The Effectiveness of Government Health Finance and Primary Health Care Outcome in Nigeria: Autoregressive Distributive Lag Model Approach

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ABSTRACT
Among the basic functions of government, is the provision of effective health care delivery and services. This is made possible by government efficient funding of the health-care sector. Therefore, this study tends to investigate the effectiveness of government health finance on primary health care outcome especially, infant mortality rate in Nigeria. A secondary data from Central Bank of Nigeria statistical bulletin and World Bank Indicator on Public Health Expenditure which ranges from 1990 to 2023 were used. The method of Autoregressive distributive lag (ARDL) model were employed to analyze the data. The model provided a co-integrating relationship among the variables of the study. Augmented Dickey Fuller (ADF) test statistic was significant at the 5% level of significance. The regression coefficient of constant is positive and it is statistically significant (P-value < 0.05) which implies that infant mortality rate is 46.31922 at the beginning of the study period, when other variables are not operational or held constant. Also, apart from out-of-pocket expenditure (OOP), other variables which include Public health expenditure (PHEXP), and health insurance (HI) were statistically significant in explaining infant mortality rate. With regards to effect of out-of-pocket health expenditure on households, the study recommends a shift from out-of-pocket health payments to pre-payment mechanism of health insurance or a subsidized healthcare system as this may be the only way to reduce financial burden Nigerian citizen.

KEYWORDS
Autoregressive distributive lag model, Public health expenditure, Infant mortality rate, out-of-pocket expenditure, health insurance.

1. Introduction

The public healthcare (PHC) financing system in Nigeria is a structure involving various government levels (federal, state, and local), international donors, private sector contributions, and out-of-pocket expenditures by citizens to fund the healthcare institution. According to Uzochukwu [18] and Soyibo et al. [16], the purposes of healthcare

financing are to make funds available, ensure suitable choice and procurement of cost-effective interventions, give suitable financial incentives to providers and ensure that all persons have access to effective health services, achieving equity and efficiency in the use of healthcare spending, ensure that essential healthcare goods and services are adequately provided for and ensure that the budget is spent prudently so that the Millennium Development Goals (MDGs) are met. Health Care Financing Options in Nigeria according to Yunusa et al. [22] include tax revenue, out-of-pocket payment, donor funding and health insurance. In examining Nigeria's PHC system and possible causes of underperformance empirically, Kress et al. [8] used the primary health care performance indicators conceptual framework including recent facility-level information from the World Bank Service Delivery Indicators Survey. Results revealed that Nigeria has a relative abundance of PHC centres with reasonable geographic accessibility and relatively high health worker density. However, the performance of the PHC system is hindered by segmented supply chains; lack of financial access to PHC; lack of infrastructure, drugs, equipment, and vaccines at the facility level and poor health worker performance. The study observed that Nigeria ranks low on nearly all PHC performance indicators when compared with peer African countries. In trying to ascertain how health expenditure influences health outcome and economic growth; how health outcomes influence economic growth, Ogunjimi and Adebayo [12] used the method of Toda-Yamamoto causality framework for a period of 1981 to 2017 to examine the relationship among health expenditure, health outcomes and economic growth in Nigeria. The results of the Toda-Yamamoto causality result showed no pattern of causality running from health expenditure to infant mortality and also no causality between real GDP and infant mortality. The study recommended that the government should make concerted efforts geared towards increasing health expenditure at least to meet up with the WHO's recommendation that all countries should allocate at least 13 per cent of their annual budget to the health sector for effective funding as this would bring desired health outcomes in Nigeria. Similarly, Nwanosike et al. [11] investigated Health expenditure and its resultant effect on health outcomes in Nigeria, the study observed that government expenditure on health for Nigeria for 1990, 2000, 2017, 2018 2020, and 2021 are N658.1million, N202.8million, N304billion, N340billion, N547billion and N427billion respectively. Infant mortality according to Madise et al. [9], is an important tool for the evaluation of a country's population's health and healthcare system. It is a tool for the measurement of a county's well-being and the state of health and health facilities. The understanding of the significance of infant mortality and the need to reduce it has prompted the fight against mortality in infants both at the national and international levels. Nigeria's infant mortality rate according to World Development Indicators, World Bank [21] stands at 54.74 deaths per 1000 live births despite substantial allocations to the health sector and government policies. Though over the years, misappropriation of funds in the health sector and insufficient per capita income may be contributing factors to the significantly high infant mortality rate (Wasiu [19]; Omoloba [13]). More so, environmental factors and low literacy levels may also contribute to high infant mortality rates (see Opeloyeru et al. [15], Wilson and Olawale [20] and Omir et al. [14]). Addressing these challenges is crucial to reducing Nigeria's infant mortality rate.

Research results on public health expenditure and health outcomes such as the infant mortality rate in Nigeria have produced differing views. Eboh et al. [4] found a positive impact, contrary to Anokwuru and Chidinma [2], Umar et al. [17] and Musa [10] who discovered a negative impact, while Byaro and Musonda [3] found no impact.

2.   Literature Review

There are several research that have explored the relationship between public health care finance and infant mortality rate in Nigeria. Elijah et al. [5] examined the impact of public health expenditure on infant mortality in Nigeria. They used annual data from 1990 to 2023 and applied the method of autoregressive distributive lag (ARDL) model to analyze the data. Their result showed capital health expenditure, recurrent health expenditure, per capita income, carbon emission, corruption perception index, literacy rate and National Health Insurance Act impacted negatively on infant mortality rate in the long run. However, only recurrent health expenditure, per capita income and literacy rate were statistically significant (P-value < 0.05) in explaining changes in infant mortality rate. Applying the method of autoregressive distributed lag (ARDL) model, Anokwuru and Chidinma [2] examined also Nigeria's government spending on health and infant mortality rate. Their data of study was from 2002 to 2021. They results revealed discovered that government spending on health and doctor's migration out of the country negatively affect infant mortality rate though not statistically significant. Kalu et al. [7] examined public health financing model and under-five mortality rate in Nigeria from 1986 to 2022. They applied the principles of Grossman health capital theoretical framework and used the method of Granger causality test and the vector error correction model (VECM) involving the forecast error variance decomposition (FEVD) and the impulse response functions (IRFs). Their result revealed that the coefficient of government health expenditure was negative but statistically significantly (P-value < 0.05) related to under-five mortality rate while foreign direct investment was negative but not statistically significant (P-value > 0.05) to under five mortality rate. Applying the method of co-integration and error correction (ECM) model, Musa [10] examined government health expenditure and infant mortality. The result of their study which span from 1986 to 2020 showed that infant mortality declines on account of an increase in government health expenditure. Similarly, Umar et al. [17] examined the influence of government health spending and health outcomes in Nigeria. They used a data that span from 1981 to 2020. They applied the method of vector autoregressive (VAR) model and discovered that infant mortality in Nigeria reduces significantly when health expenditure increases. Adeagbo [1] examined the public health expenditure and infant mortality rate in Nigeria between 1991 and 2018 using time series data. They employed the method of fully modified ordinary least square (FMOLS) to examine the variables of the relationships. Except for Diphtheria, Pertussis, and Tetanus (DPT) immunization and female literacy rate, other variables employed in the study positively impacted the infant mortality. Employing error correction model (ECM) and autoregressive distributed lag (ARDL), Wasiu [19] examined the link connecting health outcomes with public health expenditure in Nigeria from 1985 to 2018. Their result revealed that government spending on health and corruption influence infant mortality negatively and significantly. Similarly, Nigeria's health outcomes and government spending were studied by Omoloba [13], from 1980 to 2018. With the aid of Johansen Co-integration and Error correction model, the study showed that corruption is one of the reasons for the inverse relationship between government spending and infant mortality rate in Nigeria. Ewere and Eke [6], examined time series analysis and forecast of infant mortality rate in Nigeria. They used the auto-regressive integrated moving average (ARIMA) modeling approach to make forecast of infant mortality in Nigeria up to the year 2030 using data obtained from the United Nation's Inter-Agency Group for Childhood Mortality Estimation (UN-IGME). The ARIMA (1, 1, 1) model, selected

predicted a reduction of up to 30% by 2030 at 95% confidence interval. This study examines the public health care finance system and infant mortality rate in Nigeria using a secondary data from Central Bank of Nigeria statistical bulletin and World Bank Indicator on Public Health Expenditure. The data span from 1990 to 2023.The public health expenditure, out-of-pocket expenditure and health insurance are the variables consider to influence infant mortality rate in Nigeria. The method of Autoregressive distributive lag (ARDL) model were employed to analyze the data.

3.   Methodology

3.1.   *Model Specification*

The model of this study is formulated to align with the economic theory, available literature, and empirical evidence. The selected explanatory which are believed to impact on infant mortality rate, reflect the different features characterizing the Nigerian health care finance system. Public health expenditure (PHEXP), out-of-pocket expenditure (OOP) and health insurance (HI) which represents the explanatory variables, while the infant mortality rate is the dependent variable. Suppose infant mortality is a function of public health expenditure, out-of-pocket expenditure and health insurance. This can be expressed as:

$$IMR = f(PHEXP, OOP, HI) \tag{1}$$

$$IMR_t = \alpha_0 + \alpha_1 PHEXP_t + \alpha_2 OOP_t + \alpha_3 HI_t + \mu_t \tag{2}$$

Where α_0 the intercept of the relationship in the model, IMT_t is the Infant mortality rate at time t, $PHEXP$ is the Public Health expenditure, OOP is the Out-of-pocket expenditure, HI is the Health Insurance and μ_t is the error term. The variables with large figures are further standardized into log form to aid in linearizing relationships between variables, making it easier to apply linear techniques. Therefore, the model is stated as

$$logIMR_t = \alpha_0 + \alpha_1 logPHEXP_t + \alpha_2 logOOP_t + \alpha_3 logHI_t + \mu_t \tag{3}$$

3.2.   *Estimation Procedure*

When variables are integrated of different orders or a combination of both (1(0) and 1(1)), and have a single long run relationship, then autoregressive distributed lag (ARDL) model is preferable. The ARDL model specification of equation is written as unrestricted error correction model (UECM) to test for co-integration among the variables under study. The ARDL model of order (r, k) is given as

$$\Delta y_t = c_0 + c_1 t + \sum_{i=0}^{r} \phi_i \Delta y_{t-1} \sum_{i=0}^{k} \beta_i^T \Delta x_{t-1} + v_1 y_{t-1} + v_2 x_{t-1} + \mu_t \tag{4}$$

Where c_0 the intercept of the relationship in the model, $|mu_t$ is the error term, c_i, , are respectively the coefficients associated with a linear trend. Δy_t and Δx_t are the

differences of y_t and x_t. r and k are the respective lags: $i = 1, 2, \ldots, r$, $k = 1, 2, \ldots, k$. The coefficients ϕ_i and β_i for all i correspond to the short-run relationship while the v_i corresponds to the long-run relationship. The ARDL model for this study is written as:

$$\Delta IMR_t = c_0 + \sum_{i=1}^{r} \phi_1 \Delta IMR_{t-i} + \sum_{i=1}^{r} \phi_2 \Delta \log PHEXP_{1t-i} + \sum_{i=1}^{r} \phi_3 \Delta \log OOP_{2t-i}$$

$$+ \sum_{i=1}^{r} \phi_4 \Delta \log HI_{3t-i} + \beta_0 IMR_{t-1} + \beta_1 \log PHEXP_{1t-1}$$

$$+ \beta_2 \log OOP_{2t-1} + \beta_3 \log HI_{3t-1} + \mu_t \qquad (5)$$

4. Empirical Analysis

The descriptive statistics for the secondary data employed in the study as shown in Table 1 reveal that the mean values of all the variables are all positive, indicating an upward trend in the time series. Among all the variables, only infant mortality rate were negatively skewed (to the left). The negative skewness showed a long or fatter tail on the left side of the distribution while positive skewness refers to a longer or fatter tail on the right. Also, out of pocket and health insurance are leptokurtic (estimated value greater than 3) while, other variables are platykurtic (estimated values less than 3.0).

Table 1. Summary of Descriptive Statistics

	IMR	PHEXP	OOP	HI
N	34	34	34	34
Mean	102.5176	34.7588	13.6141	80.9778
Std. Deviation	18.98957	10.31492	42.29174	81.77532
Skewness	-0.072	0.432	4.211	3.201
Std. Error of Skewness	0.403	0.403	0.403	0.403
Kurtosis	-1.721	-0.822	19.171	12.910
Std. Error of Kurtosis	0.788	0.788	0.788	0.788

Source: Researchers' computation (2024)

4.1. Unit root test

The foremost step is to check for the stationarity of the variables. For this purpose, Augmented Dickey-Fuller (ADF) test is applied; the results are reported in Table 2. From Table 2, it was observed that all the variables are stationary after taking their first difference. That is, infant mortality rate, public health expenditure, out-of-pocket and health insurance were all stationary after the first difference, $I(1)$. This means that these variables were integrated of order 1. The variables were tested basically at 5% critical value and found to be significant (P-value < 0.05). The presence of unit root in a model is a necessary condition for co-integration.

Table 2. Unit Root Test Result Summary

Variable	ADF Statistic	Critical Value at 5%	P-values	Constant	Order of Integration
IMR	-3.910707	-2.963972*	0.000	Yes	I(1)
PHEXP	3.158623	-2.954021*	0.003	Yes	I(1)
OOP	-2.996076	-2.954021*	0.000	Yes	I(1)
HI	3.644944	-3.587527*	0.001	Yes	I(1)

Source: Researchers' computation (2024)

4.2. *Co-integration Test for OLS results*

Co-integration estimation was done to investigate the long run relationship in the model. The presence of a long run relationship implies that an error has occurred and must be corrected using the ECM. The co-integration tests were done by checking for the unit root of the residual using the Augmented Dickey fuller for each of the two models under consideration. The results of the unit root tests for the residuals are shown below on Table 3.

Table 3. Co-integration Test Result (Johansen Approach)

Variable	T-ADF	Critical Value at 1%	Critical Value at 5%
Residual	-3.172229	-3.670170	-2.963972

Source: Researcher's computation (2024)

Since the ADF test statistic of -3.172229 is significant at the 5% level in Table 3, it implies that a linear combination of the series is stationary.

Table 4. Summary of Model I Regression Result

Dependent variable = IMR (Infant Mortality Rate)			
Variable	**Coefficients**	**T-Statistic**	**Probability**
C	46.31922	36.11592	0.0000
PHEXP	-0.026809	-5.979110	0.0000
OOP	0.073507	2.028905	0.0517
HI	0.020862	2.809336	0.0088
R-squared	0.721390		
F-Statistic	18.77202		

Source: Researchers' computation (2024) using E-Views

From the regression result in Table 4, the coefficient of constant is positive and it is statistically significant (P-value < 0.05). The coefficient implies that infant mortality rate is **46.31922** at the beginning of the study period, when other variables are not operational or held constant. The economic implication of this result is that; that holding other factors that influences infant mortality constant, average infant mortality rate is 46 per 1000 live births. For Public health expenditure, the sign of its coefficient is negative and also statistically significant. The coefficient of **-0.026809** implies that over the study period, on average, a unit increase in the government expenditure on health leads to approximately 2.6809 unit decrease in infant mortality rate. For out-of-pocket health spending, the coefficient is **0.073507**, which is positive and not statistically significant (P-value > 0.05) and that of health insurance is **0.020862** which is equally positive and statistically significant. This means that holding other variables constant, a unit increase in of out-of-pocket health spending and health insurance will lead to a decrease in the infant mortality rate by about 7 units and 2 units respectively.

From the regression result of the model, the R^2 is **0.721390**. This means that the model explains about 72% of the total variation in health outcome (IMR). We thereby conclude that the coefficients of determination (R^2) are statistically significant and a true goodness of fit for the models.

5. Conclusion and Recommendations

This study examines the relationship public health care finance system have on infant mortality in Nigeria from 1990 to 2023. The study applied, Dickey Fuller minimum statistics to conduct the unit root test of stationarity and discovered that all the variables were of order 1 of integration. The result of the bound test revealed a long run relationship between the variables. The study proceeded to use Autoregressive Distributed Lag (ARDL) Model. The variables employed in the study were, public health expenditure (PHEXP), out of pocket payment (OOP), infant mortality rate (IMR), and Health Insurance (HI). The long run result revealed that public health expenditure (PHEXP) and Health Insurance (HI) have positive impact on infant mortality rate, The findings of the study conformed to the finds of Umar et al. [17], Nwanosike et al. [11], Omoloba [13] and Wasiu [19]. The study recommends the need for continual allocation of funds into the health sector and also an increase in the budgetary allocation to the agreed 15 per cent suggested by the African Union as this will reduce Out-of-pocket health expenditure in Nigeria.

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