025

Table 2 shows the descriptive as the mean for adult mortality rate is 403.01, indicating that, on average, there were about 403 deaths per 1,000 adults annually over the study period. The minimum recorded mortality rate is 364.60, while the maximum is 444.38, The standard deviation of 25.19 suggests moderate variability in adult mortality over the years. The skewness value of 0.23 indicates a slight positive skew, meaning that the distribution is slightly right-tailed. While the health capital expenditure mean's value of 24.12 with a median of 20.66. The minimum value is 0.54, while the maximum is 53.87. The standard deviation of 18.87 suggests high variability, showing inconsistent investments in health infrastructure. The skewness value of 0.29 suggests a slight rightward distribution, meaning occasional high capital expenditures.

The health recurrent expenditure mean's value of 142.92, reflecting the substantial role of recurrent expenditure in Nigeria's healthcare system. The minimum expenditure recorded is 0.15, while the maximum is 459.33. A high standard deviation of 149.49 suggests significant fluctuations in recurrent spending. The skewness value of 0.84 indicates a right-skewed distribution, meaning some years experienced much higher spending. Likewise, health donor expenditure's mean of 0.52, shows that donor contributions are relatively small compared to other types of health expenditures. The

minimum value is 0.00, while the maximum is 4.08. The standard deviation of 0.83 indicates considerable variations in donor funding. The skewness value of 2.82 suggests a strong rightward skew, meaning that most years had low donor funding, but a few had significant contributions.

Out-of-pocket health expenditure's mean of 70.96 with a median of 71.73. The minimum recorded value is 60.16, while the maximum is 77.39, indicating relatively less variability compared to other health expenditures. The standard deviation of 4.64 further supports the stability of out-of-pocket expenses over time. The skewness value of -0.77 suggests a slight leftward skew, indicating that lower out-of-pocket expenditures were more frequent. Furthermore, the kurtosis values for AMT (1.62), HCX (1.68), and HRX (2.38) indicate that these variables have a platykurtic distribution, meaning they are less peaked and have lighter tails than a normal distribution, suggesting a more evenly spread data distribution. Conversely, OPT (2.72) has a kurtosis value closer to 3, implying it is approximately normal. In contrast, HDX (12.02) exhibits leptokurtic characteristics, indicating a highly peaked distribution with extreme values, meaning donor expenditure is concentrated in a few years with sharp variations.

Table 3: Correlation Analysis

Correlation Probability	**AMT**	**CHX**	**RHX**	**DHE**	**OPT**
AMT	1.000000				

CHX	-0.878844	1.000000			
	0.0000	-----			
RHX	-0.863160	0.865800	1.000000		
	0.0000	0.0000	-----		
DHE	-0.513131	0.496724	0.405097	1.000000	
	0.0027	0.0038	0.0214	-----	
OPT	-0.569398	0.616617	0.582635	0.189310	1.000000
	0.0007	0.0002	0.0005	0.2994	-----

Source: Author's Computation, using E-Views 12 (2025)

Table 3 shows correlation result on this paper as the correlation analysis examines the relationship between Adult Mortality Rate (AMT) and various health expenditure components, including Health Capital Expenditure (HCX), Health Recurrent Expenditure (HRX), Health Donor Expenditure (HDX), and Out-of-Pocket Expenditure (OPT). As the correlation coefficient between AMT and HCX is -0.8784, indicating a strong negative relationship. While AMT and HRX have a correlation of -0.8632, also showing a strong negative association. Also, the correlation coefficient between AMT and HDX is -0.5131, suggesting a moderate negative relationship. Likewise, the correlation between AMT and OPT is -0.5694, indicating a moderate negative relationship. However, all the probability value confirms statistical significance at the 5% level.

Stationary tests (unit root tests)
This part of the paper looked at the unit root of each of the variable using the augmented dickey-fuller (ADF) test to ascertain stationarity of the data at 5% level of significance.

Table 4: Unit root test Result

Variable	Augmented Dickey-Fuller (ADF) Test		
	ADF	Critical Value	Status
AMT	-2.225223	-1.952473	1(0)
CHX	-5.505494	-2.963972	1(1)
RHX	-6.184162	-2.963972	1(1)
DHE	-5.934237	-3.580623	1(0)
OPT	-5.317743	-2.963972	1(1)

significant level is 5% level

Source: Researcher's Computation Using EViews-12 (2025)

The augmented dickey-fuller (ADF) test as seen in table 4 is used to examine the stationarity of the variables in the study. the unit root test results show a mixed order of integration, with adult mortality and health donor expenditure stationary at level I(0), while health capital expenditure, health recurrent expenditure, and out-of-pocket expenditure are stationary at first difference I(1). this implies the study may require a Johansen cointegration test to determine the presence of a long-run equilibrium relationship among the variables.

Co-integration of ARDL-bounds test
This section shows the ARDL co-integration bounds test of the variables used in this paper.

Table 5: ARDL-bound testing

Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	13.99284	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.68	3.53
5%	3.05	3.97
2.5%	3.4	4.36
1%	3.81	4.92

Source: Researcher's Computation Using EViews-12 (2025)

Table 5 of the ARDL bound test shows that at 5 per cent level of significant that the F statistics 13.99284 is greater than the lower critical bound 1(0) value of 3.05 and upper critical bound 1(1) value of 3.97signifying that the overall model has a long run impact.

Auto regressive distributed lag (ARDL) regression results

This part of the paper shows the short run, long run impact ARDL regression analysis, the error correction and the model fit.

Table 6: Autoregressive distributed lag (ARDL) Model Results
Dependent Variable: AMT

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AMT(-1))	-0.480676	0.712373	-0.674752	0.5482
D(AMT(-2))	2.291951	1.023073	2.240261	0.1109
D(AMT(-3))	1.533199	0.670340	2.287195	0.1062
D(CHX)	-0.388872	0.206918	-1.879353	0.1568
D(CHX(-1))	-1.112736	0.857595	-1.297507	0.2852
D(CHX(-2))	-0.009100	0.183262	-0.049658	0.9635
D(CHX(-3))	2.031174	1.331787	1.525149	0.2246
D(RHX)	0.347793	0.216115	1.609296	0.2059
D(RHX(-1))	0.097965	0.079614	1.230500	0.3062
D(RHX(-2))	-0.328975	0.262771	-1.251945	0.2993
D(RHX(-3))	0.775809	0.453860	1.709358	0.1859
D(DHE)	18.492781	12.994109	1.423167	0.2499
D(DHE(-1))	-10.828710	5.519079	-1.962050	0.1446
D(DHE(-2))	-5.065024	8.597341	-0.589138	0.5972
D(OPT)	0.577424	0.563619	1.024494	0.3810
D(OPT(-1))	1.138397	0.970721	1.172733	0.3255
D(OPT(-2))	-0.852824	1.058582	-0.805628	0.4794
D(OPT(-3))	-0.584001	0.381632	-1.530273	0.2234
CointEq(-1)	-1.120336	0.515977	-2.171289	0.1183
R-squared	0.998192			
Adjusted R-squared	0.983726			
F-statistic	69.00507			
Prob(F-statistic)	0.002449			
Durbin-Watson stat	2.679260			
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CHX	-2.437689	1.003768	-2.428538	0.0935
RHX	-0.178708	0.029509	-6.056119	0.0090
DHE	33.470038	22.729617	1.472530	0.2373
OPT	-0.086354	0.513934	-0.168025	0.8773
C	443.430289	33.953286	13.060011	0.0010

Source: Researcher's Computation Using EViews-12 (2025)

Table 6 shows the coefficient of the error correction term (CointEq(-1)) is -1.1203, which indicates a strong speed of adjustment towards long-run equilibrium. this means that any short-run deviations from equilibrium in adult mortality rates due to changes in health expenditures are corrected at a rate of 112.03% per year. However, the probability value (0.1183) suggests that the error correction term is not statistically significant at the 5% level, meaning the speed of adjustment is not strongly significant.

The long-run relationship shows that health capital expenditure (CHX) has a coefficient of -2.4377, indicating that an increase in health capital expenditure reduces adult mortality. However, the probability value (0.0935) suggests that the effect is not statistically significant at the 5% level. while health recurrent expenditure (RHX) has a coefficient of -0.1787, meaning higher recurrent health expenditures also reduce adult mortality. the probability value (0.0090) is statistically significant at the 5% level, confirming that this variable has a significant impact on adult mortality. in contrast, health donor expenditure (DHE) has a coefficient of 33.47, implying that an increase in donor-funded health expenditures is associated with higher adult mortality. however, the probability value (0.2373) suggests that this effect is not statistically significant. while out-of-pocket health expenditure (OPT) has a coefficient of -0.0864, indicating a negative but very small effect on adult mortality. the probability value (0.8773) shows that this variable is not statistically significant. The R-squared value of 0.9982 suggests that the independent variables explain 99.82% of the variation in adult mortality in Nigeria. the adjusted r-squared of 0.9837 indicates a good fit after adjusting for the number of explanatory variables. the F-statistic (69.00507) and its probability (0.0024) confirm that the overall model is statistically significant. the durbin-watson statistic (2.679) suggests no severe autocorrelation in the model's residuals.

Furthermore, H_{01}: health capital expenditure has no significant impact on adult mortality in Nigeria. So therefore, based on the probability for CHX is 0.0935, which is greater than 0.05. the null hypothesis is accepted. for H_{02} which state health recurrent expenditure has no significant impact on adult mortality in Nigeria and base on the probability value 0.0090, which is less than 0.05. the null hypothesis is rejected. for the H_{03}: health donor expenditure has no significant impact on adult mortality in Nigeria. the probability is 0.2373, which is greater than 0.05 is accepted. in the same vein H_{04} that state health out-of-pocket expenditure has no significant impact on adult mortality in Nigeria is accepted based on the probability for opt that is 0.8773, which is greater than 0.05 signifying that health out-of-pocket expenditure does not have a statistically significant impact on adult mortality.

Post-estimation checks (ARDL diagnostic test)
The ARDL result as in table are hereby validated in this section

Table 7: Results of ARDL Diagnostic Checks

Tests		**Outcomes**	
		Coefficient	**Probability**
Breusch-Godfrey-Serial-Correlation Test	F-stat.	1.064406	0.3668
Heteroscedasticity-Breusch-Pagan-Godfrey Test	F-stat.	0.569865	0.8050
Normality Test	Jarque-Bera	0.850671	0.653551

Source: Author's Computation Using EViews-9 (2025)

The post-estimation diagnostic tests were conducted to assess the validity and reliability of the estimated model. The Breusch-Godfrey Serial Correlation Test was used to check for autocorrelation in the residuals. The results table 8 showed an F-statistic of 1.0644 with a probability value of 0.3668, which is greater than the 5% significance level. This indicates that the null hypothesis of no serial correlation cannot be rejected, confirming that the residuals are free from autocorrelation, ensuring unbiased estimates. Similarly, the Breusch-Pagan-Godfrey test was conducted to check for heteroscedasticity, revealing an F-statistic of 0.5699 with a probability value of 0.8050. Since the probability is greater than 0.05, we fail to reject the null hypothesis, suggesting that the residuals exhibit homoscedasticity, meaning the variance of errors remains constant across observations. Furthermore, the Jarque-Bera normality test was employed to assess whether the residuals follow a normal distribution. The test yielded a statistic of 0.8507 with a probability of 0.6536, which is also greater than the 5% significance level. As a result, the null hypothesis of normality cannot be rejected, confirming that the residuals are normally distributed. These findings indicate that the estimated model meets the key econometric assumptions, reinforcing the reliability of the results for policy recommendations and economic interpretations.

Discussion of Findings

The long-run coefficients from the ARDL model provide insights into the impact of different components of health expenditure on adult mortality in Nigeria. The interpretation of these findings is based on statistical significance and theoretical alignment with previous studies. The coefficient of Health Capital Expenditure and probability value indicated that while the variable has a negative effect on adult mortality, it is not statistically significant at the 5% level. This implies that capital investments in health infrastructure, such as hospitals, medical equipment, and healthcare facilities, may contribute to reducing mortality rates, but the effect is not strong enough to be conclusive. These findings align with the study by Ataboh and Aigeddion (2023), who found that health capital expenditure in the short run had a negative and insignificant impact on the health sector. The coefficient of Health Recurrent Expenditure (RHX) and probability value indicated a significant negative impact on adult mortality. This suggests that increased recurrent health spending—such as salaries of medical personnel, procurement of drugs, and operational costs—plays a crucial role in reducing mortality rates. This finding is consistent with Kalu *et al.* (2023), who observed that negative and significant relationship between government health expenditure and the under-five mortality rate, indicating that increased public health spending contributed to reducing child mortality. Similarly, World Bank (2021) emphasized that recurrent spending enhances health service delivery and reduces mortality. However, Oladosu *et al.* (2022) found that public health expenditure showed a negative but statistically insignificant relationship with health outcomes.

The coefficient of Health Donor Expenditure (DHE) and probability value indicated a positive but statistically insignificant effect on adult mortality. This suggests that external funding and donor contributions to the Nigerian healthcare sector do not have a

significant impact on reducing mortality rates. This finding aligns with Awogbemi (2023) who found that that increased government expenditure in the health sector has a positive effect on life expectancy rates. Tukur *et al.* (2021) also found that health expenditure increased maternal mortality increases. So also, from the side of government expenditure and infant mortality rate, the result revealed there is significant impact on health.

The coefficient of Out-of-Pocket Health Expenditure (OPT) and probability value indicated a negative and insignificant impact on adult mortality. This suggests that high out-of-pocket health spending does not significantly contribute to reducing mortality rates in Nigeria. This finding aligns with Onifade *et al.* (2019) who observed that recurrent government expenditures were found to have a significant negative impact on economic growth. In order words, in over all, findings indicated that recurrent health expenditure has a significant impact on reducing adult mortality in Nigeria, whereas capital health expenditure, donor health expenditure, and out-of-pocket expenditure do not show statistically significant effects. These results suggest that policy efforts should focus on improving the efficiency of recurrent healthcare spending, ensuring the proper allocation of donor funds, and implementing policies that reduce the burden of out-of-pocket health expenses on households.

Conclusion and Recommendations

This study examined the long-run impact of different components of health expenditure on adult mortality in Nigeria. The findings reveal that recurrent health expenditure significantly reduces adult mortality, while capital health expenditure, donor health expenditure, and out-of-pocket expenditure do not show statistically significant effects. These results emphasize the importance of continuous investment in operational healthcare expenses, such as salaries of medical personnel, medical supplies, and routine health services, in improving health outcomes. The findings also highlight inefficiencies in the allocation of donor funds and the financial burden of out-of-pocket health expenses, which may limit their effectiveness in reducing mortality rates. So therefore, the paper recommends that:

i. Since recurrent health expenditure significantly reduces adult mortality, the Nigerian Federal Ministry of Health (FMoH) and National Primary Health Care Development Agency (NPHCDA) should ensure sustained and increased budgetary allocation for recurrent healthcare spending. This should include timely salary payments for healthcare workers, adequate medical supplies, and improved operational funding for healthcare facilities. The Budget Office of the Federation should also ensure proper monitoring and evaluation of recurrent health spending to optimize efficiency.
ii. Although capital health expenditure was found to have an insignificant effect on adult mortality, investments in health infrastructure remain essential. The Federal Ministry of Finance, Budget, and National Planning and the State Ministries of Health should prioritize health capital expenditure by directing funds toward critical healthcare infrastructure such as hospitals, diagnostic centers, and medical equipment. Additionally, the Infrastructure Concession

Regulatory Commission (ICRC) should collaborate with private sector investors to enhance public-private partnerships (PPPs) for health infrastructure development.

iii. The insignificant impact of donor health expenditure suggests inefficiencies in the utilization of external health aid. The National Health Insurance Authority (NHIA) and Development Partners Coordination Unit (DPCU) of the Federal Ministry of Health should work closely with international donors, including the World Health Organization (WHO), United Nations Development Programme (UNDP), and Global Fund, to ensure better tracking, allocation, and utilization of donor funds. Donor assistance should be directed towards sustainable health programs rather than short-term interventions.

iv. Since out-of-pocket health spending does not significantly reduce mortality, there is a need to strengthen health insurance coverage to reduce financial hardship on households. The National Health Insurance Authority (NHIA) and State Health Insurance Schemes should expand affordable health insurance coverage, particularly for low-income households, to ensure better access to quality healthcare services. Furthermore, the Central Bank of Nigeria (CBN) and Bank of Industry (BOI) should introduce subsidized loan schemes for healthcare financing to reduce the cost of private healthcare services.

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