HEALTH INFRASTRUCTURE AND CHILD HEALTH IN NIGERIA

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Abstract

The research is undertaken to investigate the impact of health infrastructure on child health in Nigeria. Poor health facilities in Nigeria's health sector have brought advanced consequences on the health status of the country. Nigeria is regarded as a country with higher child mortality, high disease prevalent rate, high morbidity and low life expectancy rate. In the modern time where countries of the world prioritize health, this study is necessitated to establish the impact of health infrastructure on the healthy child in Nigeria. The study made use of time series data on variables such as child mortality, health infrastructure, availability of health professionals and child immunization covering the period of 1988-2021. The variables were found to be stationary and multiple regression model analyse was the adapted methodology for the research. The regression results showed that there existed an inverse and significant impact between health infrastructure, availability of health professionals and child immunization on under-5 child mortality in Nigeria throughout the study. Therefore, government and health agencies are advised to be sensitive to the behaviour of the aforementioned variables to ensure effective measures capable of stimulating a reduction in child mortality in the country. In this regard, the development of health sector infrastructural needs should be vigorously pursued by the government to maintain a steady and smooth flow of well-being care service delivery in the country.

Keywords*:* Availability of Health Professionals, Child Immunization, Child Mortality and Health infrastructure.
Jel Classification Code: I10

1. Introduction

Child mortality is a global concern in public health. It is the chance of a child dying between the first and the fifth birthday (. It is the early death of children between the age of one and five years. Olatubi et al. (2018) and Okonofua et al. (2016)reiterated the World Health Organization report on Nigeria, sub-Saharan Africa and the world at large

that out of thirty countries with the world's highest child mortality rates, twenty-seven are in sub-Saharan Africa, with mortality experiences ranging from neonatal mortality, infant and child mortality to maternal mortality. It is noted that half of these deaths occurred in just five countries namely, India, Nigeria, the Democratic Republic of Congo, Pakistan and China, with India and Nigeria together accounting for one-third of the total number of child deaths worldwide. According to Ariyo and Jiang (2021), Nigeria's child mortality has declined over time but is still very high compared to developed countries of the world.

Child mortality reduction was a global target and is included in the current Sustainable Development Goals (SDGs). The determinants of child mortality have been extensively explored by researchers. Previous studies have established an evidence-based child survival framework. Apart from environmental factors (access to clean water and sanitation) and social factors (maternal education, household wealth), it is also established that health system factors such as health financing, health workforce, vaccination/immunization of children and other treatments) have a direct impact on child mortality reduction(Chendrayudu & Chandrasekarayya, 2021; Simmons et al., 2021; Mandal et al., 2021; Iddrisu et al., 2020; Zewudie et al., 2020). Thus, most child survival frameworks identify the health system as critical in reducing child mortality. The health system comprises physical structures, technology, and human capital.

Economic theory has over the years identified human capital as a catalyst to economic growth and development at the micro and macro levels. Specifically, an improvement in health infrastructure contributes to growth through the development of a healthy population. However, improving health infrastructure, therefore, remains paramount on the development agenda of several governments over the world. According to Mosley and Chen (1984), the health system contributes higher to child survival rates through institutionalized action (e.g., quarantine, immunization), cost subsidies which change relative prices of health care services, public information/education/motivation and technology (e.g., oral rehydration salts). Within the health system, the healthcare workforce is a core component, since every health system functions by either undertaken or medication by health workers. Health workers prevent diseases through disease-control measures such as vaccination programs for children which help mothers develop healthy behaviour like early breastfeeding to boost children's nutrition and immune system and provide curative health care services which could directly save children from life-threatening diseases. As far as child health is concerned, the healthcare workforce is required for the provision of medication, prenatal care, and pediatric services (Novignon & Lawanson, 2017).

In Nigeria, health infrastructure remains a frontline problem. Health infrastructure is both qualitative and quantitative of the quality of health care and accessibility to health care delivery within the country. Health infrastructure includes physical structures and technological and human resources. According to United Nations Population Division (2019), Nigeria's population is largely rural, with 63.7 per cent of the population living in rural areas with little or no health workers. Due to the growing nature of Nigeria's under-5 children, there are urgent demands that child survival issues be placed at the

forefront of the national agenda. The SDGs identify the minimum requirements to improve the general well-being of a population to involve health care delivery at a minimum and affordable cost to ensure good health and well-being (NDHS, 2018). Ensuring healthy lives and promoting the well-being of the general population at all ages is essential to sustainable development. The SDGs requirement can only be met in Nigeria only if health infrastructure is adequately provided in both rural and urban cities.

Progress has been made in increasing access to basic needs to enhance the life expectancy of Nigerians, especially children. Thus, to reduce child mortality in the country the Federal Government of Nigeria initiated and implements National Health Insurance Scheme (NHIS) was launched in 1999 as a pilot health project, titled the NHIS/MDG Maternal and Child Health Project and became operational in 2005 (Obalum & Fiberesima, 2012). The Project focuses on reducing maternal and child mortality and uses funds from the World Bank's Heavily Indebted Poor Countries Initiative (HIPCI), which provides dollar-for-dollar debt reduction against government allocation of funds to poverty reduction programs. Nigeria's Office of the Presidency/Millennium Development Goals (MDGs) in collaboration with the NHIS, Nigerian Congress, and Ministry of Health designed the Project to leverage HIPCI support in the fight against maternal and child mortality. By late 2009, it was clear that the Project was having a positive effect on the women, children, and facilities enrolled in the pilot. The Project's investments reduce maternal and child mortality and benefit Nigeria far beyond the costs of the project through the increased health of Nigerian citizens and the value these lives represent, including the ability of citizens to leave more productive lives (USAID, 2014). However, it is worthy of note that the NHIS project has significantly reduced child mortality in Nigeria, but the country is still ranked high in child mortality rate in Africa and World at large.

However, to curb child mortality in Nigeria, more effort is needed to fully eradicate every barrier to good health and address emerging health issues. Statistics show that most sub-Saharan countries in Africa, especially Nigeria, have a lot to do in achieving the SDGs. More research is therefore needed to inform the formulation of policies and implementation of programs for appropriate health intervention. However, there have been limited evaluations regarding health professionals on the reduction of child mortality. There is a need for data on the life experiences of childhood mortality. This study, therefore, evaluates the impact of health infrastructure on child mortality in Nigeria.

2. Literature Review

2.1 Conceptual Literature

Health infrastructure is most physical and nonphysical facilities supporting health services delivering. Ademiluyi and Arowolo (2021) defined health infrastructure in qualitative and quantitative terms. Health infrastructures are judged by the quality of physical, technological and human resources available at a given period in time in a nation. Hospital buildings and other fixed structures such as pipe-borne water, good

access roads, electricity and so on within the healthcare environments, whilst the technology is about the equipment meant specifically for hospital use including surgeries are all classified under physical health infrastructure (Mopa & Duan, 2022). The definition of health infrastructure as physical assets also includes computer equipment and consumables while human resource comprises health professionals including doctors, pharmacists, nurses, midwives, laboratory technologists, administrators, accountants and other sundry workers. All these put together form the structure upon which healthcare delivery is anchored in any society. Health infrastructure is larger in concept and more robust than a mix of facilities, and medical consultation in terms of diagnosis, treatment and compliance. It also involves the healthcare consumers and other factors associated with or adjunct to healthcare delivery (Barenberg et al., 2018).Discussion of healthcare infrastructure in Nigeria in particular has recognized the existence of different types and practices. There are traditional, biomedical/orthodox and synthetic types. However, our focus in this study is on the accessibility, availability of health providers and provision of health facilities within the context of hospital structure. In this context, health infrastructure of any kind is an outcome of health funding either in form of capital or recurrent health expenditure. Government health expenditure takes a larger part of health funding in Nigeria. Therefore, public health expenditure over time in Nigeria is used as a proxy for health infrastructure in this study.

Child health status is measured in terms of child mortality. Child mortality is typically defined as the number of deaths of children fewer than five years of age in a given year per one thousand children of the same age group. Child mortality includes deaths that occur between one year and the exact age of 5 (Bashir, 2016). Accordingly, Bako (2017) defined child mortality as the likelihood for a child born alive to die between its first and fifth birthdays .NDHS (2018) specified child mortality as the probability of a child dying between the first and the fifth birthday. Hence, child mortality is the maximum risk of a child dying between the first and the fifth birthday. Generally, all childhood deaths occur before age 5, thus the probability of a child dying by age 5 can be regarded as a good index of the overall level of child mortality. The age parameters, however, may vary among different reports. Some reports might include only children between the ages of one and four years, while others might include all minor children. It is imperative to note the operational definition employed in a report before making comparisons with other reported data. Therefore, this study adopts the definition given in NDHS (2018).

The utility of child mortality as a health indicator depends upon the population context in which it is used. For example, in a developed country, where the leading global cause of child mortality is not as prevalent, the rates of specific causes of child mortality could be used in the prioritization of prevention programming (e.g., geared toward motor vehicle passenger safety). In a developing country, however, child mortality rates may play a more significant role as an indicator of broader health, environmental and social issues, such as malnutrition, water sanitation, poverty, and access to health systems(Kim& Saada, 2013). It is important to note that child mortality may drastically skew life expectancy measures. For example, the reported life expectancy at birth for a

population with a high child mortality rate may be significantly shorter than in a population with a low child mortality rate even though the life expectancy at five years of age might be similar between the two populations.

2.3 Empirical Literature

Adeosun and Faboye, (2020) studied healthcare expenses on the mortality level of infants and children in Nigeria. The study adopted vector autoregressive techniques in analyzing government expenditure on health and child mortality between 1986 and 2016. The result of the finding showed that government expenditure on health care possesses a negative correlation with the mortality level of infants and children in Nigeria.

Okwuwa and Adejo (2020) examined child mortality and access to primary health centres (PHCs) as behavioural tendencies capable of shaping the present and future of infancy, childhood, the family and the nation, in the Bwari community. The study employed both qualitative and quantitative methods. NHDS 2018 data was used in testing the hypotheses. The findings revealed that accessing healthcare facilities has a significant negative impact on child mortality. The responses of the respondents' on health talks from medical professionals, and free medical treatment on child mortality, suggested that human capital quality and health outcomes had significant inverse relationships with child mortality.

Okereke et al. (2019)assessed the performance of community health workers on maternal and child mortality in the Nigerian healthcare system. The study utilized a qualitative research design. Interviews were conducted with 44 purposively selected key informants. The key informants were selected based on their knowledge and experience working with different cadres of frontline health workers at the primary healthcare level. The study showed that community midwifery has a significant negative relationship with maternal and child mortality in Nigeria.

Ude and Ekesiobi (2019) employed multiple regression to empirically analyze the effect of government expenditure on health and child mortality. Child mortality was proxied by an infant, under-5 and neonatal mortality rates. The study employed the OLS method and analyzed a time series of data from the 1990 to 2018 study period. The result obtained in the study revealed the presence of an inverse relationship between government expenditure on health and child mortalities, hence denoting the decline in child mortality as income per capita and government expenditure on health increase.

Liang et al. (2019) evaluated the association between increased health professionals and the under-five mortality rate in rural Chinese counties from 2008 to 2016. The study adopted fixed effects models with rural counties as the unit of analysis to evaluate the association between health professional density and U5MR. Covariates included county-level gross domestic product (GDP) per capita, female literacy rate, the value of medical equipment per bed, and province-level health expenditures (measured as a proportion of provincial GDP). The results showed that U5MR dropped by 36.19% during the study period. One additional health professional per 1000 population was associated with a

2.6% reduction in U5MR, after controlling for other covariates. County poverty status and GDP trajectories moderated this relationship. The U5MR reductions attributed to a one-unit increase in health professionals were 6.8% among poor counties, but only 1.1% among non-poor ones. These reductions were, respectively, 6.7%, 0.7%, and 4.3% in counties with initially low GDP that slowly increased, medium-level GDP that rose at a moderate pace, and high GDP that rose rapidly.

Oluwaseun (2019) examined the impact of health expenditure on child mortality in selected West African countries. The variables used for the study are government expenditure on health, infant mortality, under-five mortality, and maternal mortality rates. The research used the panel data estimation method on a panel data set for 14 countries for the period 2000 -2018. The study shows that a one per cent increase in government expenditure on health will reduce infant mortality by 2.4 per cent, under-five mortality by 3.9 per cent and maternal mortality by 4.9 per cent. The variables are economically significant. The study indicates that committing resources to the health sector of these countries will build the healthy human capital of the various countries.

Salami et al.(2019) investigated the impact of health expenditures on child mortality in Nigeria within the period 1980-2015. The study made use of five variables: Infant mortality rate, public health expenditure, private health expenditure and per capita income. Autoregressive Distributed Lagged (ARDL) model was used to expose the long-run relationship that existed between the stationary and non-stationary variables. The variables were found to be co-integrated and the ECM was statistically significant indicating short-run adjustment to equilibrium in the long run. The ARDL model estimates showed that all the variables used have short-run and long-run negative impacts on infant mortality and the results are statistically significant.

Makinde et al. (2018) investigated the distribution of health facilities in Nigeria. A secondary analysis of data from the Federal Ministry of Health's facility register was carried out to assess the geographic and sectoral distribution of health facilities in Nigeria. Primary health facilities make up 88% of health facilities in Nigeria while secondary and tertiary health facilities make up 12% and 0.25% respectively. There are more government-owned health facilities than privately owned health facilities (67% and 33%). Secondary health facilities are predominantly privately owned. The ratio of public to private health facilities is much higher in the Northern part of the country than in the South.

David (2018) investigated the relationship between infant mortality and public expenditure on health in Nigeria from 1980 to 2016. The study employs s Autoregressive Distributive Lag (ARDL) model in establishing a relationship between the variables. The variables of the study were public health expenditure, immunization, private health expenditure, external resources and infant mortality. The results indicated the presence of a significant co-integrating(long-run) relationship between infant mortality and government health expenditure (and private health expenditure, immunization and external health resources),coupled with the existence of a bi-directional causal relationship between infant mortality and government health

expenditure. In addition, the results also demonstrate that government health expenditure, private health expenditure, immunization, and external health resources significantly influence infant mortality negatively both in the long and short term.

Nwankwo (2018) examined the effects of public health spending on maternal mortality in Nigeria. It is informed by the escalating nature of maternal mortality outcomes in Nigeria. A panel data regression analysis was employed from the years 2003 to 2015 from selected 25 States in Nigeria. The study adopted instrumental variables strategy as a solution for possible endogeneity for its econometric analysis. The control variables are female per capita income, female literacy rate, and urbanization. The finding revealed that public health expenditure is a vital factor in reducing incidences of maternal mortality in Nigeria.

Barenberg et al. (2018) examined the effect of public health expenditure on infant mortality in Indian states during the period 1983- 1984 and 2014-2015. Using panel data set of Indian states, the study shows that public expenditure on health care reduces infant mortality. Accordingly, female literacy and urbanization also contribute to the decline of the infant mortality rate in Indian states.

Dhrifi (2018) investigated the effects of health expenditure on child mortality rates using a simultaneous equation model for 93 developed and developing countries with data spanning from 1998 to 2016. He analyzes the relationship between developed and developing economies by comparing low, lower middle, upper-middle and high-income countries. The study employed the three-stage least squares (3SLS) technique to be able to solve the endogeneity problems by introducing instrumental variables. Results show that the explanatory variables differ according to the sample considered. Government health spending has a positive and very significant effect in reducing mortality rates for upper-middle and high-income countries buts for low and lower-middle-income countries, government health expenditure is not statistically significant. Higher health expenditure was found in the developed economies and low health spending in less developed economies. The insignificant spending in the less developed countries according to this study may indicate resources not being allocated effectively towards health care spending. The study also showed that in less developed countries, public expenditure on health has a greater effect on mortality rates than private health expenditure, while in developed countries private expenditure has a positive impact on child health status.

Farag et al. (2018) provided a more recent empirical investigation into the relationship between a country's health spending and selected health outcomes, measured by infant and child mortality. Using data from 133 low and middle-income countries for the years 2010 to 2016, the study showed a significant impact of health spending on reducing infant and under-five mortality rates with elasticities from 0.13 to 0.33 for infant mortality and 0.15 to 0.38 for under-five mortality rates. The study also found that the level of good governance determined the magnitude of the impact of government health spending on infant and under-five mortality rates for each country. Countries with

higher levels of good governance showed a higher impact of government health spending on health outcomes.

Nikoloski and Amendah (2018)examined the probability of increased health expenditure on health leading to better health outcomes for the populace in 14 African countries from 2003 to 2015, focusing on infant mortality, neonatal mortality, under-five mortality, and life expectancy at birth. The study employed descriptive and multivariate analyses, and their findings revealed that public health expenditure reduces infant, neonatal and under-5 mortality, while increasing the life expectancy at birth significantly in the 14 African countries.

Mesike and Mojekwu (2018) in their study examined the environmental determinants of child mortality in Nigeria using principal component analysis and simultaneous multiple regression for child mortality modelling in Nigeria. Estimation from the stepwise regression model showed that household environmental characteristics do have a significant impact on mortality as lower mortality rates were experienced in households that had access to immunization, sanitation facilities, good and proper refuse and solid waste disposal facilities, good healthy roofing and flooring materials as well as those using low polluting fuels as their main source of cooking.

Rhee (2018) provided econometric evidence of a link between health expenditures and three health outcomes (infant mortality, under-5 mortality and life expectancy) within four different healthcare systems. Panel data were collected and grouped for 25 countries according to the health care system throughout 15 years (2000-2015). The countries included in the study are based on their different healthcare systems. The study classified the health systems into 4 different categories as National Health Insurance System, Traditional Sickness Insurance, National Health Services, and mixed systems. A multivariate regression model was used to investigate the effects of studied variables on health. The results showed that among various explanatory variables, health expenditure (public and private) had an important effect on health outcomes. Based on the classification of countries with different healthcare systems, an increase in health expenditure also has a significant impact on improving health outcomes.

Bako (2017)analyzed infant and child mortality trends and differentials in Kaduna State, Nigeria, from 2005-2014 using primary data analysis. The data were analyzed using descriptive statistics, ANOVA and regression analysis. The descriptive statistics showed that 66.3% of the respondents are between the ages of 20 and 34 years, 36.8% are Hausa/Fulani, 28.8% have attended secondary school, and most of the respondents (21.8%) have a monthly income between ₦30,001-₦40,000. Malaria is the major cause of under-five deaths with 30.1%. Experience of under-five (U5) mortality was found to differ by education, income, and occupation. The result also shows that under-five mortality is higher among women within 15-24 than among 25-34 years. Women that got married early (15-24 years) experience more under-five mortality than the adult (25-34 years). Women with no formal education were found to experience more under-five mortality than those with formal education.

Edeme et al. (2017) also examined the link between Public Health Expenditure and infants in Nigeria from 1982-2016. The study applied OLS and found that public health expenditure on health and per capita income poses a decreasing function of infant mortality in Nigeria during the period under study.

Avignon and Akanni (2017) studied the relationship between child health outcomes and health spending. The study employed panel data from 45 Sub-Saharan African countries between 2000 and 2015, using the lag effect model. Under five, infant and neonatal mortality were used as child health outcomes while total health spending was disaggregated into public and private spending. The effects of one and two-period lags of expenditure were estimated. The results showed a positive and significant relationship between health expenditure and child health outcomes with elasticities of 0.11 for infant mortality, 0.15 (under-five mortality) and 0.08 (for neonatal mortality). Public health expenditure was found to be relatively more significant than private expenditure.

Eric et al.(2017) investigated the relationship between healthcare expenditures and health outcomes (i.e. infant mortality, under-5 mortality and life expectancy) from 1995 to 2014 in Ghana. The study adopts the OLS method in analyzing the data generated. The results, infant and under-5 mortalities declined by 50 and 25%, respectively, as of 2014, while life expectancy increased from 60.7 to 64.8 years. Out-of-pocket payments for health care decline but are higher than the World Health Organization's recommended financial threshold. While the government's expenditure on healthcare yielded positive results, the improvement in health outcomes is not attributable to the increasing health expenditure alone.

Avignon and Lawanson (2017) sought to understand the relationship between child health outcomes and health spending. The study employed panel data from 45 sub-Saharan African countries over the period 2000 -2015. The results of the study indicated that health expenditure had a significant and positive influence on child health outcomes in Sub-Saharan African nations with elasticities of 0.11 for infant mortality, 0.15 for under-five mortality and 0.08 for neonatal mortality. From the analysis, there also exists a positive and significant lagged effect of health expenditure on child health. On the disaggregated level, public health expenditure was found to be more significant than private expenditure.

Sanni et al. (2017)examined the prevalence and determinants of childhood mortality in Nigeria. The study variable was the total number of children lost by male partners and female partners respectively who were married. Zero-inflated negative binomial (ZINB) regression analysis was used to determine the factors associated with childhood mortality. The results of ZINB were reported in terms of IRR and 95% confidence interval (CI). The result showed that education, residence, wealth index, and region are associated with childhood mortality. The results showed that parents with higher education have a lower risk of childhood mortality than parents with lower education. It also showed that rural parents experience a 28.3% increase in childhood mortality than parents in urban cities. The risk of childhood mortality was significantly lower in the middle, richer and richest economic quartile. Similarly, the eastern and western regions

experience lower childhood mortality at 21.5% and 35.9% than the northern region with 38.6% in Nigeria.

However, the variables of the reviewed empirical studies differ across researchers; Okwuwa and Adejo (2020)employed quantitative and qualitative methods of analysis to investigate access to healthcare facilities, free medical treatment, maternal education and maternal age at given birth, while Ude and Ekesiobi (2019) used OLS method to study government expenditure on health child mortality. Liang et al. (2019) adopted a simple percentage analysis to measure female literacy, medical equipment per bed, and level of health expenditure on child mortality. Dhrifi (2018) and Farag et al.(2018) used 3SLS to evaluate public and private health expenditures in low, lower, middle, upper-middle and higher-income countries on child mortality. While David (2018) used the ARDL method and investigated immunization, external resources, and private and public health expenditure on child mortality. The present study employed the ordinary least square(OLS) method similar to the work of Ude and Ekesiobi (2019) but health infrastructure variables were disaggregated into; availability of health professionals, provision of health facilities and immunization of children against diseases on child mortality in Nigeria.

3. Methodology

3.1 Model Specification

The theoretical framework adopted for this study is the functionalism theory. The theory view society as a system of interconnected parts. The major assumption of the theory is that health and social institutions are society's pivots. The theory emphasized that health institution provides a pattern in the maintenance of health needs to reduce sicknesses and diseases. The theory opines that high mortality in countries partially reflects systemic dysfunctions, signifying the failure of the health institution. David (2018) adopted the theory and modifies it through autoregressive and distributive lag (ARDL) to study infant mortality.

The function of infant mortality is specified as:

$$IMR = f(PHEXP, IMMUN, EHRES, PrEXP) \quad (1)$$

Empirically the model is specified linearly as:

$$IMR_t = \alpha_0 + b_1 PHEXP_t + b_2 IMMUN_t + b_3 EHRES_t + b_4 PrEXP_t + \mu_t \quad (2)$$

IMR denotes infant mortality rate which is measured by the number of children less than one year of age that died, divided by the number of live births during the year, multiplied by 1,000.

PHEXP is the government's health expenditure.

IMMUN is the percentage of children under the age of one immunized against certain diseases and infections.

EHRES denotes external health resources.

PrEXP is private health expenditure.

This study will adapt David (2018) model specification, modified it and incorporates variables relevant to the present research study. The study variables are; child mortality, availability of health professionals, provision of health facilities and immunization of children against diseases. This study functionally specifies child mortality in Nigeria as follows:

$$CMR = f(AHP, PHF, IMM) \quad (3)$$

To measure and ascertain the size and signs of these factors empirically, the model to be estimated is specified as follows:

$$CMR_t = \beta_0 + \beta_1 AHP_t + \beta_2 PHF_t + \beta_3 IMM_t + \mu_t \quad (4)$$

Where;

$CMR =$ Child Mortality Rate, which is measured by the number of children one year of age that died before the fifth birthday, divided by the number of live children within one and five years of age, multiplied by 1,000.

$AHP =$ Availability of Health Professionals, this variable is measured as the number of health professionals per 1000 children.

$PHF =$ Provision of Health Facility, which is measured by government expenditure on health as a percentage of gross domestic product.

$IMM =$ Immunization of children against diseases, this variable is a measured number of 12 – 23 months of age immunized against diseases as the percentage of 1000 children aged 12-23 months.

$\mu_t =$ Error term

$\beta_i =$ Coefficient (i = 0, 1, 2, 3,)

3.2 Data Source

The data for this study was extracted from World Development Indicators (WDI) 2021 Microsoft Excel database published by the World Bank. The annual time series data on Nigeria covers the period between 1988 and 2021inclusive.

3.3 *a priori* Expectation

A priori expectations reveal the expected sign of the coefficient of exogenous variables and their expected impact on the endogenous variable of the model. The a priori expectations for the exogenous variables in this study are:

$\beta_1 < 0, \beta_2 < 0, \beta_3 < 0$

It's expected empirically that the availability of health professionals (AHP), provision of health facilities (PHF) and immunization of children against diseases (IMM) will all have negative impacts on child mortality in Nigeria. This means that the higher the aforementioned explanatory variables, the lower the level of child mortality in Nigeria.

4. Presentation And Discussion Of The Results

4.1: Descriptive Summary Statistics

The descriptive summary statistics of the variables for the empirical analysis are presented in Table 4.1.

Table 4.1:Descriptive Summary Statistics of the variables employed for estimation

VARIABLES	Mean	Std. Dev.	N. Stardard E.	Skewness	Kurtosis	Jarque-Bera	Probability
CMR	164.67	38.94	0.24	0.25	1.49	3.47	0.18
PHF	3.80	0.48	0.13	0.01	3.99	1.34	0.51
AHP	0.29	0.11	0.37	0.41	1.63	3.50	0.17
IMM	42.09	11.67	0.28	0.02	1.85	1.81	0.41

Source: *Author's Computation, 2021*

In Table 4.1, child mortality, provision of health facilities, availability of health professionals and immunization of children against diseases are positively skewed. The result shows that on average child mortality rate is 165 per 1000 children in Nigeria. The availability of health professionals in the country is one (1) per 3448 children. Also, the provision of a health facility is 4% of the GDP growth rate on average. Immunization of children against diseases is 42per 1000 children on average within the study period. The Jarque-Bera probability values of all the variables are greater than 0.05, which means that all the variables are normally distributed.

4.2:The Unit Root Test

The study tested the variables' stationarity status to determine the order of integration of the time series data for other analyses. For more robust estimates, the study employed three stationarity tests which are common in the literature. The variables were tested using first, Augmented Dickey-Fuller (ADF, 1979), second, Phillip-Perron (PP, 1988) and third Kwiatkowski-Phillips-Schmidt-Shin (KPSS, 1992). The results of the stationarity are reported in table 4.2 below.

Table 4.2: Stationarity Test Results (ADF, PP & KPSS)

	Stationarity Results at Level			
Variabes	ADF	PP	KPSS	Order of Integration
CMR	-1.006582	-0.49019	0.639044**	I(0)
AHP	-1.304195	-1.16263	0.632327**	I(0)
PHF	-3.64836**	-2.29699	0.448786*	I(0)
IMM	-1.542574	-1.20982	0.696836**	I(0)

Source: *Author's Computation, 2021*

Note: *The asterisks (*) mean significance at 10%; (**) significance at 5%; (***) significance at 1%, the Lag Length based on SIC, Probability based on Mackinnon's (1996) one-sided p-value.*

Table 4.2 shows the results of the unit root tests. The results indicate that the variables are all stationary having order of integration I (0) s. The results of the multiple regression analysis, using the Ordinary Least Square (OLS) estimation method are shown in table 4.3 below.

Table 4.3: Ordinary Least Square (OLS)Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	296.0978	20.14194	14.70056	0.0000
AHP	-132.6266	38.80030	-3.418183	0.0019
IMM	-1.767381	0.315900	-5.594756	0.0000
PHF	-0.297738	5.813412	-0.051216	0.9595

REGRESSION STATISTIC

R-squared	0.829061
Adjusted R-squared	0.811378
F-statistic	46.88372
Prob(F-statistic)	0.000000
Durbin-Watson stat	1.873857

Source*: Author's Computation, 2021*

The results from the multiple regression model show that the coefficient of availability of health personnel (AHP) is negative. This indicates the inverse impact of the availability of health personnel on the child mortality rate and the result is statistically significant at 1 percentage level of significance. The coefficient of availability of health personnel is -132.6266, meaning that a 1 per cent increase in the availability of health personnel will result in a 133 decrease in child mortality in Nigeria throughout the study while holding other variables constant. The result also shows that there exists a negative relationship between children(1-13) immunized against diseases and the child mortality rate in Nigeria. A per cent increase in child immunization will bring about a 1.763 decrease in child mortality. The result is significant at a 1% level of significance. The same is also applicable to Public funds to the health sector. One per cent increase in health funding from the government will lead to a 0.298 decrease in child mortality in Nigeria within the period of study. The result is not significant.

The R-squared of 0.829 shows that the model is a good fit because 83 per cent of the variation in child mortality is explained by changes in the independent variables used in the model while 17 per cent not explained is accounted for by the error term. The Durbin-Watson statistic of 1.874 shows that the model is free from autocorrelation problems. The F-Statistics and probability value of 1% shows the general significance of the model regression estimates.

Table 4.4: Diagnostic Test

Test Statistics	LM Test Statistics	F-Version
A: Serial Correlation	Chi-Square (2) = 3.8745(.1441)	F (2, 19) = 1.2808 (.3197)
B: Heteroscedasticity (.114)	Chi-Square (9) = 16.8408 (0.0780)	F (9,21) = 1.9831

***Source**: Author's Computation, 2021*

A: Lagrange multiplier test of residual serial correlation; B: Based on the regression of squared residuals on squared fitted value

The Breusch-Godfrey serial correlation test in table 4.4; shows a chi-square X^2 value of 3.8745 witha probability of 0.1441 and it is greater than 0.05. Therefore, null hypothesis of no serial correlation is accepted. This means no serial correlation in our model. Breusch-Pagan-Godfrey heteroskedasticity test result. The test follows the chi-square distribution of the number of observations times R-square($n.R^2$). The test statistic of the calculated chi-square is 16.8408, with a probability of 0.0780. Since the probability of the calculated chi-square is greater than 0.05, the null hypothesis of no heteroskedasticity is accepted. This means that the variance of each residual of our observation in our model is constant.

4.3: Discussion of Results

The main objective of this study is to examine the impact of health infrastructure on child mortality in Nigeria. The result showed that the availability of health personnel has a significant and negative impact on child mortality in Nigeria. This is in line with the findings of Okereke et al. (2019);Liang et al. (2019). The multiple regression estimates also showed that a negative and significant impact exists between child immunization and child mortality in Nigeria for the study. The result is perfectly in agreement with the works of David (2018); Mesike and Mojekwu (2018); Winter et al. (2016). The provision of health facilities exhibited a negative and insignificant impact on child mortality in Nigeria throughout the study. This finding is in accord with many findings in literature such as in the works of Adeosun and Faboye (2020); Ude and Ekesiobi (2019); Oluwaseun (2019); Salami et al. (2019);David (2018); Barenberg, et al. (2018); Dhrifi (2018); Faraget al. (2018); Nikoloski and Amendah (2018);Rhee (2018); Edeme et al. (2017)but findings from works of Novignon and Akanni (2017);Eric et al. (2017) found a positive relationship between government health expenditure and child mortality. The discord could be a result of instruments and sources of data employed by various authors of the studies stated above. The diagnostic tests showed that model variables estimates are heteroscedasticity free and have no serial correlation while the pre-estimation normality test showed that the model variables are normally distributed.

5. Conclusion And Recommendation

This study estimated a multiple regression model of the impact of health infrastructure on the health status of a child in Nigeria. The study used secondary data generated from World Development Indicators (WDI) from 1989 to 2021. However, from the empirical result, it is observed that health infrastructure has a significant and negative impact on child mortality in Nigeria. Therefore, the study found that the availability of health

professionals, provision of health facilities and immunization of children against diseases conform to the theoretical and a priori expectations of being negative. The variables are negatively related to child mortality in Nigeria. Therefore, health infrastructure has a significant negative impact on the reduction of child mortality in Nigeria. Based on the empirical findings of this study, the researcher, therefore, concludes that the availability of health professionals, provision of health facilities and immunization of children against diseases are determinants of child mortality. Therefore, government and health agencies are advised to be sensitive to the behaviour of the aforementioned variables to ensure effective measures capable of stimulating a reduction in child mortality in the country. In this regard, the development of health sector infrastructural needs should be vigorously pursued by the government to maintain a steady and smooth flow of health care service delivery in the country.

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