



PUBLIC HEALTH EXPENDITURE AND MATERNAL MORTALITY IN NIGERIA

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Abstract:

This study examined the effect of public health expenditure on maternal mortality in Nigeria from 2002 to 2021. To achieve this objective, the study utilized data on maternal death, total government expenditure on health, and migration of doctors and nurses trained in Nigeria - doctors and nurses trained in Nigeria but working in other countries from OECD Health Statistics, 2021, WHO, UNICEF, UNFPA, World Bank Group, the United Nations Population Division, and Central Bank of Nigeria Statistical Bulletin. The study employed an Autoregressive Distributed Lag (ARDL) Bounds testing technique for data analyses. The result revealed that in the long run, total government expenditure on health has a negative and significant relationship with maternal mortality in Nigeria. Meanwhile, the migration of doctors and nurses trained in Nigeria - doctors and nurses trained in Nigeria but working in other countries have a positive and significant relationship with maternal mortality in Nigeria. In the short run, total government expenditure on health has a positive and significant relationship with maternal mortality in Nigeria. At the same time, the migration of doctors and nurses trained in Nigeria - doctors and nurses trained in Nigeria but working in other countries has a negative and significant relationship with maternal mortality in Nigeria. Based on the findings of this study, it is recommended here that the government should step up investment in all components of health infrastructure to cope with the explosive population growth requiring medical services in Nigeria. Put differently, a crucial effort should be made by the government to channel more funds to the health sector in order to improve health standards, reduce the mortality rate and hence the life expectancy of the citizens since a healthy population and workforce is a major ingredient for rapid and sustainable productivity and growth.

Keywords: public health expenditure, maternal mortality, ARDL and Nigeria

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1. Introduction

In both developed and developing nations, mothers play important roles in economic, social, and political development. They participate in the production of goods and services in all nations of the world. They are also children-bearers. They nurture newborn children into maturity. Their health affects everything from how much they enjoy life to what work they can perform. Health improvement influences the productivity of mothers. At every given point in time, there is a link between the health of a mother and that of a newborn child. Therefore, it is important to minimize the risk of mothers falling ill and to promote their health in order to increase their productivity and earning capacity. This explains why one of the United Nations' Sustainable Development Goals (SDGs) aims at ensuring healthy lives and promoting well-being for all at all ages. The challenge of combating maternal mortality is widely considered as one of the key policy priorities for every country in the world. The persistent government budget allocation on social expenditure, including health, represents one of the key instruments to tackle maternal mortality and one of the drivers to meet important elements of the Sustainable Development Goals (SDGs).

Therefore, it is crucial to put the health sector in a good state through adequate funding to deliver quality healthcare to the inhabitants of Nigeria. Adequate investments in childcare and healthcare together with resources available for households through direct transfers, are expected to reduce the maternal mortality rate to near-zero level. Amazingly, Nigeria has not been able to deliver quality healthcare to the majority of its inhabitants because the health sector in Nigeria suffers poor funding.

In 2020, Azuh, Osabohien, Orbih, and Godwin argued that public spending on health in Nigeria is very low, leading to poor access to quality health care, high morbidity, and mortality in addition to low productivity and economic growth. Available data from the publications of the Central Bank of Nigeria (CBN) revealed that in 2013, consolidated federal government spending on key primary welfare sectors indicated that expenditure on health dropped by 12.5 percent relative to its level in 2012 to N212.4 billion. In 2014, analysis of Federal Government expenditure on the primary welfare sectors indicated that outlay on health rose by 11.4 percent to 236.7 billion relative to its level in 2013 (CBN, 2014). In 2015, analysis of total Federal Government spending on the primary welfare sector indicated that the outlay on health increased by 21.7 percent from the level in 2014 to N288.0 billion (CBN, 2015). In 2016, analysis of total Federal Government spending on the primary welfare sector revealed that the outlay on health decreased by 19.3 percent to N232.5 billion from the level in 2015 (CBN, 2016). In 2017, analysis of total Federal Government spending on the primary welfare sectors revealed that outlay on health increased by 22.7 percent to N305.6 billion over the level in 2016 (CBN, 2017). In 2018, Analysis of total Federal Government spending on the primary welfare sectors revealed that expenditure on health increased by 22.8 percent to N367.1 billion compared with the level in 2017 (CBN, 2018). In 2019, an Analysis of total Federal Government spending on the primary welfare sectors revealed that expenditure on health increased by 25.6 percent to N461.3 billion compared with the level in 2018 (CBN, 2019).

The poor funding of the health sector which is reflected in the area of poor state of the infrastructural facilities, poor salaries to health workers, inadequate staffing, etc. has resulted in intermittent strikes by some unions including the Nigerian Medical Association. This state of affairs can harm the maternal mortality rate. As reported by Umo (2012), inadequate investment in all components of health infrastructure including personnel to cope with the explosive population growth requiring medical services has affected health outcomes in Nigeria. Another challenge facing the sector is that a large number of healthcare professionals have continuously migrated to more developed countries. Medical brain drain (migration of doctors and nurses trained in Nigeria) has become one of the contributing factors leading to the continuous deterioration of Nigeria's health sector. The scarcity of qualified healthcare professionals in Nigeria due to brain drain has negatively affected the nation's health sector. In Nigeria, human health indicators are very poor and these are reflections of grossly inadequate health infrastructure. According to Akpakpan (1999), health facilities are inadequate and also are poorly maintained. Examples of health statistics reflecting poor health infrastructure include a high maternal mortality rate (Umo, 2012).

According to WHO (2019), maternal mortality (Maternal mortality includes deaths of women during pregnancy, delivery, and 42 days after delivery excluding deaths that were due to accidents or violence). Between 2005 and 2015, it is estimated that over 600,000 maternal deaths and no less than 900,000 maternal near-miss cases occurred in the country. In 2015, the country's estimated maternal mortality ratio was over 800 maternal deaths per 100,000 live births, with approximately 58,000 maternal deaths during that year. WHO (2019) identified delays in accessing adequate levels of healthcare due to poor funding of the health sector and shortages of health professionals playing a major part in the occurrence of maternal deaths in Nigeria. A report by the World Health Organisation (WHO) tagged "The 2023 Progress Report", revealed that Nigeria is now second highest among countries with a high number of maternal deaths in the world as Nigeria accounts for 29 percent of the global toll in 290,000 maternal deaths cases every year and may miss the SDG target by 2030. The country also ranked highest globally in incidences of neonatal and child deaths (Vanguard Newspaper, May 12, 2023).

Empirical studies on the effect of public health care expenditure on maternal mortality have produced conflicting or mixed results. While some studies including Aziz, He, Sarker, and Sui (2018) produced evidence of a positive relationship between public healthcare expenditure and maternal mortality. That is, a one percent rise in healthcare expenditure will increase the maternal mortality rate, others including Nwankwo (2018), Igbinedion and Olele (2018), Owusu, Sarkodie, and Pedersen (2021) showed a negative relationship between public healthcare expenditure and maternal mortality. That is the maternal mortality rate declines as public health care spending increases. The difference in empirical findings on the effect of public health care expenditure on maternal mortality is of serious concern, especially in Nigeria. The above state of affairs raised a pertinent question: what is the relationship between public health care expenditure and maternal mortality in Nigeria? An answer to this question was the major concern of this work because maternal mortality has been a burning issue in Nigeria. The remaining segments

of this paper were organized into a literature review, materials and methods, results and discussions, conclusion, and recommendations.

2. Literature Review

2.1 Stylized Facts on Maternal Mortality Rate and Public Health Expenditure

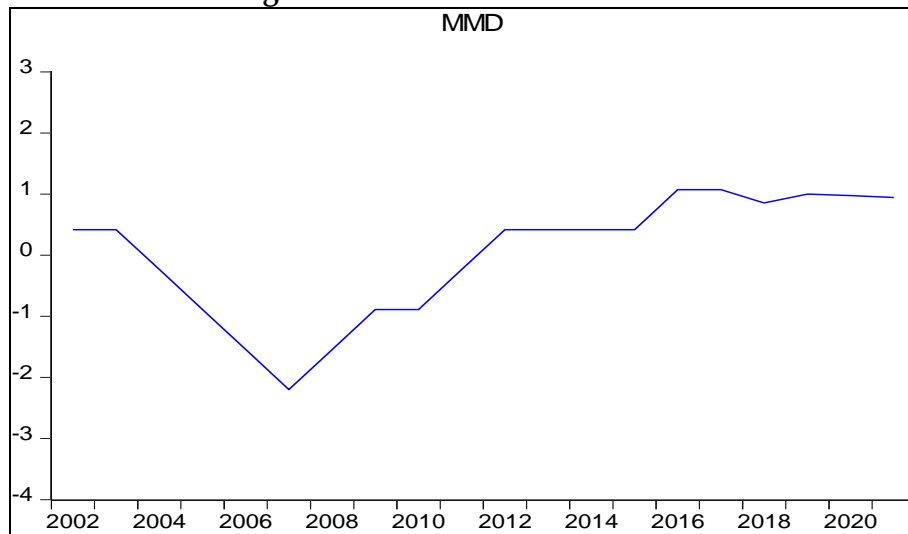
The World Health Organization (WHO) defined a maternal death as “*the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes*”. Furthermore, the maternal mortality rate is the number of resident maternal deaths within 42 days of pregnancy termination due to complications of pregnancy, childbirth, and the puerperium in a specified geographic area (country, state, county, etc.) divided by total resident live births for the same geographic area for a specified time period, usually a calendar year, multiplied by 100,000. Maternal death has remained a major challenge to the health system in Nigeria.

According to WHO (2019), maternal deaths in Nigeria stood at 66000 in 2002 and 2003. In 2004, 2005, 2006, 2007, 2008, 2009, and 2010 it stood at 65000, 64000, 63000, 62000, 63000, 64000, and 64000 respectively. It increased slightly from 64000 in 2010 to 65000 in 2011. In 2012, 2013, 2014, and 2015 maternal deaths stood at 66000 respectively. It was 67000 in 2016 and 2017. According to the Nigeria Demographic and Health Survey (2018, NDHS), the maternal mortality ratio is 512 deaths per 100,000 live births. Thus, for every 1,000 live births in Nigeria, about five women die during pregnancy, childbirth, or within two months of childbirth. Clearly, there is a need for the government to continuously invest in promoting maternal and child health. The reasons for the increase in maternal deaths in Nigeria include inadequate health personnel/facilities, poverty, and early marriage. Importantly, banditry/insurgency has also hindered pregnant women from ante-natal services. The trend of maternal mortality is presented in Figure 1.

2.2 Trend of Maternal Deaths

Public expenditure on health is needed to ensure that the health sector is in good condition to deliver quality healthcare services to the inhabitants of Nigeria. In order to ensure that the health sector functions very well in Nigeria at the rate needed to significantly reduce maternal mortality rate, successive governments in Nigeria have allocated huge sums of money, often meagre relative to the importance of this sector in various budgets to increase labour productivity, economic growth and well-being of the inhabitants of Nigeria. For instance, in 2013, consolidated federal government spending on key primary welfare sectors indicated that expenditure on health dropped by 12.5 percent relative to its level in 2012 to N212.4 billion (CBN, 2013).

Figure 1: Trend of Maternal Deaths



Source: Computed by the researcher using E-Views 10.

In 2014, analysis of Federal Government expenditure on the primary welfare sectors indicated that outlay on health rose by 11.4 percent to 236.7 billion relatives to its level in 2013 (CBN, 2014). In 2015, analysis of total Federal Government spending on the primary welfare sector indicated that the outlay on health increased by 21.7 percent from the level in 2014 to N288.0 billion (CBN, 2015). In 2016, analysis of total Federal Government spending on the primary welfare sector revealed that the outlay on health decreased by 19.3 percent to N232.5 billion from the level in 2015 (CBN, 2016). In 2017, analysis of total Federal Government spending on the primary welfare sectors revealed that outlay on health increased by 22.7 percent to N305.6 billion over the level in 2016 (CBN, 2017). In 2018, Analysis of total Federal Government spending on the primary welfare sectors revealed that expenditure on health increased by 22.8 percent to N367.1 billion compared with the level in 2017 (CBN, 2018). In 2019, Analysis of total Federal Government spending on the primary welfare sectors revealed that expenditure on health increased by 25.6 percent to N461.3 billion compared with the level in 2018 (CBN, 2019). Even with the above expenditure in the health sector, the services of the health sector in Nigeria have remained generally poor.

2.3 Theoretical Literature

Theoretically, Keynes (1936) argued that fiscal policy instrument (i.e., government expenditure) is an important tool for achieving short-term stability and superior long-run growth rate. Therefore, government expenditure is needed to improve the performance of various sectors of the economy including the health sector. Following Keynes' line of thinking, to have a better healthcare system in the economy, the government must intervene in the economy through economic policy specifically fiscal policy (government expenditure in the health sector). To the Keynesians, increased investment in health care by the government will improve health and productivity in the economy. Improved capabilities of health care lead to a reduction in maternal mortality rate. It will also reduce healthcare costs for families. This can stimulate or increase the

output growth of the country. At the same time, expenditure to improve the welfare of medical workers (a good salary scheme and incentives) will boost the morale of the medical workforce for efficiency which in turn will help to reduce brain drain, infant mortality rate, and maternal mortality rate. Following this theory, maternal mortality is a function of government expenditure in the health sector. That is,

$$\text{MMR} = (\text{GEX}) \quad (1)$$

Where,

MMR is maternal death, and

GEX is government expenditure in the health sector.

3.1 Review of Related Empirical Literature

Empirically, Nwankwo (2018) examined the effects of public health spending on maternal mortality in Nigeria. A panel data regression analysis was employed from the years 2003 to 2015 from selected 25 States in Nigeria. The study adopted an instrumental variables strategy as a solution for possible endogeneity for its econometric analysis. After controlling for other relevant covariates like female per capita income, female literacy rate, and urbanization, the study revealed that public health expenditure is a vital factor in reducing incidences of maternal mortality in Nigeria.

Using fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) models, Aziz, He, Sarker, and Sui (2018) explored the association between expenditure on health and maternal mortality by using a data set consisting of 18 years spanning 2000 to 2017. The results showed that a one percent rise in health expenditure increased the maternal mortality rate by 1.95 percent in the case of FMOLS estimator and 0.16% in the case of DOLS estimator. The findings also revealed that population growth has a significant long-term effect on maternal mortality—an increase of 40% in the case of FMOLS and 10% in the case of DOLS—and inferred that an increase in population growth has also dampened efforts towards reducing maternal mortality in the South Asian panel. Furthermore, the results in the case of economic growth, sanitation, and clean fuel technologies showed significant long-term negative effects on maternal mortality by 94%, 7.2%, and 11%, respectively, in the case of the FMOLS estimator, and 18%, 1.9%, and 5%, respectively, in the case of the DOLS estimator. The findings suggest that gross domestic product, access to sanitation, and clean fuel technologies are more nuanced in reducing maternal mortality.

Igbinedion and Olele (2018) studied the association between public health expenditure and health outcomes (maternal mortality) in Nigeria spanning 1981 to 2014. The study employed the error correction model technique. The results of the analysis revealed that the maternal mortality rate declined as both public health spending and private health expenditure rise, suggesting that public health spending does not crowd out private health financing within the Nigerian context. The poverty rate was, however, found to contribute significantly to the rising rate of maternal mortality. Finally, health-

oriented official development assistance had a negative but insignificant impact on the maternal mortality rate in Nigeria.

Rana, Alam, and Gow (2018) studied the association between health expenditure and health outcomes. Heterogeneity and cross-section dependence were controlled for in the panel data which consist of 161 countries over the period 1995–2014. Infant, under-five, and maternal mortality along with life expectancy at birth were selected as health outcome measures. Cross-sectional augmented IPS unit root, panel autoregressive distributed lag, Dumitrescu-Hurlin, and the Toda-Yamamoto approach to Granger causality tests were used to investigate the relationship across four income groups. An impulse response function modeled the impact on health outcomes of negative shocks to health expenditure. The results indicated that the health expenditure and health outcome link is stronger for low-income compared to high-income countries. Furthermore, rising expenditure on health can reduce child mortality but has an insignificant association with maternal mortality at all income levels. Countries with lower incomes are more at risk of adverse impacts on health because of negative shocks to health expenditure. Variations in child mortality are better explained by rising health expenditure than maternal mortality. However, the estimated results showed dissimilarity when different assumptions and methods were used. The study concluded that the influence of health expenditure on health outcomes varies significantly across different income levels except for maternal health.

Achille and Steve (2018) assessed the impact of out-of-pocket (OOP) health expenditure on maternal health outcomes using a panel of twenty Central and Latin American countries between 2000 and 2015. Six different estimation techniques were used in the analysis in order to check the robustness of the findings. Those estimation techniques were: the ordinary least squares method, the Prais-Winsten correlated panels corrected standard error regression, the fixed and the random effects models, the generalized least squares method, and the bias-corrected least squares dummy variable method. After controlling for gross domestic product, remittances, and female education, it was discovered that a surge in out-of-pocket health expenditure meaningfully deteriorates maternal health as it leads to a decrease in skilled birth attendance and an increase in maternal mortality. It was also found that in Central and Latin American countries, educated women tended to be healthier, and maternal health care was mainly financed with the money received from friends and family members living abroad.

Aderopo and Emmanuel (2019) examined the impact of public health expenditure on the infant mortality rate in Nigeria between 1991 and 2018 using time series data. The Fully Modified Ordinary Least Square (FMOLS) analytical method was used to examine the relationships. Various robustness checks were carried out to ensure the reliability of the result for policymakers. Findings revealed that all variables employed positively impacted infant and maternal mortality except for Diphtheria, Pertussis, and Tetanus (DPT) immunization and female literacy rate.

In Zimbabwe, Wellington, Laston, Apivat, Stephen, and James (2020) investigated the association between government health expenditure and maternal mortality between 1980 and 2011. The study used multiple regression analysis. The result revealed that

government health expenditure had a statistically significant association with maternal mortality, with less expenditure associated with high rates of maternal mortality. This substantiates the proposition that expenditure made by the government on health is one of the major determinants of maternal mortality in Zimbabwe. An increase in government health expenditure will contribute to a significant reduction in maternal mortality. Institutional delivery and the proportion of people living below the Total Consumption Poverty Line (TCPL) were negatively correlated with maternal mortality.

Owusu, Sarkodie, and Pedersen (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 outcomes and health expenditure. The researchers found a negative relationship between expenditure on health and mortality across all percentiles. Infant mortality rate declines between 0.19 percent and 1.45 percent while the maternal mortality rate declines ranging from 0.09 percent to 1.91 percent. To attain the sustainable development goal of ensuring healthy lives and well-being of all people (i.e., SDG 3), the study inferred that expenditure on health potentially reduces maternal and infant mortality across countries with lower and middle income. The researchers highlighted the need for enhanced health care expenditure, especially in developing countries to curb the levels of infant and maternal deaths.

Fatoye (2021) used Ordinary Least Square (OLS) to assess the impact of healthcare expenditure on the Maternal Mortality Rate (MMR) in Nigeria for the period of 16 years (2000-2015). The study used time series data comprising the Maternal Mortality Rate (MMR), Private Health Expenditure, Public Health Recurrent Expenditure, and Public Health Capital Expenditure (HCEXP) obtained from the World Bank development reports and the Central Bank of Nigeria (CBN) annual statistical bulletin respectively. The results of the study showed that the health recurrent expenditure had the most positive significant impact on the maternal mortality rate. However, the impact of private health expenditure on maternal mortality was insignificant. Similarly, capital expenditure on health had a long-run significant but negative effect on maternal mortality.

Aziz, He, Sarker, and Sui (2021) employed the fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) models to investigate the association between expenditure on health and maternal mortality by using a data set consisting of 18 years from 2000 to 2017. The results revealed that a 1% rise in expenditure on health increased the rate of maternal mortality by 1.95 percent in the case of FMOLS estimator and 0.16 percent in the case of DOLS estimator. The findings also revealed that population growth has a significant long-term effect on maternal mortality—an increase of 40% in the case of FMOLS and 10% in the case of DOLS—and infers that an increase in population growth has also dampened efforts towards reducing maternal mortality in the South Asian panel. Further, the results in the case of economic growth, sanitation, and clean fuel technologies showed significant long-term negative effects on maternal mortality by 94%, 7.2%, and 11%, respectively, in the case of the FMOLS estimator, and

18%, 1.9%, and 5%, respectively, in the case of the DOLS estimator. The findings suggest that gross domestic product, access to sanitation, and clean fuel technologies are more nuanced in declining maternal mortality.

A systematic scrutiny of the previous empirical studies on the effect of public healthcare expenditure on maternal mortality has produced conflicting or mixed results. While some studies including Aziz, He, Sarker, and Sui (2018) produced evidence of a positive relationship between public healthcare expenditure and maternal mortality. That is, a one percent rise in healthcare expenditure will increase the maternal mortality rate, others including Nwankwo (2018), Igbinedion and Olele (2018), Owusu, Sarkodie, and Pedersen (2021) showed a negative relationship between public healthcare expenditure and maternal mortality. That is the maternal mortality rate declines as public health care spending increases. Meanwhile, some of these studies adopted the ordinary least squares, while others applied Autoregressive Distributed Lag (ARDL) Bound test technique for data analysis, thereby recording incongruent empirical results. In related terms, previous studies have lost touch on the current realities of the influence of public healthcare expenditure on infant mortality in Nigeria. The previous studies ignored the impact of medical brain drain (doctors and nurses trained in Nigeria but working in other countries) on the health sector in Nigeria. That is, none of the above scholars included medical brain drain (using data on migration of doctors and nurses trained in Nigeria but working in other countries) in their models to see how doctors and nurses migration has affected the infant mortality rate in Nigeria. In view of the foregoing, this research is unique and differs from others. This study investigated the effect of public healthcare expenditure on maternal mortality in Nigeria from 2002 to 2021.

3. Material and Methods

3.1 Framework Specification

The research model for this study was founded on the explicit form of the Keynesian idea which made it clear that expenditure to improve the health sector and welfare of medical workers (a good salary scheme and incentives) will boost the morale of the medical workforce for efficiency which in turn will help to reduce maternal mortality rate and brain drain. That is, $MMR = f(GEX)$ (1^a see theoretical framework) where; MMR is maternal death and GEX is government expenditure on the health sector. Also, the loss of a significant number of skilled healthcare workers through migration has an effect on the infant mortality rate in Nigeria. Based on this, migration (outflow of doctors and nurses) is captured in the model as one of the variables that affect the infant mortality rate in Nigeria.

Therefore, the model for this study is presented thus:

$$MMR = f(TGEH, MDN) \quad (2)$$

The linear form of equation (2) produced:

$$\text{MMR}_t = \alpha_0 + \alpha_1 \text{TGEH}_t + \alpha_2 \text{MDN}_t + \varepsilon_t \quad (3)$$

The long form of equation (2) produced:

$$\text{LnMMR}_t = \alpha_0 + \alpha_1 \text{LnTGEH}_t + \alpha_2 \text{LnMDN}_t + \varepsilon_t \quad (4)$$

Where,

MMR is maternal mortality (maternal death),

TGEH is the total government expenditure on health,

MDN is doctors and nurses trained in Nigeria but working in other countries,

ε is an error term that denotes other variables not included in the model,

t is the period of time, and

Ln is natural logarithm.

The parameter estimates are expected to behave in line with $\alpha_1 < 0$ and $\alpha_2 > 0$.

3.2 Sources of Data

This study sourced data on total government expenditure on health, maternal mortality, and brain drain (migration of doctors and nurses trained in Nigeria). This study sourced data from World Health Organization (WHO) 2019, Central Bank of Nigeria Statistical Bulletin, OECD Health Statistics, 2021.

Specifically, data on migration of doctors and nurses trained in Nigeria were obtained from OECD Health Statistics (2021). Data on maternal mortality were obtained from WHO (UNICEF, UNFPA, World Bank Group, and the United Nations Population Division). Data on total government expenditure on health were obtained from Central Bank of Nigeria Statistical Bulletin of various issues.

3.3 Techniques of Data Analysis

This study first of all employed the Augmented Dickey Fuller (ADF) unit root test to check the order of integration of the variables in the model. That is, ADF was used to test for the unit root property of the variables included in the model. The general form of ADF is estimated by the following regression:

$$\Delta \text{LS}_t = \alpha_0 + \alpha_1 \text{LS}_{t-1} + \sum \alpha_i \Delta \text{LS}_i + \delta_t + u_t \quad (5)$$

Where,

y is a time series,

t is a linear time trend,

Δ is the first difference operator,

α_0 is a constant,

n is the optimum number of lags in the independent variables, and

u is the random error term.

The variables were integrated of order (0) and (1). For this reason, this study checked for cointegration via Autoregressive Distributed Lag (ARDL) Bounds testing

approach. The ARDL cointegration approach was developed by Pesaran and Shin (1999) and Pesaran et al. (2001). Furthermore, the ARDL model which uses a bounds test approach based on unrestricted error correction mechanism (UECM) was employed here to measure the effect of public health expenditure on maternal mortality in Nigeria and also to test for a long run relationship among the relevant variables. The main advantage of this approach lies in the fact that it can be applied irrespective of whether the variables are 1(0) or 1(1). This approach also allows for the model to take a sufficient number of lags to capture the data generating process in a general-to-specific modeling framework. Therefore, the ARDL model based on equation 4 is presented thus:

$$\Delta \ln MMR_{t,j} = a_0 + a_1 \ln MMR_{t-1,j} + a_2 \ln TGEH_{t-1,j} + a_3 \ln MDN_{t-1,j} + \sum_{i=1}^{n1} a_{1i,j} \Delta \ln MMR_{t-1,j} + \sum_{i=0}^{n2} a_{2i,j} \Delta \ln TGEH_{t-1,j} + \sum_{i=0}^{n3} a_{3i,j} \Delta \ln MDN_{t-1,j} + \mu_t \quad (6)$$

Please, note the variables as earlier defined.

3.4 Post Estimation Tests

Post estimate tests were performed in this study to confirm whether or not the statistical criteria of the estimated model are met, to validate whether parameters are reliable and to determine whether the model is generally fit for policy recommendations. Thus, the Wald test and Jarque-Bera test for normality are the various post estimate tests that were conducted in this study.

4. Results and Discussion

Table 1: Augmented Dickey-Fuller Unit Root Test (2002-2021)

Variables	ADF Test Statistic @ Level	ADF Test Critical Value @ 5% (level)	Order of Integration	ADF Test Statistic @ 1 st Difference	ADF Test Critical Value @ 5% (1 st Diff.)	Order of Integration
MMR	-4.367485	-3.733200	Stationary	-	-	1(0)
TGEH	-4.931967	-3.081002	Stationary	-	-	1(0)
MDN	-1.837781	-3.029970	Not Stationary	-5.608647	-3.040391	1(1)

Note: MMR, TGEH and MDN as earlier defined.

Source: Computed by the researcher using E-Views 10.

To avoid spurious regressions which may arise as a result of carrying out regressions on time series data, this study first subjected the data to stationarity test by using the Augmented Dickey Fuller (ADF) test.

The stationarity test results presented in Table 1 show that at 5% level of significance, the variables were stationary. For instance, MMR and TGEH were stationary at level 1(0). While MDN was stationary at first difference 1(1). That is, it became stationary at first difference (integrated of order one). Given that the variables were integrated in order 1(0) and 1(1). The requirement to fit in an ARDL model to test for a long-run relationship is satisfied.

Table 2: ARDL Bounds Co-integration Test Result

Model		F-Statistic = 7.155007
MMR = F(TGEH, MDN)		K = 2
Critical Values	Lower Bound	Upper Bound
5%	4.87	5.85

Source: Computed by the researcher using E-Views 10.

From the ARDL bounds test result presented in Table 2, it is clear that there is a long-run relationship among the variables (MMR, TGEH, and MDN). This is because the computed F-statistic of about 7.155007 is higher than the lower and upper critical bounds at a 5% critical value. This provided evidence to reject the null hypothesis of no co-integration at a 5% significance level for the maternal mortality (MMR) model. It can therefore be concluded from the ARDL bounds test that there is a long-run relationship among the variables. Therefore, this study illustrates that total government expenditure on health (TGEH), as well as migration of doctors and nurses trained in Nigeria - doctors and nurses trained in Nigeria but working in other countries (MDN) have a long-run relationship with maternal mortality (MMR) in Nigeria. Following the establishment of long-run co-integration relationship among the variables, the long-run and short-run dynamic parameters for the variables were obtained.

Table 3: Estimated ARDL Long Run Coefficients. Dependent Variable: MMR (3, 3, 3)

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(TGEH)	-0.477065	0.102482	-4.655131	0.0096
LOG(MDN)	0.051697	0.011295	4.576915	0.0102

Source: Computed by the researcher using E-Views 10.

The estimated ARDL long-run coefficients reveal that total government expenditure on health has a negative and significant relationship with maternal mortality. This means that in the long run, a percentage increase in total government expenditure on health will decrease maternal mortality in Nigeria. This conforms to the apriori expectation. At the same time, the migration of doctors and nurses trained in Nigeria - doctors and nurses trained in Nigeria but working in other countries have positive and significant relationship with maternal mortality. This means that in the long run, a percentage increase in migration of doctors and nurses trained in Nigeria - doctors and nurses trained in Nigeria but working in other countries will increase maternal mortality in Nigeria. This also conforms to the apriori expectations.

Table 4: Error Correction Representation for the Selected ARDL Model ARDL (3, 3, 3)

Regressors	Coefficients	t-Statistic	P-Value
DLOG(TGEH)	0.097358	4.490612	0.0109
DLOG(MDN)	-0.014204	-3.543778	0.0239
ECM (-1)	-0.687452	-5.674287	0.0048
R-squared = 0.971025 Durbin-Watson stat = 2.942491			
Adjusted R-squared = 0.922732 Akaike info criterion = -8.487225			
Schwarz criterion = -7.948086			

Source: Computed by the researcher using E-Views 10.

The above-tabulated result of the dynamic model suggests that the model is a good fit, as the power of the predictors, captured as the R^2 accounted for about 97 percent variations in the model. In other words, an estimated R^2 result of 0.971025 disclosed that 97 percent of the vicissitudes in maternal mortality were due to changes in total government expenditure on health, as well as migration of doctors and nurses trained in Nigeria - doctors and nurses trained in Nigeria but working in other countries. Hence, the explanatory influence of the regressors included in the model is 97 percent. In terms of the autocorrelation problem, the estimated Durbin Watson's (DW) value, which is 2.942491, suggests that autocorrelation is not a problem for the model. The coefficient of ECM has the hypothesized negative sign (-0.687452). This shows that the variables employed properly adjusted from the short-run dynamics to long-run stability.

The coefficient of total government expenditure on health is positively signed. This outcome is not consistent with the theoretical expectation in economics. This means that a one percent increase in this regressor (total government expenditure on health) will increase maternal mortality by 0.097358 percent. That is, a percentage increase in total government expenditure on health did not help to reduce maternal mortality in Nigeria during the period of study. This is suggestive that released budgetary allocations for the health sector have not been so employed as is blamable for mismanagement and corruption, consequently undermining health workers' productivity in Nigeria. This outcome reflects that the prevailing healthcare system is not adequate for reducing maternal mortality. Also, the meager system and the priorities established by an elitist system in which the powerless and poor are not considered may lead to worsen the situation. Statistically, the absolute t-statistic value of total government expenditure on health appeared significant; meaning that there is a significant relationship between total government expenditure on health and maternal mortality in Nigeria. It also means that health expenditure significantly deteriorates maternal health as it leads to an increase in maternal mortality. This finding corroborates the empirical work of Fatoye (2021) which produced evidence of a positive and significant relationship between public healthcare expenditure and maternal mortality, this also suggests that if this predictor (total government expenditure on health) is properly managed it will reduce Nigeria's maternal mortality rate.

The coefficient of migration of doctors and nurses trained in Nigeria - doctors and nurses trained in Nigeria but working in other countries is negatively signed. This outcome is not consistent with the theoretical expectation in economics. This means that a one percent increase in this regressor (migration of doctors and nurses trained in Nigeria) will decrease maternal mortality by 0.014204 percent. However, the absolute value of the t-statistic of migration of doctors and nurses trained in Nigeria slope coefficient is significant, this means that there is a significant relationship between doctors and nurses trained in Nigeria and maternal mortality in Nigeria during the period of study.

4.1 Post Diagnostic Test Results

This study specifically employed the Wald and normality tests. The Wald test was applied for the confirmation of the joint significance of the coefficients of the causal variables utilized in the ECM model. The F-statistic in Table 5 was utilized to ascertain this. For the normality test, the Jarque-Bera statistic was applied to examine whether the error term in the ECM model is normally distributed at 5 percent significance level or not. The normality result is presented in Figure 2.

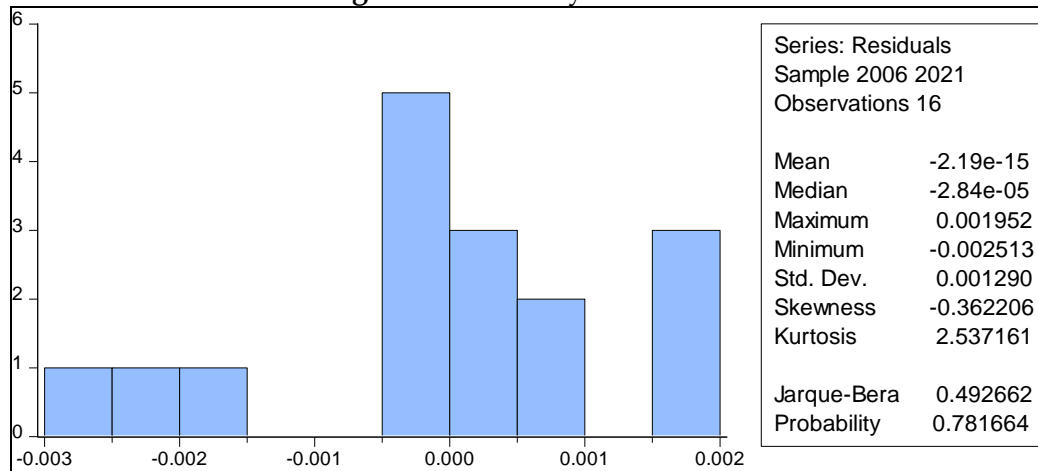
Table 5: Wald Test for Coefficient of Restrictions

Test Statistic	Value	Df	Probability
F-statistic	74.72929	(3, 2)	0.0123
Chi-square	224.1879	3	0.0000

Source: Computed by the researcher using E-Views 10.

The result organized in Table 5 revealed that the F-statistic value is approximately 75, and its probability value of 0.0000 is less than 0.05 at the conventional 5 per cent level. Thus, it follows that all the explanatory variables included in the model are collectively significant in explaining the maternal mortality condition of Nigeria over the sampled period of this study.

Figure 2: Normality Test Result



Source: Computed by the researcher using E-Views 10.

The result shown in Figure 2 depicts that the error term is normally distributed at the conventional level (i.e., 5%). This is because the probability value of the Jarque-Bera statistic of approximately 0.78 is greater than the 0.05% conventional level. This implies that the Jarque-Bera statistic hypothesis of normally distributed residuals in the parsimonious ECM model is accepted.

5. Conclusion and Recommendations

In Nigeria, human health indicators are very poor and these are reflections of grossly inadequate health infrastructure. Examples of health statistics reflecting poor health

infrastructure include a high infant mortality rate - the death of an infant before the infant's first birthday. In order to ensure that the health sector functions very well at the rate needed to significantly reduce infant mortality rate, successive governments in Nigeria have allocated huge sums of money, often meagre relative to the importance of this sector in various budgets. This study investigated the effect of public health expenditure on maternal mortality in Nigeria from 2002 to 2021. To achieve this goal, the study utilized data on maternal death, total government expenditure on health, and migration of doctors and nurses trained in Nigeria - doctors and nurses trained in Nigeria but working in other countries from OECD Health Statistics, 2021, WHO, UNICEF, UNFPA, World Bank Group, the United Nations Population Division and Central Bank of Nigeria Statistical Bulletin of various issues. The study employed an Autoregressive Distributed Lag (ARDL) Bounds testing technique for data analyses. The result revealed that in the long run, total government expenditure on health has a negative and significant relationship with maternal mortality in Nigeria. Meanwhile, the migration of doctors and nurses trained in Nigeria - doctors and nurses trained in Nigeria but working in other countries have a positive and significant relationship with maternal mortality in Nigeria. In the short run, total government expenditure on health has a positive and significant relationship with maternal mortality in Nigeria. At the same time, the migration of doctors and nurses trained in Nigeria - doctors and nurses trained in Nigeria but working in other countries have a negative and significant relationship with maternal mortality in Nigeria. What this means is that though there have been expenditures on the health sector in Nigeria by the government from 2002 to 2021, the expenditures are low and couldn't reduce maternal deaths to a near-zero level in Nigeria. Based on the foregoing, it is recommended here that the government should step up investment in all components of health infrastructure to cope with the explosive population growth requiring medical services in Nigeria. Put differently, a crucial effort should be made by the government to channel more funds to the health sector to improve health standards and reduce the mortality rate and hence life expectancy of the citizens since a healthy population and workforce is a major ingredient for rapid and sustainable productivity and growth.

Conflict of Interest Statement

The author declares no conflicts of interest.

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