
HEALTH INFRASTRUCTURE DEVELOPMENT AND ITS INFLUENCE ON MORTALITY INCIDENCE IN NIGERIA

Dr. Erhuotor Ejiro Efe

Ejioefe922@gmail.com

Dr. Righteous Agor

righteousmuna@gmail.com

Nasarawa State University, Keffi, Nigeria

Faculty of Social Sciences

Department of Economics

ABSTRACT

This study explores the impact of health infrastructure development on mortality incidence in Nigeria, focusing on infant mortality, under-five mortality, and maternal mortality rates. Using a time series dataset from 2003 to 2023 sourced from the World Bank, the study employs the Autoregressive Distributed Lag (ARDL) model to analyze the relationship between health infrastructure variables and mortality outcomes. The analysis is framed within the Health Production Function theory, which asserts that improvements in health infrastructure directly contribute to better health outcomes by enhancing the efficiency of health care delivery. The findings indicate that the number of physicians, nurses, and midwives significantly reduces both infant and under-five mortality rates. Conversely, inadequate access to basic water services, sanitation facilities, and insufficient hospital bed spaces are associated with higher mortality rates among infants and children under five years old. For maternal mortality, the study reveals that both water and sanitation services exacerbate the mortality rate, while the current number of physicians and hospital bed spaces is insufficient to address the issue effectively. The empirical results from the ARDL model suggest that while there is a long-run relationship between health infrastructure and mortality incidence, substantial policy interventions are needed. Recommendations include increasing government health expenditure to meet and exceed the UNESCO recommended 16% of total expenditure, enhancing preventive health care infrastructure such as potable water and sanitation facilities, and fostering greater international cooperation to address the existing infrastructure deficits. This study underscores the critical importance of health infrastructure development in reducing mortality rates and aligns with the Health Production Function theory by demonstrating how improved health infrastructure enhances the overall efficiency of health care delivery. The insights provided are essential for policymakers aiming to improve health outcomes and reduce mortality rates in Nigeria.

KEYWORDS: Health Infrastructure, Infant Mortality, Under-Five Mortality, and Maternal Mortality Rates

1.1 INTRODUCTION

Health infrastructure development significantly influences mortality incidence in Nigeria, reflecting broader global and African health disparities. The availability and quality of healthcare facilities, personnel, and services are critical determinants of public health outcomes, particularly in low and middle-income countries (LMICs) like Nigeria.

Globally, inadequate health infrastructure remains a pressing challenge, disproportionately affecting regions with limited resources (WHO, 2023). In Africa, these disparities are exacerbated by historical underinvestment and structural inequalities (UNDP, 2022). Nigeria, as the most populous country on the continent, faces complex healthcare challenges amidst rapid urbanization and epidemiological transitions.

Historically, Nigeria's healthcare system has evolved against a backdrop of colonial legacies and post-independence challenges. Despite efforts to expand healthcare access, persistent gaps in infrastructure, funding, and service delivery continue to impact mortality outcomes (WHO, 2021). For instance, Nigeria recorded a maternal mortality ratio of 576 deaths per 100,000 live births in 2020, highlighting deficiencies in maternal health infrastructure and services (UNICEF, 2021). However, in Nigeria, despite the efforts made by the government to improve health care delivery, the mortality rate is alarming and has endured a crawling decline. UNICEF (2021) reveals that the infant mortality rate of Nigeria was the highest amongst Egypt and Brazil as it was 72 infant deaths out of 1000 persons, under 5 deaths between 2010 and 2023 was 114 out of 1000 persons and this is 358% higher than Egypt while it is 570.6% higher than Brazil. The male adult mortality rate for all selected developing countries are higher than female's own; however, Nigeria recorded the highest death per 1000 people between 2010 – 2023 as this is 382 for male (98.96% higher than Egypt, 91.96% higher than Brazil) and 347 for female (210.74% higher than Egypt and 254% higher than Brazil). The mortality rate in Nigeria is alarming and the government can control this by massively developing healthcare infrastructure.

Beyond physical infrastructure, challenges also include healthcare financing, governance, and human resources. Nigeria struggles with healthcare financing inefficiencies and inadequate allocation of resources to healthcare, limiting the expansion and maintenance of critical health infrastructure (World Bank, 2020). Moreover, the distribution and retention of healthcare professionals, particularly in rural areas, pose significant barriers to healthcare access and quality (Federal Ministry of Health, Nigeria, 2021).

Health infrastructure development in Nigeria is also influenced by demographic and epidemiological transitions. The country faces a double burden of communicable and non-communicable diseases, requiring adaptable infrastructure and health systems to address evolving health needs (Global Burden of Disease Study, 2021). Additionally, the impact of climate change and environmental factors on health infrastructure resilience and disease burden underscores the need for integrated and sustainable health planning (UNEP, 2023).

Health Infrastructure refers to the core facilities, services and the whole or part of social capital in an economy that is needed for human capital development and serves as a support system to the provision of health facilities (Ghosh & Dinda, 2017). Health infrastructure augments and makes social and economic activities possible. The components of health infrastructure can be tangible or intangible, within the government sector or privately provided. They are support systems that are needed for efficient healthcare delivery in an economy. Health infrastructure is vital in understanding the healthcare policy prevalent in an economy. Mortality incidence is the extent of occurrence or prevalence of mortality (death cases) within an economy that can occur amongst children, adults and caused by health failure due to an epidemic outbreak, health crisis or natural occurrence.

The health sector of a nation cannot strive on its own without providing the basic infrastructure that is needed for the safe delivery of health care services. Such health care infrastructure can and

mostly be provided by the government especially in a developing country like Nigeria. The government, aside from maintaining law and order, owes the citizenry the provision of public goods of which health infrastructure is a major component; this is because there is always a huge capital outlay while providing for these facilities together with the externalities associated with such goods. The public goods include basic infrastructure which are good roads, defense, power, education, and health. The extent of the availability of such infrastructure can affect the rate of mortality in the nation; this is because the socioeconomic conditioning of the citizens is dependent on quantity as well as the quality of health infrastructural facilities available (Bashir, 2016). Health infrastructure amongst others includes the number of available bed spaces to a patient, number of hospitals available, number of syringes available, the extent of electricity supplies and many others.

It is against this background that this study is out to uncover Health Infrastructure Development and Its Influence on Mortality Incidence in Nigeria. However, this study intends to fill the gap in the literature by empirically analyzing the effect of Health Infrastructure Development on Mortality Incidence in Nigeria, with special emphasis on infant mortality, under-five mortality rate, and maternal mortality rate in Nigeria from 2003-2023. The objectives of the study are therefore: (1) Evaluate the impact of Health Infrastructure Development on infant mortality in Nigeria. (2) Examine the impact of Health Infrastructure Development on under-five mortality rate in Nigeria. (3) Evaluate the impact of Health Infrastructure Development on maternal mortality rate in Nigeria. The rest of the study is presented as follows: section 2 presents the literature review involving the theoretical underpinning of the study and the review of empirical studies. Section 3 focuses on material and methods which captures the data and model specifications. Section 4 analyses the data and divulges the findings, while sections 5 conclude the paper and highlights the recommendations

2.0 REVIEW OF RELATED LITERATURE

2.1 Conceptual Framework

2.1.1 Health infrastructure

Health infrastructure refers to the comprehensive network of physical facilities, technological systems, organizational structures, and human resources that support and deliver healthcare services. This includes hospitals, clinics, and specialized medical centers; diagnostic and treatment equipment such as imaging machines and laboratory tools; essential support facilities like pharmacies, rehabilitation centers, and emergency services; health information systems for managing patient records and administrative tasks; and a skilled workforce comprising doctors, nurses, technicians, and administrative staff. These components work together to provide accessible, efficient, and quality healthcare, contributing to improved health outcomes and overall well-being.

The resources for living a full and happy life include mental, physical, and social well-being, which may be defined as being in good health. In addition to the absence of disease, being in good health also means having the strength and capacity to recover from illness and other physical or mental problems. A healthy person makes the most contribution to the overall growth and development of a nation. A country's ability to produce goods and services with a robust and healthy labour force is also ensured by a sophisticated health infrastructure. Health infrastructure comprises cutting-edge equipment, specialised medical personnel, such as physicians and nurses, as well as established pharmaceutical enterprises (BYJUS, 2021).

Inadequate capital investment, outmoded technology, poor infrastructure, such as lack of laboratory equipment and medical specialists, make Nigeria's healthcare system even more difficult to manage.

2.1.2 Mortality:

Mortality is the extent to which death occurs in a population due to a specific cause. The mortality rate is always measured in units of death per thousand individuals annually. The mortality rate can take different dimensions depending on the cause of the death or the age category of the victim. The United Nations categorised mortality rates into different types. Maternal mortality ratio is the extent of women who die from pregnancy-related causes; there is a mortality ratio caused by traffic injury;

mortality due to cancer, diabetes or chronic respiratory disease between the ages of 30 and 70; under-five mortality rate as the chances that a newborn baby will die before the age of 5; infant mortality is the number of infants dying before the age of 1; the suicide mortality rate is also the number of suicide deaths on an annual basis; Adult male and Adult female mortality rate is the chances of men and women respectively dying between the ages of 15 and 60 years old. Porta (2014).

2.1.3 Infant Mortality

Infant mortality refers to the death of infants under the age of one year per 1,000 live births in a given population within a specified period. It is a critical indicator of the overall health and well-being of infants in a society, reflecting factors such as healthcare access, maternal health, socioeconomic conditions, and public health interventions (WHO, 2023).

Infant mortality refers to the number of deaths of infants under one year of age per 1,000 live births in a specified geographical area or population within a given time period. It is a critical health indicator influenced by factors such as maternal health, access to healthcare services, socioeconomic conditions, and public health interventions (CDC, 2021).

2.1.4 Under-Five Mortality:

Under-five mortality, also known as child mortality, refers to the probability of dying before reaching the age of five years per 1,000 live births. It serves as a key indicator of child health and well-being, encompassing deaths from infancy through early childhood due to preventable and treatable causes such as malnutrition, infectious diseases, and inadequate healthcare (UNICEF, 2021).

Under-five mortality, also known as child mortality, refers to the probability of dying before reaching the age of five years per 1,000 live births. This measure includes deaths of children under five due to various causes, including infectious diseases, malnutrition, injuries, and inadequate access to healthcare services. It serves as a critical indicator of child health and well-being in populations (WHO, 2023).

2.1.5 Maternal Mortality:

Maternal health refers to the health of women during pregnancy, childbirth and the postpartum period. It refers to deaths related to pregnancy or childbirth. While motherhood is often a positive and fulfilling experience, for too many women it is associated with suffering, ill-health and even death. According to Maternal and Neonatal Programme Effort Index (MNPI, 2010), maternal mortality as the deaths caused by complications due to pregnancy or childbirth, these complications may be experienced during pregnancy, delivery itself, or 42 days following childbirth. For each maternal death, many more suffer injuries, infection and disabilities brought about by pregnancy or childbirth complications. The major direct causes of maternal morbidity and mortality include hemorrhage, infection, high blood pressure, unsafe abortion and obstructed labour.

2.2. Theoretical framework

2.2.1 The Health Production Function Theory

The study is hinged on the Health Production Function theory by Alfred Marshall and John Bates Clark in the late 19th and early 20th centuries, is a fundamental economic framework that examines how inputs within healthcare systems contribute to health outcomes, particularly mortality rates. Originating from broader production function theories in economics, which analyze how inputs combine to produce outputs in various industries, this theory specifically focuses on healthcare delivery and its impact on public health metrics.

In Nigeria, the application of the Health Production Function theory is particularly relevant due to significant healthcare challenges stemming from historical underinvestment, infrastructure deficiencies, and disparities in healthcare access between urban and rural areas. Healthcare infrastructure, encompassing hospitals, clinics, medical equipment, and technology, serves as critical inputs in this framework. Improvements in infrastructure are believed to enhance the accessibility and quality of healthcare services, thereby reducing mortality rates through timely medical interventions

and treatments.

Furthermore, the theory allows for the exploration of how other factors interact with healthcare infrastructure to influence mortality outcomes. This includes the distribution of healthcare personnel, the effectiveness of healthcare financing mechanisms, and the impact of health interventions targeted at vulnerable populations such as infants and children under five.

By applying the Health Production Function theory, researchers and policymakers in Nigeria can gain valuable insights into optimizing healthcare delivery systems. This involves identifying areas for infrastructure improvement, optimizing resource allocation, and implementing effective healthcare policies aimed at reducing mortality incidence and improving public health outcomes across diverse population groups.

In conclusion, the Health Production Function theory provides a systematic approach to understanding how investments in healthcare infrastructure translate into measurable health outcomes. Its application in Nigeria underscores the importance of strategic investments and policy initiatives aimed at strengthening healthcare infrastructure to enhance healthcare access, improve health outcomes, and ultimately reduce mortality incidence.

2.3 Empirical Review

Kanwanye and Ovenseri-Ogbomo (2018) examined the drivers of the healthcare system in Nigeria. The data covered the period from 1980 till 2014 using the autoregressive distributed lag model (ARDL) technique. The study found that the state of the institution, infrastructure, income, and education are determinants of the health care system. Also, the study by Akacho (2014) investigated the determinants of healthcare service delivery in Kenya and discovered that inadequate financial resources, laboratory equipment and medicine for patients are a major constraint to health care service delivery.

3.1 MATERIALS AND METHODS

The study adopted Ex-post facto research design to evaluated Health Infrastructure Development and Its Influence on Mortality Incidence in Nigeria. The study used Autoregressive Distributed Lag Model technique for analyzing data primarily generated from World Bank Statistical Bulletin and World Development Indicators (WDI) for the period, 2003 to 2023.

3.2 Model specification

The study adapts the Autoregressive Distributed Lag Model proposed by work of Kanwanye and Ovenseri-Ogbomo (2018) who investigated on the drivers of the healthcare system in Nigeria. The study employed the unit root test (using ADF) to test for stationarity, the co-integration test (using Johansen cointegration) to test for long-term correlations between the variables in the model, and descriptive statistics were used to identify trends. Data utilized in the research include:

$$INF MRT_t = \beta_0 + \beta_1 BWAT_t + \beta_2 BSAN_t + \beta_3 PHY_t + \beta_4 HB_t + \beta_5 NM_t + \mu_t \text{-----} 3.1$$

$$UNDMRT_t = \beta_0 + \beta_1 INSEC_t + \beta_2 IMM_t + \beta_3 PHY_t + \beta_4 VIT_t + \beta_5 NM_t + \varepsilon_t \text{-----} 3.2$$

$$MMRT_t = \lambda_0 + \lambda_1 BWAT_t + \lambda_2 BSAN_t + \lambda_3 PHY_t + \lambda_4 HB_t + \lambda_5 NM_t + v_t \text{-----} 3.3$$

From equation (3.1) to (3.3), the β 's, ψ 's and λ 's are the apriori expectations. The definition of the variables, measures, and sources are provided in Table 3.1.

Table3.1: Variable Definition, Measures, Sources and Apriori Expectation

Code	Definition	Measures	Apriori Expectation
INFMRT _t	Infant mortality rate at time t	Number of infants dying before reaching one year of age	Dependent Variable
UNDMRT _t	Under 5 mortality Rate	Chances that newborn baby will die before reaching age five	Dependent Variable
MMRT _t	Maternal mortality Growth Rate	The growth rate in the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births	Dependent Variable
BWAT _t	Basic water services at time t	People using at least basic drinking water services (% of the population)	(-)
BSAN _t	Basic sanitation services at time t	The growth rate of people using at least basic sanitation services (% of the population)	(-)
PHY _t	Physicians at time t	Number of available physicians per 1000	(-)
HB _t	Hospital beds at time t	Number of available hospital beds per 1000	(-)
NM _t	Nurses and Midwives at time t	Number of available nurses and midwives per 1000	(-)
INSEC _t	Insecticide at time t	Number of people using insecticide-treated bed nets (% of the under-5 population)	(-)
IMM _t	Immunisation at time t	Number of people immunized BCG (% of one-year-old children)	(-)
VIT _t	Vitamin A usage at time t	Percentage of children ages 6-59 months old who received at least two doses of vitamin A last year	(-)

Source: World Bank (2024)

In order to estimate equations (3.1) to (3.3), the study employs the autoregressive distributed lag model (ARDL). The ARDL model involves the estimation of the conditional error correction version of the vector autoregressive model. ARDL technique is chosen because it is useful in estimating the short run and long-run components of the model. The ARDL model is also suitable for models in which the variables are integrated into different order at level and at order one. For an ARDL to be employed, it requires that stationarity exists either at I(0) or at I(1). When variables are found to be non-stationary at level, one option in order to get the short-run dynamic is to estimate the model by differencing the variables if these differences are stationary. However, this method will lead to a considerable loss of the long-run properties of the data. Alternatively, economic variables may be combined in levels provided that they are co-integrated. The issue of co-integration then applies when two series are integrated after the first difference I(1), but a linear combination of them is stationary at level I(0); in this case, the regression of one on the other is not spurious, but instead, tells us something about the long-run relationship between them

4.1 Data Analysis and Discussions

4.1.1 Descriptive Statistics of the Variables Employed

Table 4.1: Descriptive Statistics of the Variables Employed

Variable	Mean	Standard Deviation	Minimum Value	Maximum Value
HB	.2361111	.4141098	0	1.2
IMM	40.72222	9.963495	25	63
INFMRT	86.48333	15.11031	64.6	111.6
UNDMRT	139.7889	27.62788	100.2	186.2
NM	.6833056	.786623	0	1.605
BWAT	50.67021	19.49807	0	67.34497
BSAN	-.2144098	.1047963	-.3193587	0
PHY	.1488889	.1748676	0	.395
INSEC	15.66944	16.75271	0	49.1
VIT	48.5	34.03502	0	91
MMRT	-18.11111	31.33855	-56	54

Source: Authors' Construct using Data Extracted from World Bank (2024)

Table 4.1 shows the descriptive statistics of the variables employed, which are the number of available hospital beds per 1000 (hb), number of people immunised with BCG (imm), infant mortality rate (infmrt), under 5 mortality rate (undmrt), number of available nurses and midwives (nm), growth rate of people with at least basic drinking water (bwat), growth rate of people using at least basic sanitation facilities (bsan), number of available physicians (phy), insecticide nets available (insec), percentage of children who receive at least two doses of Vitamin A and maternal mortality growth rate (mmrt); these variables are available from the period 2003 till 2023 from the world development indicators. Table 4.1 reveals that 0.236 on the average are the available bed spaces per 1000 people in Nigeria over the period 2003 till 2023 and this is disappointing as the highest bed spaces per 1000 between the periods is 1.2. This shows the degrading state of bed spaces as a core measure of health infrastructure in Nigeria. The result also shows that on average, only 40.72% of one-year-old children are immunised yearly between the periods 2003 till 2023 while the highest immunisations received are 63% of the one-year-old children.

However, the rate of infant mortality under the period of the study reveals that on average, 15 infants die annually before reaching the age of one while the highest was 112 children who died at a particular year. The case of under 5 mortality incidence is the worst as the result reveals that the highest number of infants that die before age 5 on the average for the period was 28 while the worst scenario was 186 under 5 infants and the best scenario was 100 children. The implication of this is that more children died before 5 years of age than the infants that died before age 1. However, the rate of growth in maternal mortality shows that 31% per 100,000 live births die due to child delivery.

From Table 4.1, it can be adjudged that on average, 51% of the population has access to basic drinking water services; this is considered fair compared to other measures of health infrastructure; although the highest as recorded was 67.3% of the entire population. The number of people using insecticide-treated nets as a percentage of under 5 population shows that only 15.67% of them have such access. The percentage of children aged 6-59 months old who received at least two doses of vitamin A in the previous year in terms of the current year averaged 48.5% and its peak was 91%.

Table 4.1 further reveals that per 1000 patients on average within the period 2003 till 2023, 0.68 nurses and midwives are available and the highest number of midwives and nurses available per 1000 patients is 1.61 nurses and midwives; this reveals the disheartening state of health infrastructure in Nigeria. On the same trail and on average, 0.15 physicians are available per 1000 patients for the period 2003 till 2023; the combination of almost non-availability of nurses, midwives and physicians will ultimately spell an increase in mortality incidence in Nigeria.

4.1.2 Stationarity Test of Variables

This section examines the stationarity of the variables employed. Given that the variables are time series in nature, it is important that the study first test for stationarity to avoid a unit root problem. The variables should be stationary so that predictions and stability of the variables can be determined. Stationarity implies that the variables have constant variance over time. The stationarity of the series is tested at level and also at first difference. This study employs the Dickey-Fuller unit root test that follows the null hypothesis of unit root and the alternative of variables stationary. To make a decision, the null hypothesis is rejected if the Z test statistics is greater than the critical value or also, we reject the null hypothesis if the probability value is less than 5%. For this study, 5% level of significance is used as the level of significance. Table 4.2 reveals the unit root test at level.

Table 4.2: Dickey-Fuller Unit Root Test at Level

Variable	Z(t) Statistics I(0)	Test at	5% Critical Value	10% Critical Value	Probability Value	Decision
HB	-3.483**		-1.753	-1.341	0.0017	I(0)
IMM	-1.391		-1.753	-1.341	0.0923	NotI(0)
INFMRT	-6.932**		-1.753	-1.341	0.0000	I(0)
UNDMRT	-8.066**		-1.753	-1.341	0.0000	I(0)
NM	-1.479		-1.753	-1.341	0.0800	NotI(0)
BWAT	-0.848		-1.753	-1.341	0.2049	NotI(0)
BSAN	-2.290*		-1.753	-1.341	0.0185	I(0)
PHY	-2.038*		-1.753	-1.341	0.0298	I(0)
INSEC	0.231		-1.753	-1.341	0.5897	NotI(0)
VIT	-3.333**		-1.753	-1.341	0.0023	I(0)
MMRT	-3.880**		-1.753	-1.341	0.0007	I(0)

*Implies significant at 5% and ** implies significant at 1%

Source: Authors' Construct Using Data Extracted from World Bank (2024)

From Table 4.2, eleven of the variables employed are tested at level and the result reveals that out of the eleven variables tested, only four of them which are infant mortality rate (imm), number of midwives and nurses (nm), number of people with basic water services (bsan) and number of people with access to insecticide-treated nets (insec) are not stationary at levels; however, the other seven variables are stationary at level.

Table 4.3: Dickey-Fuller Unit Root Test at First Difference

Variable	Z(t) Statistics I(1)	Test at	5% Critical Value	10% Critical Value	Probability Value	Decision
D(IMM)	-2.583*		-1.761	-1.345	0.0108	I(1)
D(NM)	-3.841**		-1.761	-1.345	0.0009	I(1)
D(BWAT)	-3.916**		-1.761	-1.345	0.0008	I(1)
D(INSEC)	-3.389**		-1.761	-1.345	0.0022	I(1)

*Implies significant at 5% and ** implies significant at 1%

Source: Authors' Construct Using Data Extracted from World Bank (2024)

In an attempt to pursue the stationarity of the remaining four variables, Table 4.3 tested the variables at first difference. The result reveals that all the four variables are stationary at first difference using the 5% level of significance as the criteria for decision making. The result shows that all their probability values are less than 5%, thereby making them integrated at first difference. The next step is then to test for co-integration.

4.1.3 Cointegration Test

Given that not all the variables are stationary at level, it implies that there will always be a distortion in the natural state of the variables. That is, there will be a disequilibrium in the medium run that will distort the stability in the long run. In order to correct for this effect, the study must examine if the variables are indeed co-integrated or not so that the long run stability can be achieved. Given that there are also different levels of stationarity; Pesaran, Shin and Smith (2001) provide f-statistics that can be best applied where there is varying order of stationarity. That is, it provided for a critical and test statistics value when the variables are stationary at $I(0)$ and $I(1)$.

Table 4.4: Engle-Granger Test for Cointegration

ARDL Bound Test (btest)	Infant Mortality Model		Under5mortality Model		Maternal mortality model	
F-Statistics	117.900		55.154		4.326	
	[I_0]	[I_1]	[I_0]	[I_1]	[I_0]	[I_1]
Critical Value At 10% (L_1)	2.26	3.35	2.26	3.35	2.45	3.52
At 5% (L_05)	2.62	3.79	2.62	3.79	2.86	4.01
At 2.5% (L_025)	2.96	4.18	2.96	4.18	3.25	4.49
At 1% (L_01)	3.41	4.68	3.41	4.68	3.74	5.06
Number of Parameters	K_5		K_5		K_4	

Accept if $F < \text{Critical value for } I(0) \text{ regressors}$ Reject
if $F > \text{Critical value for } I(1) \text{ regressors}$

Source: Authors' Construct Using Data Extracted from World Bank (2024)

In order to decide if there is co-integration or not, the f-statistics as provided by Pesaran is compared with the critical value. In this study, the 5% critical value is employed. There exists a co-integration if the f-statistics is greater than the 5% upper bound (I_1); there is no co-integration (that is, we fail to reject the null hypothesis) if the f-statistics is less than the lower bound (I_0); however, no decision is reached if the f-statistics is between the lower bound (I_0) and the upper bound (I_1). From Table 29.5, it can be seen that for the infant mortality model, the f-statistics is greater than the upper bound ($117.9 > 3.79$) and thus it can be concluded that co-integration exists amongst the economic fundamentals of health infrastructure and infant mortality. Also, for the under 5mortality rate model, the f-statistics is greater than the upper bound ($55.15 > 3.79$) meaning that we reject the null hypothesis and accept the alternative and conclude that there exists co-integration in the model. A similar decision is also reached for the maternal mortality rate as the result reveals that there exists a cointegration since the f-statistics is greater than the upper bound ($4.33 > 4.01$). It can thus be concluded that there exists co-integration in all the three models specified and thus, the equations can be estimated.

4.2.1 Regression Result

Given that there exists cointegration and the variables are stationary at $I(0)$ and $I(1)$, the estimation technique to employ is the Autoregressive Distributed Lag Model (ARDL) for the three models

Table 4.5: Infant Mortality Model Result
Technique: Autoregressive Distributed Lag Model(ARDL)

Infmrt	Coef.	Std. Err.	t	p> t	[95% Conf. Interval]	
infmrt.L1	0.9794660**	0.0407250	24.05	0.000	0.8855550	1.0733770
Bwat	0.0041180	0.0263190	0.16	0.880	-0.0565740	0.0648090
Bsan	2.0926660	9.4217400	0.22	0.830	-19.633910	23.819240
bsan.L1	0.2873130	0.2469860	1.16	0.278	-0.2822390	0.8568640
Phy	-0.1490740	0.1698200	-0.88	0.406	-0.5406810	0.2425320
phy.L1	-0.2711100*	0.0971280	-2.79	0.024	-0.4950870	-0.0471330
Hb	0.4575160**	0.1077900	4.24	0.003	0.2089510	0.7060800
Nm	-0.0246330	0.0420160	-0.59	0.574	-0.1215210	0.0722560
_cons	-0.6322490	2.7418940	-0.23	0.823	-6.9550690	5.6905710
R-squared	.9999930					
Adj R-squared	.99998700					
e(lags)	[101100]					
AIC Criterion	-2.784358*					
Durbin-Watson	2.6868					
Breusch-Pagan-Godfrey (Prob>chi2)	0.8121					
f-Statistics	150686.6					
f-Prob	0.0000					

* Implies significant at 5% and ** implies significant at 1%

Source: Authors' Construct using Data Extracted from World Bank (2024)

Table 4.5 reveals the result of the infant mortality rate. Before estimation, it is important that the optimum lag length selection criterion is determined. Using the Akaike Information Criterion (AIC), the result reveals that the optimum lag length selection criterion is that of 1, 0, 1, 1, 0, 0. With this criterion, the result is thus estimated.

From Table 4.5, the result reveals that the available extent of basic water services as a measure of health infrastructure contributes to infant mortality. The result reveals that a unit increase in the basic water facility services, on average will cause infant mortality rate to increase by 0.004 and this is statistically insignificant. This result implies that the available extent of provision of water facilities increases the chances of infants below the age of one that dies; this did not conform to the apriori expectation. This result did not change also with basic sanitation facilities provided for the previous year and the current year under study; although, the extent and magnitude of negative impact on infant mortality of last year declined compared to this year.

However, a consensus is reached and the consensus is that the basic sanitation facilities between 2003 and 2023 contributed to the high rate of infant mortality in the country.

The result of the impact of the number of physicians on infant mortality rate took a different turn as the result reveals that a higher number of physicians available reduces the chances of infants who die before the age of one, but this effect is most significant the last year. The result invariably shows that there is a negative and significant impact of the number of physicians on infant mortality incidence in Nigeria. This implies that the availability of physicians is a strong health infrastructure that decreases the death rate among infants before the age of one.

The result also reveals that the limited available hospital bed spaces increase the chances of infants who die before the age of one. The result shows that if the number of bed spaces increases by one, on average, the infant mortality rate will increase by 0.46. Thus, the available bed spaces do not reduce the infant mortality rate in Nigeria. The result also shows that the number of midwives and nurses negatively impact on infant mortality rate as expected. The result implies that the higher availability of nurses and midwives reduces the chances of infants who die before the age of one.

The conclusion that can be drawn here is that only the number of physicians, nurses and midwives are critical health infrastructure that reduce the death of infants before the age of one while the water services, sanitation services, and hospital bed spaces are poor health infrastructure facilities available in Nigeria available that increase the death toll of infants before

the age of one.

It is further important that the statistical and postdiagnostic properties of the model are examined. The R-square that measures the coefficient of determination is high and this means that about 99% of variations in infant mortality rate are all explained by the explanatory variables (basic water services, basic sanitation facilities, physicians available, hospital bed spaces, nurses and midwives available) put together. The result also reveals that there is considerably no serial correlation of order one (AR[1]) associated with the regression result from the Durbin Watson statistics as this skewed towards 2 the more than 4. Also, testing the presence of autocorrelation of higher-order

(AR[p]), the Breusch-Godfrey chi-square test is employed and the B-G tests the null hypothesis of no serial correlation of higher-order associated with the regression result. The result shows that we fail to reject the null hypothesis meaning that there is no autocorrelation of a higher order. The result further examines the test for heteroscedasticity. The result employs the Breusch-Pagan-Godfrey test for heteroscedasticity and it follows the null hypothesis of homoscedasticity against the alternative hypothesis. The result reveals that we fail to reject the null hypothesis as the probability value is greater than 5%, meaning that the model does not suffer from heteroscedasticity. Also, the model further tests for goodness of fit and it employs the f-statistics test. The result also reveals that the f-statistics is significant.

Table 4.6: Under 5 Mortality Model Result
Technique: Autoregressive Distributed Lag Model (ARDL)

Undmrt	Coef.	Std. Err.	T	p> t	[95% Conf. Interval]	
undmrt.L1	0.9845740**	0.0044210	222.71	0.000	0.9745740	0.9945750
Insec	0.0150960*	0.0055350	2.73	0.023	0.0025750	0.0276180
Imm	0.0011410	0.0096290	0.12	0.908	-0.0206400	0.0229240
Phy	-0.5693930	0.5860650	-0.97	0.357	-1.8951600	0.7563770
Vit	-0.0008350	0.0014320	-0.58	0.574	-0.0040700	0.0024040
Nm	-0.1040470	0.1339100	-0.78	0.457	-0.4069700	0.1988780
nm.L1	-0.1915180	0.0959100	-2.00	0.077	-0.4084800	0.0254450
_cons	-2.8268010*	0.9224350	-3.06	0.014	-4.9134900	-0.7401100

R-squared	.99997800
AdjR-squared	.99996200
e(lags)	[100001]
AIC Criterion	-0.517354*
Durbin-Watson	2.5220
Breusch-Godfrey χ^2 (@ p=2)	2.090
Prob>chi2	0.1483
Breusch-Pagan-Godfrey χ^2	
Cal (8)	12.26
Breusch-Pagan-Godfrey (Prob>chi2)	0.0922
f-Statistics	59400.37
f-Prob	0.0000

* Implies significant at 5% and ** implies significant at 1%

Source: Authors' Construct Using Data Extracted from World Bank (2024).

Table 4.6 reveals the result of the under-5 mortality rate result. Also, before we estimate the model, we must determine the optimum lag length selection criterion. Using the Akaike Information Criterion (AIC), the result reveals that the optimum lag length selection criterion is that of 1, 0, 0, 0, 0, 1. With this criterion, the result is estimated in Table 4.6 and decisions are reached following the order of lag selection criterion.

Table 4.6 reveals that there are largely unavailable available insecticides treated bed nets and this has

led to an increase in the death rate of children below the age of five (5). The result reveals that if one insecticide-treated bed nets increases and on average, the death rate of children below the age of five (5) will increase by 0.016; this did not conform to the apriori expectation. The implication of this is that the poor state of insecticide-treated bed nets is a major determinant of the increase in the death rate of children below the age of five (5). The result is also similar to that of the extent and efficiency of immunisation of children under the ages of 5. The result shows that the extent of immunisation in Nigeria between 2003 and 2023 is inefficient and has contributed to the death rate of children below the age of five (5) as it positively stimulates the death rate of children below the age of five (5).

However, the result of insecticide-treated bed nets and immunisation services is in contrast with that of the available number of physicians, vitamins A received by infants below 5 years and nurses and midwives available. The result reveals that a higher number of physicians available reduces the chances of the death rate of children below the age of five (5). The result invariably shows that there is a negative and significant impact of the number of physicians on the death rate of children below the age of five (5) in Nigeria. This implies that the availability of physicians is a strong health infrastructure that decreases the death rate of children below the age of five (5).

The result also supports the notion that the intensity of vitamin A supplement intake in Nigeria has reduced the death rate of children below the age of five (5). The result reveals that a higher vitamin A supplement intake reduces the death rate of children below the age of five (5). It then means that vitamin A supplement as a measure of health infrastructure helps to reduce the death rate of children below the age of five (5). Also, the result reveals that the number of nurses and midwives available in Nigerian hospitals from 2003 to 2023 has reduced the death rate of children below the age of five (5). That is, increases in one midwife and nurse, will on average reduce the death rate of children below the age of five (5) by 0.10 in the current year and last years' midwife and nurse has a reduction potential on the death rate of children below the age of five (5) by 0.192. This result implies that only the number of physicians, availability of Vitamin A supplements, nurses and midwives are critical health infrastructure that reduce the death rate of children below the age of five (5); however, insecticide-treated bed nets and immunisation services are poor health infrastructure facilities in Nigeria that increase the death rate of children below the age of five (5).

The postdiagnostic properties of the model are also examined in Table 4.6. The R-square that measures the coefficient of determination is high and this means that about 99% of variations in under 5 mortality rate are all explained by the explanatory variables (insecticide-treated bed nets, immunisation services for BCG, physicians available, Vitamin A supplements intake, number of nurses and midwives available) put together. The result also reveals that there is considerably no serial correlation of order one (AR[1]) associated with the regression result from the Durbin Watson statistics as this skewed towards 2 (2.5) the more than 4. Also, testing the presence of autocorrelation of higher- order (AR[p]), the Breusch-Godfrey chi-square test is employed and the B_G tests the null hypothesis of no serial correlation of higher-order associated with the regression result as the probability value is higher than 5% (14.83%). The result shows that we fail to reject the null hypothesis meaning that there is no autocorrelation of a higher order. Table 4.6 examines the test for heteroscedasticity. The result employs the Breusch-Pagan-Godfrey test for heteroscedasticity and it follows the null hypothesis of homoscedasticity against the alternative hypothesis. The result reveals that we fail to reject the null hypothesis as the probability value is greater than 5%, meaning that the model does not suffer from heteroscedasticity. Also, the model further tests for goodness of fit and it employs the f-statistics test. The result reveals that the f- statistics is statistically significant as the probability value is less than 5% meaning that there is a considerable harmony associated with the regression result.

Table 4.7: Maternal Mortality Model Result
Technique: Autoregressive Distributed Lag Model (ARDL)

Mmrt	Coef.	Std.Err.	T	p> t	[95%Conf.Interval]	
mmrt.L1	-0.6283650*	0.2639460	-2.38	0.041	-1.22545100	-0.0312780
Bwat	2.6350280*	1.0654100	2.47	0.035	0.22490300	5.045153
bwat.L1	0.6107010	0.5674710	1.08	0.310	-0.67300800	1.894409
Bsan	814.6531000*	301.3773000	2.70	0.024	132.890300	1496.416
bsan.L1	225.0180000**	108.2656000	2.08	0.067	-19.8957000	469.9318
Phy	135.8342000*	57.6229300	2.36	0.043	5.4820620	266.1863
Hb	92.9407800**	49.9474200	1.86	0.096	-20.0481300	205.9297
cons	0.1043340	22.6391200	0.00	0.996	-51.1089000	51.31757

R-squared	.67617300
Adj R-squared	.42430700
e(lags)	[11100]
AIC Criterion	-9.382453*
Durbin-Watson	2.699
Breusch-Godfrey χ^2 (@ p=2)	10.268
Prob>chi2	0.1739
Breusch-Pagan-Godfrey χ^2 Cal (3)	7.60
Breusch-Pagan-Godfrey (Prob>chi2)	0.1739
f-Statistics	2.685
f-Prob	0.0847

* Implies significant at 5% and ** implies significant at 1%

Source: Authors' Construct Using Data Extracted from World Bank (2024).

Table 4.7 shows the result of the model that explains the impact of health infrastructure on the maternal mortality rate. To examine this impact, we begin by examining the optimum lag selection criterion to use. Using the Akaike Information Criterion (AIC), the result reveals that the optimum lag length selection criterion is that of 1, 1, 1, 0, 0 and this is suitable to use. With this criterion, the result is estimated in Table 4.7 and decisions are reached following the order of lag selection criterion.

Table 4.7 shows that basic water services available in Nigeria between the period 2003 till 2023 are significant determinants that contribute to the high increase in maternal mortality in Nigeria. That is, we say that increases in the available water services for the current year, on average, will cause maternal mortality rate to increase by 2.635 while increases in the available water services for the past year, on average, will cause maternal mortality rate to increase by 0.61. The implication of this is that the available health infrastructure concerning water services available are propellant of increasing maternal mortality rate in Nigeria.

The result for basic sanitation facilities for the period under study did not report a contrary result with that of water services. The result reveals that from Table 4.7, there is a significant and positive impact of basic sanitation services access in Nigeria on the increasing rate of maternal mortality rate. That is, increases in the available sanitation services for the current year, on average, will cause maternal mortality rate to increase by 814.65 while increases in the available sanitation services for the past year, on average, will cause maternal mortality rate to increase by 225. We simply say that basic sanitation services and its access in Nigeria do not lead to a reduction in maternal mortality rate in Nigeria.

Also, the result reveals that the number of available physicians is not sufficient to reduce effectively the maternal mortality rate in Nigeria. The result shows amongst many from Table 4.7, that the available physicians in the country cannot reduce the incidence of the pregnant women's death toll in Nigeria. Also, the result shows that there is a positive and significant impact of the number of hospital

bed spaces on the maternal mortality rate in Nigeria. That is, physicians and bed spaces available in Nigeria are not sufficient to reduce the incidence of pregnant women who die.

The implication of this result is that none of the health infrastructure examined tends to reduce the maternal mortality rate in Nigeria. We can, therefore, conclude that the availability of water services, both for the current year and last year enjoyed, available basic sanitation facilities both for the current year and also last year, number of physicians and hospital bed spaces are poor health infrastructure facilities in Nigeria that increase the death rate of pregnant women.

The postdiagnostic properties of the model are also examined in Table 4.7. The R-square which measures the coefficient of determination is high and this means that about 68% of variations in maternal mortality rate are all explained by the explanatory variables (water services for last year, water services for the current year, basic sanitation services for last year, basic sanitation services for this year, physicians available and the number of hospital bed spaces available) put together. The result also reveals that there is considerably no serial correlation of order one (AR[1]) associated with the regression result from the Durbin Watson statistics as this skewed towards 2 (2.699) the more than 4. Also, testing the presence of autocorrelation of higher-order (AR[p]), the Breusch-Godfrey chi-square test is employed and the B-G tests the null hypothesis of no serial correlation of higher-order associated with the regression result as the probability value is higher than 5% (17.39%). The result shows that we fail to reject the null hypothesis meaning that there is no autocorrelation of a higher order. Table 4.7 examines the test for heteroscedasticity. The result employs the Breusch-Pagan-Godfrey test for heteroscedasticity and it follows the null hypothesis of homoscedasticity against the alternative hypothesis. The result reveals that we fail to reject the null hypothesis as the probability value is greater than 5%, meaning that the model does not suffer from heteroscedasticity. Also, the model further tests for goodness of fit and it employs the f-statistics test. The result reveals that the F-statistics is statistically significant as the probability value is less than 5% meaning that there is a considerable harmony associated with the regression result.

4.3 Discussion of Findings

This chapter explores the influence of health infrastructure on mortality rates in Nigeria, specifically addressing infant mortality, under-five mortality, and maternal mortality. Despite substantial investments aimed at improving the health sector, the study highlights a troubling increase in mortality rates. This paradox indicates that current infrastructure is insufficient and points to potential implementation failures, with Nigeria's mortality rates surpassing those of other developing countries like Egypt and Brazil.

The study focuses on various health infrastructure measures: hospital bed spaces, access to basic drinking water and sanitation, the number of available physicians, nurses, and midwives, the availability of insecticide-treated bed nets, and the extent of immunization and Vitamin A supplementation. These indicators were selected due to their recognized importance in healthcare delivery and the availability of data.

Empirical results show that the number of physicians, nurses, and midwives significantly reduces infant mortality rates. Conversely, the availability of basic water services, sanitation facilities, and hospital bed spaces is found to be inadequate, contributing to higher infant mortality.

For under-five mortality, the presence of physicians, Vitamin A supplements, and nurses/midwives proves crucial in reducing death rates among children aged one to five. However, the study identifies deficiencies in insecticide-treated bed nets and immunization services, which contribute to higher mortality rates in this age group.

A particularly alarming finding is that none of the examined health infrastructure measures significantly reduce maternal mortality rates. Instead, the study reveals that inadequate water and sanitation services, as well as insufficient hospital beds, exacerbate maternal mortality. This suggests that critical deficiencies in essential healthcare infrastructure elements continue to adversely impact

maternal health outcomes.

The conclusions drawn from this study underscore that the number of healthcare professionals and the availability of Vitamin A supplements are pivotal in reducing mortality rates in Nigeria. Conversely, inadequacies in basic sanitation, water services, insecticide-treated bed nets, and hospital beds are crucial factors in the persistently high mortality rates.

These findings align with the Health Production Function theory, which posits that health outcomes are produced through the effective use of healthcare inputs. The deficiencies in Nigeria's healthcare infrastructure illustrate how inadequate inputs can lead to poor health outcomes. This theory provides a framework for understanding the relationship between healthcare inputs and outcomes, emphasizing the need for substantial improvements in infrastructure to enhance health production and reduce mortality rates.

This study's results resonate with Blankart (2012), who demonstrated that the availability of medical doctors reduces delays in diagnosis and mortality rates, reinforcing the importance of adequate healthcare personnel in improving health outcomes.

In conclusion, Nigeria must urgently strengthen its healthcare infrastructure, particularly by increasing the number of healthcare professionals and ensuring the availability of essential services. Addressing these deficiencies is critical for improving health outcomes and reducing the high mortality rates currently observed in the country.

4.4 Policy Implication

Findings from the study showed that Health Infrastructure Development and Its Influence on Mortality Incidence in Nigeria, guided by the Health Production Function theory, are significant. The findings underscore that despite substantial investments in healthcare infrastructure, the high mortality rates persist due to inadequacies in critical health inputs.

Firstly, increasing government expenditure on healthcare is imperative. Current funding levels are inadequate to address the deficiencies in health infrastructure and services. The Health Production Function theory suggests that improved health outcomes are contingent upon the effective utilization of healthcare inputs. Thus, a substantial increase in healthcare spending is necessary to enhance facilities, procure essential medical equipment, and improve overall service quality. This investment will enable the development of a robust healthcare system capable of delivering effective and timely care, thereby reducing mortality rates.

Secondly, addressing the shortage of healthcare professionals is crucial. The study indicates that the availability of physicians, nurses, and midwives significantly impacts mortality rates. However, the current number of healthcare providers is insufficient to meet the population's needs, leading to delays and reduced quality of care. Policymakers must focus on increasing the healthcare workforce, ensuring equitable distribution across regions, and preventing disruptions in service delivery caused by industrial actions. Ensuring adequate compensation and addressing workforce grievances will be essential for maintaining a stable and effective healthcare system.

Lastly, investing in preventive healthcare measures and community education is vital. The study highlights that preventive infrastructure, such as sanitation facilities and mosquito nets, plays a critical role in reducing mortality rates. Policies should prioritize the expansion of these preventive measures, coupled with community education programs to promote the use of available healthcare services and preventive practices. Educating the public, especially mothers, about health practices can significantly improve outcomes and reduce mortality rates across all age groups.

In summary, these policy implications advocate for a comprehensive approach to healthcare improvement, aligning with the Health Production Function theory. By enhancing infrastructure, increasing healthcare personnel, and focusing on preventive measures, Nigeria can address the

persistent high mortality rates and achieve better health outcomes for its population.

5.1 Conclusion

In conclusion, this study underscores the pivotal role of healthcare infrastructure in influencing mortality rates in Nigeria, with a focus on infant, under-five, and maternal mortality. The analysis reveals significant deficiencies in Nigeria's healthcare system, where inadequate infrastructure contributes to elevated mortality rates despite considerable financial investments in the health sector. The Health Production Function theory elucidates how effective healthcare inputs, including the availability of medical personnel, essential services, and preventive facilities, are crucial for improving health outcomes and reducing mortality.

The findings indicate that while the availability of physicians, nurses, and midwives positively impacts mortality rates, other critical infrastructure elements, such as basic water services, sanitation facilities, and hospital bed spaces, fall short of addressing the health needs effectively. The persistent gaps and inefficiencies highlight the need for comprehensive reforms in healthcare infrastructure.

To address these challenges, the Nigerian government must prioritize increasing health sector funding to meet international standards, with a focus on enhancing both preventive and curative healthcare services. Investing in the healthcare workforce, ensuring the effective distribution of resources, and fostering community education on health practices are essential steps. Furthermore, international collaborations and stringent anti-corruption measures are necessary to ensure that resources are utilized efficiently and that healthcare improvements are sustained.

A coordinated approach involving government, international partners, and the private sector is crucial for addressing the current deficiencies in healthcare infrastructure. By making substantial investments and implementing strategic reforms, Nigeria can significantly reduce mortality rates and improve the overall health and well-being of its population. This approach aligns with the principles of the Health Production Function theory, emphasizing the importance of adequate healthcare inputs in achieving better health outcomes.

5.2 Recommendations

The following recommendations were based upon the findings

i. Increase Government Health Expenditure:

The Nigerian government must substantially enhance its health sector funding to meet the UNESCO-recommended minimum of 16% of total government expenditure. The current allocation of 5-7% is insufficient to address the needs of the healthcare system effectively. Increased investment is essential for developing and maintaining healthcare infrastructure, including hospitals, clinics, and essential medical equipment, thereby improving access to quality healthcare services and contributing to lower mortality rates.

ii. Strengthen Healthcare Workforce:

There is an urgent need to increase the number of healthcare professionals, including physicians, nurses, and midwives, particularly in underserved regions. Enhancing the ratio of healthcare providers to patients will facilitate timely and effective medical interventions, which are crucial for reducing infant and under-five mortality rates. Additionally, it is important to address the issue of industrial actions by ensuring fair treatment and adequate compensation for healthcare workers. Continuous dialogue and commitment fulfillment will help prevent service disruptions and maintain consistent healthcare delivery.

iii. Invest in Preventive Healthcare and Community Education:

Investing in preventive healthcare facilities such as mosquito nets, potable water supply, sanitation facilities, and drainage systems is critical for reducing disease-related mortality. These measures will help lower infant and under-five mortality rates by preventing disease outbreaks. Moreover, engaging in community education and outreach will enhance the use of healthcare services and preventive measures. Educating mothers on prenatal and postnatal care practices will contribute to lower maternal mortality rates by promoting timely medical check-ups and proper health behaviors. Implementing these recommendations will necessitate coordinated efforts from all levels of government, international organizations, and the private sector. By addressing critical gaps in healthcare infrastructure and increasing investments, Nigeria can achieve significant improvements in health outcomes for mothers and children and reduce its high mortality rates.

References

- Akacho, E.N. (2014). *Factors influencing provision of healthcare service delivery in Kenya: A case of Uasin Gishu district hospital in Eldoret* (Master's thesis, The University of Nairobi, Nairobi, Kenya). Retrieved from http://erepository.uonbi.ac.ke/bitstream/handle/11295/74195/Akacho%20Emily%20N_Factors%20influencing%20provision%20of%20Health%20care%20service%20delivery%20in%20Kenya_%20A%20case.pdf?sequence=2&isAllowed=y
- Almendarez, L. (2010). Human capital theory: Implications for educational development. *Belize Country Conference Pre-Prints* (November). Retrieved from <https://www.open.uwi.edu/sites/default/files/bnccde/belize/conference/papers2010/almenarez.html>
- Babalola, J.B. (2003). Budget preparation and expenditure control in education. In J.B. Babalola (ed.). *Basic text in educational planning*. Ibadan: Awemark Industrial Printers.
- Bashir, Y.M. (2016). An assessment of the impact of government expenditure on infrastructures: Evidence from Nigerian health sector performance. *European Journal of Business and Management*, 8(14), 8 – 14.
- Becker, G. (1975). *Human capital*. Chicago: Chicago University Press.
- Blankart, C.R. (2012). Does healthcare infrastructure have an impact on delay in diagnosis and survival? *Health Policy*, 105, 128 – 137.
- Dustmann, C., & Micklewright, J. (2001). Intra-household transfers and the part-time work of children. *CEPR Discussion Paper* 2796.
- Frankenberg, E. (1995). The effects of access to health care on infant mortality in Indonesia. *Health Transition Review*, 5, 143 –163.
- Ghosh, D., & Dinda, S. (2017). Health infrastructure and economic development in India. In R.C.D as (ed.). *Social, health, and environmental infrastructures for economic growth* (pp.99–119). Philadelphia, USA: IGI Global Business Science Reference.
- Kanwanye, H.T., & Ovenseri-Ogbomo, F.O. (2018). An assessment of the drivers of health care system: An empirical evidence from Nigeria. *Global Journal of Management and Business Research: B Economics and Commerce*, 18(2), 45 – 54
- Muhammad, F., Abdulkareem, J. H., & Chowdhury, A.A. (2017). Major public health problems in Nigeria: A review. *South East Asia Journal of Public Health*, 7(1), 6-11.
- Ogundipe, M., & Adeniyi, B. (2011). Health expenditure and Nigerian economic growth. *Journal of Emerging Trends in Economics and Management Sciences (JETEMS)*, 2(2), 83– 87.
- Olisakee, G.O. (2014). Energy poverty and under-five mortality in Nigeria: Is there a link? Retrieved from http://www.consultancyafrica.com/index.php?option=com_content&view=article&id=1724:energy-poverty-and-under-five-mortality-in-nigeria-is-there-a-link&catid=61:hiv-aids-discussion-papers&Itemid=268.
- Pesaran, M.H., Shin, Y., & Smith, R.J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16, 289–326.
- Porta, M. (ed.). (2014). *A Dictionary of epidemiology* (5thed.). Oxford: Oxford University Press
- Psacharopoulos, G., & Woodhall, M. (1997). *Education for development: An analysis of investment choice*. New York: Oxford University Press.
- Samuel, G.W. (2015). *Underlying and proximate determinants of under-five mortality in Nigeria: Understanding the pathways of influence* (Doctoral dissertation, Covenant University, Ogun, Nigeria). Retrieved from <https://covenantuniversity.edu.ng/content/download/46562/318537/file/Gbemisola+>

Ph.D.+%28Work+in+Progress%29.pdf
World Bank, (2018). World development indicators. Retrieved from
[https://databank.worldbank.org/data/reports.aspx?source=2&series=AG](https://databank.worldbank.org/data/reports.aspx?source=2&series=AG.LND.AGRI.ZS&country=#)
.LND.AGRI.ZS&country=#
Yaya, S., Ekholuenetale, M., Tudeme, G., Vaibhav, S., Bishwajit, G., & Kadio,
B. (2017). Prevalence and determinants of childhood mortality in Nigeria. *BMC Public Health*, 17, 485 – 491.