Impact of health infrastructure on under-five child mortality rates in Nigeria

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Abstract
The study examined the impact of health infrastructure on under-five child mortality rates in Nigeria. Specifically, the study sought to: determine the impact of stock of health practitioners on under-five child mortality in Nigeria; ascertain the impact of health immunization programme on under-five child mortality in Nigeria and assess the impact of hospital bed space on under-five child mortality in Nigeria. This study made use of ex-post-facto research design. The data analytical techniques were descriptive Statistics, Augmented Dickey-Fuller Unit Root test and dynamic ordinary least square method (DOLS). These variables of the study consist of under-five-child (UFCM), stock of health practitioners (SHP), health immunization programme (HIP) and hospital bed space (HBS) were sourced from the CBN Statistical bulletin and World Bank database (WDI) from 1991 to 2025. The empirical result shows that stock of health practitioners have negative and significant impact under-five child mortality (t-statistic -2.1518< Sig-value; 0.05; P-value; 0.0445); health immunization programme has negative and significant impact under-five child mortality (t-statistic -2.8988 < Sig-value; 0.05; P-value; 0.0092) and hospital bed space has negative and significant impact under-five child mortality (t-statistic 17.5220 < Sig-value; 0.05; P-value; 0.0000). The study recommended that Nigeria government at all levels from the federal, state and local to massively invest in the provision of health infrastructure which is a strong viable means of reducing mortality incidence in Nigeria. Nigeria's share of government expenditure to the health sector falls massively below the minimum standard of 16% as recommended by UNESCO for a developing country.

Keywords: Stock of health practitioners, Hospital bed space, Health immunization programme, Under-five child mortality rates

1.1 Background of the study

Healthcare infrastructure and provision of the healthcare system are the backbone of societal development. It is well known fact that health is wealth. Also, healthcare infrastructure can help to improve the healthcare system and prevent the mortality rate in society. Healthcare infrastructure includes the entire infrastructure for the operative delivery of services such as physical and non-medical equipment, transportation, expertise technology, etc. (Okafor, 2020) [14].

Health infrastructure is an important indicator for understanding the health care policy and welfare mechanism in a State. It signifies the investment priority with regards to the creation of health care facilities. Infrastructure has been described as the basic support for delivery of public health activities. To deliver quality health services in public health facilities, adequate and properly maintained building infrastructure and equipment are of critical importance. Enriquez (2024) [5] opined that an adequate health care infrastructure has many components: physical facilities that make care accessible; laboratory, training, and other support facilities; reliable supplies of pharmaceuticals and other materials; trained staff and professional training systems; and mechanisms to distribute resources and expertise.

The increase in stock of health practitioners and the percentage of deliveries attended by skilled healthcare workers are primary drivers in mitigating preventable child deaths. Conversely, acute shortages in human resources for health severely worsen mortality rates, leaving children vulnerable to treatable conditions like malaria, pneumonia, and diarrhea. Health immunization programmes may significantly reduce under-five child mortality in Nigeria by preventing deadly vaccine-preventable diseases (VPDs) like measles, pneumonia, and polio. However, their overall impact remains limited by systemic challenges, with Nigeria currently accounting for one of the highest numbers of "zero-dose" (unvaccinated) children globally. Routine immunizations protect children from life-threatening conditions. According to the World Health Organization vaccines safely stimulate the immune system and are one of the most cost-effective public health interventions available. In Nigeria, insufficient hospital bed space directly correlates with higher under-five child mortality rates. Health production frameworks confirms that a shortage of physical bed infrastructure severely restricts a hospital's capacity to admit and treat critically ill young children (World Health Organization WHO 2021) [20]. Without adequate clinical oversight, these vulnerable children often suffer medical relapses at home, significantly increasing post-discharge under-five mortality.

Child health remains a critical issue in Nigeria, as the country continues to experience one of the highest child mortality rates

globally. According to the World Health Organization (2021) [20], child health encompasses the physical, mental, and social well-being of children from birth to 18 years. It involves disease prevention, healthy growth promotion, and timely treatment of illnesses. The under-five mortality rate in Nigeria stands at 128 deaths per 1,000 live births, significantly higher than the global average of 41 per 1,000 live births (Muhammed, 2025) [10]. Reports from the Multiple Indicator Cluster Survey (MICS, 2021) and other studies indicate that child mortality rates vary across different regions of the country (Nymphas & Dugule, 2024) [11]. One of the major challenges contributing to high child mortality in Nigeria is inadequate health infrastructure. This includes a shortage of healthcare facilities, limited access to medical professionals, and insufficient technological resources. Many Nigerians, particularly in rural areas, have little or no access to healthcare services, with about 63.7% of rural dwellers affected (MICS, 2018). Additionally, children under 15 years make up about 45% of Nigeria's population, with 24 million under the age of five. This highlights the urgent need for child health to be a national priority.

While childbirth is a moment of joy, it can also bring sorrow due to high infant mortality. Child health is a key indicator of a country's healthcare system and overall development. Nigeria, with a population of over 200 million, faces a significant challenge in child mortality, with an estimated 132 deaths per 1,000 live births (NDHS, 2018). This means that one in every eight children does not survive beyond the age of five. The high mortality rate is primarily linked to poor access to quality healthcare. Contributing factors include a shortage of healthcare professionals, inadequate medical facilities, low immunization awareness, lack of clean drinking water, poor sanitation, and socioeconomic factors such as maternal education, age, and income level. To address these issues, the Nigerian government has introduced several intervention programs, including the National Health Insurance Scheme (NHIS), the Maternal and Child Health Plan, and the National Midwives Service Scheme (NMSS). Other initiatives include free medical treatment for pregnant women and children. However, despite these efforts, child mortality rates remain unacceptably high, with an estimated 117.2 deaths per 1,000 live births as of 2019 (WDI, 2020). This study aims to examine the impact of health infrastructure on child mortality in Nigeria.

1.2 Statement of the problem

Healthcare infrastructure is a critical component of any health system, shaping how medical services are delivered, how patient care is managed and how resources are allocated. It encompasses physical facilities, technological systems and organizational structures that together form the backbone of health services. 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. Healthcare is unequal in many developing countries where inequality is more prevalent in healthcare infrastructure and provision. Inadequate accessibility to healthcare services leads to poor people's further poorer health and a vicious cycle, which further increases health risks with suffering from chronic and communicable diseases for a prolonged period. Therefore, the overall development of the poor people remains static, perpetuating their poor condition. The accessibility to healthcare services is less provident to the poor people due to a lack of available medical staff, essential drugs, and provision of medical resources, workforce, supervision, infrastructure, equipment, etc.

The extent of the availability of such health infrastructure can affect the rate of child 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 (Nymphas & Dugule, 2024) [11]. 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. 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.

Health financing inefficiencies have contributed to persistently high under-five mortality rates; in 2020 the estimate was 113 deaths per 1000 live births. Given these statistics, Nigeria must reduce early childhood mortality by 70% to meet the SDGs by 2030, urgent attention is required to reduce childhood deaths to below the global average. Public health expenditure in Nigeria is far below the World Health Organization (WHO) recommendation, that is, 15% of the national budget. Owing to these problem statement, this study investigates the impact of health infrastructure on under-five mortality rates in Nigeria from 1991 to 2025.

1.3 Research questions

The study is set out to answer the following research questions.

- What is the impact of stock of health practitioners on under-five child mortality in Nigeria?
- What is the impact of health immunization programme on under-five child mortality in Nigeria?
- What is the impact of hospital bed space on under-five child mortality in Nigeria?

1.4 Objectives of the study

The broad aim of the study was to examine the impact of health infrastructure on under-five child mortality rates in Nigeria. The specific objectives were to:

- Determine the impact of stock of health practitioners on under-five child mortality in Nigeria.
- Ascertain the impact of health immunization programme on under-five child mortality in Nigeria.
- Assess the impact of hospital bed space on under-five child mortality in Nigeria.

1.5 Significance of the study

This study is beneficial and important to the following group of individuals and group namely: Nigeria citizens, government, students and researchers.

Nigeria citizens: The outcome of this study would educate citizens of Nigeria that an adequate, retained stock of health practitioners is vital for Nigerian citizens to prevent healthcare collapse, reduce child and maternal mortality, and ensure equitable medical access in underserved rural areas.

Government: The outcome of this study would enlighten Nigerian government to identify that increase in number of benefits of hospital beds space reduces hospital overcrowding which is a primary driver of preventable deaths in Nigerian emergency departments.

Student and researchers: The outcome of this study would be useful to researchers by adding knowledge to the existing literature and provides a basis for future research in the area of impact of health infrastructure on under-five child mortality rates in Nigeria. This research would make a contribution to the academic literature.

1.6 Scope of the study

Content scope: the content scope of study covered the impact of health infrastructure on under-five child mortality rates in Nigeria.

Variable scope: The variable scope of the study was channeled on examining public health expenditure, health donor expenditure and out-of-pocket health expenditure as independent variables while under-five-child mortality is the dependent variables.

Geographical scope: The geographical scope of the study was Nigeria. The choice for Nigeria as area of study was Nigeria has the highest record of under-5 mortality in Sub-Sahara Africa.

Time scope: The study covered only a period of 1990 to 2025 due to availability of data. This choice of the period follows the objective of this study.

2.1 Conceptual literature

2.1.1 Health infrastructure

Health infrastructure is understood in both qualitative and quantitative terms to mean the quality of care and accessibility to health care delivery within a country. It is judged by the quality of physical, technological and human resources available at a given period. Physical structure entails the 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 equipments meant specifically for hospital use including surgeries (Erhuotor & Agor, 2024) [6]. This also includes computer equipments and consumables while human resource comprises the health professionals including doctors, pharmacists, nurses, midwives, laboratory technologists, administrators, accountants and other sundry workers. All these put together form the structure upon which the healthcare delivery is anchored in any society and the determinants of its infrastructure. Health infrastructure is a part of a larger concept of the health system which contains the health policy, budgetary allocation, implementation and monitoring (Kalu, Anigbogu, Ezenekwe & Nga, 2023) [8]. This is larger in concept and more robust than a mix of facilities, medical consultation in terms of diagnosis, treatment and compliance. It also involves the healthcare consumers and other factors associated with or adjunct to health-care delivery.

Furthermore, health infrastructure, from these all-inclusive criteria, has to do with people, institutions and legal framework, all interacting systematically to mobilize and allocate resources specifically for health management, prevention and care of diseases, illnesses and injuries. On one hand, it can be inferred that the structure of healthcare delivery intricately intertwined with the quality of health personnel, efficient management, effective financing and communication. An equally crucial factor is a willing government in active support of and participation in the health system for the overall benefit of the society (Odey, Bassey & Enya, 2023) [12]. Discussion of healthcare infrastructure in sub-Saharan Africa and 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 paper is on the bio-medical or Western orthodox healthcare with its expansive bureaucratic ethos within the context of hospital structure. Health infrastructure refers to the essential facilities, such as community health centers, clinics, hospitals, labs, equipment, staff, and technologies that are necessary to expand access to healthcare and deliver universal health coverage. It includes both physical structures and digital components that can enhance service delivery, especially in underserved areas (Yohanna and Ezie, 2025) [24].

2.2 Infant mortality

Infant mortality is defined as the death of a child before reaching the age of one year, expressed as the number of deaths per 1,000 live births in a given year or period (WHO, 2023). UNICEF (2022) [19] described infant mortality as the probability of a newborn dying between birth and exactly one year of age, measured per 1,000 live births. The organization emphasized that infant mortality reflects the overall health and development status of a nation (UNICEF, 2022) [19] while in the Global Burden of Disease study, Murray and Lopez define infant mortality as the total number of deaths of infants under one year of age in a given population, often used as an indicator of public health and socio-economic conditions.

According to Yaqub, Ojapinwa and Yussuff, (2021) [23], infant mortality is a critical demographic indicator influenced by biological, socioeconomic, and environmental factors, serving as a measure of healthcare accessibility and child wellbeing. Infant mortality is also seen as the proportion of newborns who do not survive beyond their first year of life, largely influenced by maternal health, nutrition, infectious diseases, and healthcare system effectiveness (Olayiwola, Oloruntuyi & Abiodun, 2021) [17]. Infant mortality is influenced by various factors, including maternal health, access to medical care, socioeconomic status, sanitation, nutrition, and immunization rates (United Nations Children's Fund [UNICEF], 2022) [19].

Child mortality, that is death between the first and the fifth birthday, is measured by a rate equal to the ratio of the deaths of this age and the average population in the same age range. (This is different from the infant mortality rate, which is

obtained by dividing the number of deaths by births). In most industrialized countries this rate is under 0.5 deaths per 1,000 children of this age; the lowest rate in 1995 was 0.17 per 1,000 in Sweden. Only a few Central and Eastern European countries have a rate above 0.5 per 1,000, particularly Estonia, Moldova, Romania, and Russia, where it is over 1 per 1,000. Child mortality is much lower than infant mortality, as the rate of death between one and five years on average is one twentieth of rates during the first year of life (UNICEF, 2022) [19].

2.3 Theoretical literature

2.3.1 Grossman framework (1972)

The Grossman framework (or Grossman model) is a foundational health economics model introduced by Michael Grossman in 1972. It views health as a form of human capital**.** Rather than simply demanding medical care, individuals invest in their health to increase their amount of "healthy time". The theoretical framework of this study is anchored on the Grossman framework. Grossman's theory provides a robust foundation for understanding the relationship between health expenditure and infant mortality rates, making it a suitable framework for this research. The Grossman health theory posits that individuals invest in their health as a form of human capital, with health serving as both a consumption good and an investment good. As a consumption good, health directly contributes to an individual's well-being. As an investment good, health influences productivity, earning capacity, and life expectancy. Grossman's model suggests that health is a stock variable that depreciates over time and can be replenished through investments such as healthcare spending, lifestyle choices, and preventive measures. The Grossman health theory is typically expressed as: H=f (M,L,E,Z), Where: H = Health status, M = Medical care (health expenditure), L = Lifestyle factors (e.g., nutrition, exercise), E = Environmental factors, Z = Socioeconomic factors (e.g., income, education) In this framework, health expenditure is a key input that enhances the stock of health capital, leading to improved health outcomes and reduced infant mortality rates. Grossman's Health theory is particularly relevant to this study because it emphasizes the role of health expenditure in influencing infant mortality rates. The study examines health expenditure in Nigeria through the proxies of capital health expenditure, recurrent health expenditure, donor health expenditure, and out-of-pocket health expenditure. These expenditures represent investments in healthcare infrastructure, personnel, external aid, and household spending, all of which are critical for improving healthcare delivery and reducing infant mortality.

2.3.2 Theory of public expenditure by musgrave (1910-2007)

In (1964), Musgrave propounded the theory of public expenditure. He discovers that the need for government services is in three stages of per capita income experience changes in the income elasticity of demand. Musgrave opined that when the per capita income is low the need for government services will be low because the income will be channeled to meet basic needs. In the situation that the per capita income increases above the low level, the demand for public services like security, electricity, health, water, transport and education begin to increase, hence moving public expenditure on these items to rise. Musgrave notice that, when the per capita income is high, there will befall in the government sector growth rate since most primary needs are provided, in most advanced countries (Danladi *et al*., 2019).

This theory is quite imperative; however, it has a strong shortcoming, the size of government expenditure cannot be forecasted in later stages. It is not always the case that the share of the government sector further falls during later stages. Because the pattern of private consumption changes because of increasing per capita income in the later industrialization stages, the public share might rise also to satisfied the growing need for government services like health, social security, education, and infrastructure, and. It, therefore, depends on the income level and the individual needs of the citizens if the government share increases or fall. In addition, it is also always difficult to identify one single level of development for any economy in particular. In underdeveloped countries like Nigeria, different levels can be seen simultaneously: Whereas in towns and cities the economy might be placed in a higher level of development, villages and ghettos are still often far behind and are situated in the lower level of development.

2.4 Empirical literature

Muhammed, (2025) [10] examined impact of health infrastructure on the survival of Nigeria's youngest citizens. Between 2000 and 2019, the examined how the availability of healthcare professionals, the strength of primary healthcare centers (PHCs), and the reach of immunization programs influence the chances of a child reaching their fifth birthday. While other research has explored factors like healthcare spending and maternal health, our focus is squarely on the direct contribution of these core elements of health infrastructure. Using data from sources like the World Development Indicators and the Nigerian Demographic Health Survey, the study employed a statistical model called the autoregressive distributed lag (ARDL) model to uncover both immediate and long-term connections. The study emphasizes the vital role of a robust health system, including its infrastructure, in reducing child deaths. The study also looked at the trends in child mortality, the presence of healthcare workers, the state of PHCs, and how many children are being immunized. The study recommended that Nigeria Government should continue to invest in the training and deployment of healthcare professionals to improve the accessibility and availability of healthcare services, particularly in rural and underserved areas.

Yohanna and Ezie, (2025) [25] investigated the impact of government health spending on under-5 mortality rates in Nigeria from 1999 to 2024. The specific objectives of the study were determining the impact of public health expenditure on under-five child mortality in Nigeria; ascertain the impact of capital expenditure on under-five child mortality in Nigeria and

assess the impact of recurrent expenditure on under-five child mortality in Nigeria. The paper adopted an ex-post facto research design using annual time series data. Data on government health spending were sourced from the Central Bank of Nigeria (CBN) and National Bureau of Statistics (NBS), while under-5 mortality data were obtained from the World Bank. The paper estimated both long-run and short-run dynamics using the Autoregressive Distributed Lag (ARDL) model. Findings showed that Government Recurrent Health Expenditures and Health Insurance Expenditures had significant negative effects on under-5 mortality in the long run, suggesting that increases in these spending categories contributed to reduced child deaths. Conversely, Government Capital Health Expenditure had an insignificant impact, indicating that infrastructure-related spending alone was not sufficient to drive improvements in child health outcomes during the period under review. The study recommended that the Federal Ministry of Health and the Federal Ministry of Finance, Budget and National Planning increase and sustain recurrent health spending to ensure continuous availability of essential services. The National Health Insurance Authority (NHIA) was urged to expand health insurance coverage to the informal sector and underserved communities.

Erhuotor and Agor, (2024) [6] explores the impact of health infrastructure development on mortality incidence in Nigeria. The specific objectives are ascertaining the impact of number of physicians, nurses, and midwives, access to basic water services, sanitation facilities, hospital bed spaces on under-five mortality. 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 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.

Nymphas and Dugule, (2024) [11] examined the impact of public health investment on economic growth in Nigeria spinning from 1981 – 2020. Gross Domestic Product (GDP) was proxied to economic growth as the dependent variable while recurrent health investment (RHI), capital health investment (CHI), domestic health spending (DHS) and external health investment (EHI) were used to represent the health investment parameters as the independent variables. This paper applied Augmented Dickey Fuller (ADF) and Philips-Perron (PP) tests for unit root which indicated that all the variables were stationary at first difference except gross fixed capital formation at level. While, Autoregressive Distributive Lagged (ARDL) model was employed for examining the impacts of the independent variables on the dependent variable. From the results of the analysis so far, this paper concludes that, recurrent health investment, capital health investment, domestic health spending and external health investment have positive impacts on economic growth in Nigeria during the period understudy. It therefore recommends that: Monetary authority should maintain and sustain a deliberate fiscal and monetary policy measures that could encourage external health financing by external donors agencies to the health sector for promoting and sustaining economic growth in Nigeria.

Odey, Bassey and Enya, (2023) [12] examined the relationship between health Infrastructure and economic development in Nigeria. Specifically, the study sought to: investigate the impact of per capita gross national income (PCGNI); recurrent expenditure on health (REH); capital expenditure on health (CEH); gross fixed capital formation (GFC); exchange rate (EXR) on economic development in Nigeria. The study employed time series data. The Autoregressive Distributive Lag (ARDL) estimation technique was used to establish the long run relationship among the variables. It was revealed that long run relationship exists among the variables in the estimated model. The results of the Error Correction Mechanism (ECM) within the framework of the ARDL shows that health infrastructure has significant impact on economic development in Nigeria. The study concludes that health infrastructure plays key roles in influencing economic development in Nigeria, and for the optimal performance of the economy, the government must increase infrastructural spending on health care in order to reduce the rate of maternal, infant and under-five mortality in the country. The study recommends that; there is a need for the government at all levels to massively invest in the provision of health infrastructure which is a strong viable means of reducing mortality incidence.

Kalu, Anigbogu, Ezenekwe & Nga, (2023) [9] examined the impact of public health expenditure on under-five mortality rate in Nigeria from 1986 to 2022 using the Grossman health capital theoretical framework. Specifically, the study sought to examine the impact of foreign direct investment, food security, per capita income, urbanization, carbon emission, sanitation, female school attainment and government expenditure on under-five mortality rate. The analytical techniques used were the Granger causality test and the vector error correction model (VECM) involving the forecast error variance decomposition (FEVD) and the impulse response functions (IRFs). The result showed that the coefficient of government health expenditure was negative but significantly related to under-five mortality rate while foreign direct investment was negative and insignificant to under-five mortality rate. The result further showed a unidirectional causality between government health expenditure and under-five mortality rate and no causality

between foreign direct investment and under-five mortality. From the result the shock of public health expenditure is exogenously weak throughout the ten period horizons implying that public health expenditure had no significant positive impact on under-five mortality rate. This study recommended among others, the need for government and policy makers to make concerted efforts to ensure full implementation of capital spending on the health sector, as any negative shock from government health expenditure health human development outcome including under-five mortality rate.

2.5 Gaps in literature

There exist research gap between this study and past researches. The research gap covers subject gap, gap on geographical location of the study, gap on the variables and contents of the study, gap on literature and gap on methodology.

Subject gap: The subject matter of this work and some reviewed empirical studies have some differences. There are limited studies on impact of health infrastructure on under-five child mortality rates in Nigeria. The study aim to provide insights into how health infrastructure has influenced child mortality and to identify potential policy gaps.

Gap on the variables: The study was channeled to examine impact of stock of health practitioners, health immunization programme and hospital bed space as independent variables while under-five-child mortality is the dependent variables. This study covered the existing gaps by contribute to the ongoing debate about the effectiveness of public health investments in achieving sustainable health outcomes in Nigeria.

Gap on methodology: The data analytical techniques used in this work in some ways differ from what was employed from past researches. The data analytical technique of the study was fully modified least square method. The statistical technique was chosen because of its basic properties of best Linear, unbiased and efficient (BLUE) estimators. It is best for impact analysis.

3.1 Methodology

This study made use of ex-post-facto research design. The data analytical techniques were descriptive Statistics, Augmented Dickey-Fuller Unit Root test and Error Correction Model (ECM). These variables of the study consist of under-five-child (UFCM), stock of health practitioners (SHP), health immunization programme (HIP) and hospital bed space (HBS) were sourced from the CBN Statistical bulletin and World Bank database (WDI) from 1991 to 2025. The study employed e-view version (9) statistical application software to analysis the data because it is user- friendly software.

3.2 Theoretical framework

The study adopted Grossman health theory is typically expressed as: H=f (M, L, E, Z), Where: H = Health status, M = Medical care (health expenditure), L = Lifestyle factors (e.g., nutrition, exercise), E = Environmental factors, Z = Socioeconomic factors (e.g., income, education).

3.3 Model specification

This study specifically adopts the model of Erhuotor and Agor, (2024) [6] that explores the impact of health infrastructure development on mortality incidence in Nigeria between the periods of 2003 to 2023.

The functional relationship is expressed as: UFM = (NHP, BWS, SAF, BED) (3.1)

Where UFC is under-five-child mortality, NHP is number of health practitioners, BWS is basic water service, SAF is sanitation facilities and BED is number of hospital bed.

3.3.1 Model Specification for the Study

The functional form of the model used in this work was specified in equation 3.2 as: UFCM =f (SHP, HIP, HBS) (3.2)

Where, UFCM is under-five-child, SHP is stock of health practitioners (proxied by number of available physician 1000), HIP is health immunization programme (proxied by Number of people immunized BCG (% of one-year-old children) and HBS is hospital bed space (proxied by Number of available hospital beds per 1000).

In a linear function, it is represented as follows:

$UFCM = \beta_0 + \beta_1 SHPt + \beta_2 HIPt + \beta_3 HBSt + \mu t$ (3.3)

Where: β0 = Constant term, β_1 to β_5 = Regression coefficient, μt = Error Term and t is the period. To reduce the outliers among the variables, all variables will be expressed in logarithmic form.

$LogUFCM = \beta_0 + \beta_1 SHPt + \beta_2 HIPt + \beta_3 HBSt + \mu t$ (3.4)

Where: β0 = Constant term, β_1 to β_3 = Regression coefficient, Ut = Error Term and t is the period.

4.1 Results and Discussion

Table 1: Descriptive statistics of the variables

	UFCM	SHP	HIP	HBS
Mean	129.8200	1260.863	105.5241	5.054761
Median	135.4000	1050.900	125.8081	5.129370
Maximum	193.2000	2100.800	157.4987	7.400000
Minimum	54.20000	852.9000	9.909492	3.153269
Std. Dev.	50.18117	387.2184	49.41393	1.305348
Skewness	-0.116885	0.885821	-1.020905	0.071090
Kurtosis	1.373915	2.336276	2.424390	1.766469
Jarque-Bera	3.935753	5.219733	6.562963	2.248478
Probability	0.139753	0.073544	0.037573	0.324900
Sum	4543.700	44130.20	3693.343	176.9166
Sum Sq. Dev.	85617.10	5097896.	83019.03	57.93375
Observations	35	35	35	35

Source: e-view's result

The table shows descriptive statistics of the variables. In the model established in the study, there is one dependent variable and five independent variables. The descriptive statistics of the variables show the nature and status of mean, median, maximum, minimum, sum of the variable respectively.

Table 2: Result of correlation matrix

	UFCM	SHP	HIP	HBS
UFCM	1.000000	-0.452271	-0.684766	0.975239
SAP	-0.452271	1.000000	0.551759	-0.440296
HIP	-0.684766	0.551759	1.000000	-0.756369
HBS	0.975239	-0.440296	-0.756369	1.000000

***Source*:** e-view's Result

This correlation matrix presents a table showing correlation coefficients between sets of variables. This result of correlation matrix helps to identify which pairs of variables have the highest correlation. This test is to detect whether exact or perfect relationship exist among explanatory variables (multicollinearity). The result of correlation matrix showed that every explanatory variable in the study is linearly independent of each other.

4.1.1 Unit root test using augmented dickey-fuller fisher test

Table 3: Results of stationarity (unit root) test

Variables	Variables' name	ADF- statistic	5% critical value	Remark
UFCM	Under-five Child Mortality	-5.057598	-2.941145	1(1)
SAP	Stock of Health Practitioners	-5.484595	-2.941145	1(1)
HIP	Health Immunization Programme	-5.535829	-2.941145	1(1)
HBS	Hospital Bed Space	-4.651514	-2.941145	1(1)

Source: Author's computation

In the table 3, the variables that were tested with unit root are shown, the values for Augmented Dickey Fuller (ADF) statistics are presented, the lag level of each variable was identified, and the P-values at 5% level of significant were pointed out. The order of integration of each variable was enumerated. The test detected that under-five-child (UFCM), stock of health practitioners (SHP), health immunization programme (HIP) and hospital bed space (HBS) were stationary at difference one. It is now referable to use dynamic ordinary least square method to estimate the parameters.

4.1.2 Co-integration test results

Ho = There is no co-integration (no long run relationship among Variable)

Table 4: Co-integration test results

Date: 06/22/26 Time: 14:50				
Sample (adjusted): 1993 2025				
Included observations: 33 after adjustments				
Trend assumption: Linear deterministic trend				
Series: UFCM SHP HIP HBS				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace statistic**	**0.05 Critical value**	**Prob.****
None *	0.473943	53.28634	47.85613	0.0142
At most 1 *	0.416767	32.08895	29.79707	0.0268
At most 2	0.271016	14.29637	15.49471	0.0752
At most 3 *	0.110521	3.864934	3.841466	0.0493
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				

Source: E-view results

The co-integration results in table 4.2.1 for the model UFCM, SHP, HIP and HBS) reveals that both trace test and the Max-eigenvalue test indicates 2 co-integrating equation(s) at the 5 percent level of significance. Thus there is a long-run relationship among the variables (UFCM, SHP, HIP and HBS). We therefore reject the null hypothesis of no co-integration amongst the variables and accept the alternative hypothesis.

4.1.3 Estimation of regression model

Table 5: Empirical results of the Dynamic Ordinary Least Square Method (DOLS)

Dependent Variable: UFCM				
Method: Dynamic Least Squares (DOLS)				
Date: 06/22/26 Time: 14:53				
Sample (adjusted): 1993 2024				
Included observations: 32 after adjustments				
Cointegrating equation deterministics: C				
Fixed leads and lags specification (lead=1, lag=1)				
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
SHP	-0.017724	0.008236	-2.151880	0.0445
HIP	-0.169154	0.058353	-2.898804	0.0092
HBS	-43.71778	2.495022	-17.52200	0.0000
C	-71.83602	17.58571	-4.084908	0.0006
R-squared	0.983494	Mean dependent var		128.3500
Adjusted R-squared	0.973069	S.D. dependent var		48.29536
S.E. of regression	7.925643	Sum squared resid		1193.501
Long-run variance	51.81972	-		-

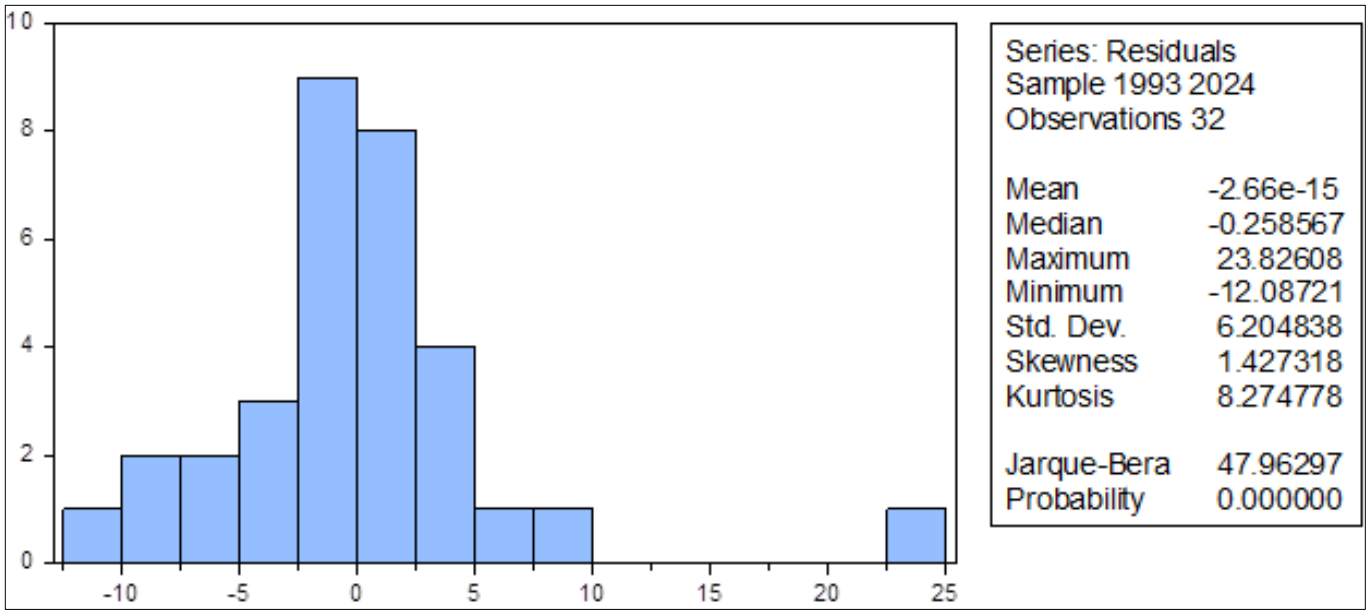
Source: E-view results

The dynamic ordinary least square method on was carried out to examine parameters estimates. In testing this hypothesis, stock of health practitioners (SHP), health immunization programme (HIP) and hospital bed space (HBS) were regressed against under-five-child (UFCM). The empirical result shows that the coefficient of stock of health practitioners (SHP) has negative and significant impact on under-five-child (UFCM) because [P-value (0.8625) was greater than its significant value (0.05]. The health immunization programme (HIP) has negative and significant impact on under-five-child (UFCM) because [P-value (0.0050) was less than its significant value (0.05]. The hospital bed space (HBS) has positive and significant impact on under-five-child (UFCM) because [P-value (0.0016) was less than its significant value (0.05]. The result of the F – statistical test shows that the overall regression

of the variables was statistically significance because [*p*-value (0.0000) was less than its significant value (0.05]. Again, our empirical result shows that the R-squared (R^2) is 0.8054.

4.1.4 Econometric/Second order test

Histogram normality test



Sources: E-view 9.0 version

Fig 1: Presents normality test for each of the distribution

Jarque-Bera (JB) test is statistics that compute both skewness and Kurtosis. Skewness shows the degree symmetry (normal distribution). The normal measurement is zero/0. Kurtosis is a statistics that compute degree of peakedness. The normal measurement is three/3. A distribution is skewed if one of its tails is longer than the other. A skewed distribution can be positive or negative. Positive skewed distribution means that it has a long tail in the positive direction. Negative skewed distribution means that it has a long tail in the negative direction. The null hypothesis is that there are no skewness and Kurtosis in the model. We reject the null hypothesis because the Jarqua-Bera statistics (47.9629) is greater than probability value (0.000). We reject null hypothesis and accept the alternative that there are no skewness and Kurtosis in the model. The skewness is normal because the value was 1.4273. The model of the study produced positive skewed distribution meaning that it has a long tail in the positive direction. The kurtosis was 8.2747 meaning that the degree of peakedness was high that normal value of three (3). This implies that the standardized residuals from the estimated model in the regression framework is normally distributed, which is consistent with the OLS assumption.

4.2 Test of hypotheses

The results for the various hypotheses testing are presented in the section.

4.2.1 Test of hypothesis one

H_{O1} stock of health practitioners has no significant impact on under-five child mortality in Nigeria

In testing this hypothesis, stock of health practitioners was regressed against under five child mortality (UFCM). The empirical result shows that the coefficient of stock of health practitioners have negative and significant impact under-five child mortality (t-statistic -2.1518< Sig-value; 0.05; *p*-value; 0.0445). The stock of health practitioners has 17 percent negative and significant impact on under-five child mortality in Nigeria. A percent change in stock of health practitioners results to 17 percent decrease in under-five child mortality in Nigeria.

4.2.2 Test of Hypothesis two

H_{O2} Health immunization programme has no significant impact on under-five child mortality in Nigeria

In testing this hypothesis, health immunization programme was regressed against under five child mortality (UFCM). The empirical result shows that the coefficient of health immunization programme has negative and significant impact under-five child mortality (t-statistic -2.8988 < Sig-value; 0.05; *p*-value; 0.0092). The health immunization programme has 16 percent negative and significant impact on under-five child mortality in Nigeria. A percent change in health immunization programme results to 16 percent decrease in under-five child mortality in Nigeria.

4.2.3 Test of hypothesis three

H_{O3} Hospital bed space has no significant impact on under-five child mortality in Nigeria

In testing this hypothesis, hospital bed space was regressed against under five child mortality (UFCM). The empirical result shows that the coefficient of hospital bed space has negative and significant impact under-five child mortality (t-statistic 17.5220 < Sig-value; 0.05; P-value; 0.0000). The hospital bed space has 43 percent negative and significant

impact on under-five child mortality in Nigeria. A percent change in hospital bed space results to 43 percent decrease in under-five child mortality in Nigeria.

4.3 Discussion of the Results

4.3.1 Impact of stock of health practitioners on under-five child mortality in Nigeria

It was observed from the hypothesis tested that coefficient of stock of health practitioners have negative and significant impact under-five child mortality (t-statistic -2.1518 <Sig-value; 0.05; *p*-value; 0.0445). The stock of health practitioners has 17 percent negative and significant impact on under-five child mortality in Nigeria. A percent change in stock of health practitioners results to 17 percent decrease in under-five child mortality in Nigeria.

The finding of this study was not in line with study of Muhammed, (2025) [10] that examined impact of health infrastructure on the survival of Nigeria's youngest citizens. Between 2000 and 2019, we examined how the availability of healthcare professionals, the strength of primary healthcare centers (PHCs), and the reach of immunization programs influence the chances of a child reaching their fifth birthday. While other research has explored factors like healthcare spending and maternal health, our focus is squarely on the direct contribution of these core elements of health infrastructure. Using data from sources like the World Development Indicators and the Nigerian Demographic Health Survey, the study employed a statistical model called the autoregressive distributed lag (ARDL) model to uncover both immediate and long-term connections. The study emphasizes the vital role of a robust health system, including its infrastructure, in reducing child deaths. The study also looked at the trends in child mortality, the presence of healthcare workers, the state of PHCs, and how many children are being immunized.

4.3.2 Impact of health immunization programme on under-five child mortality in Nigeria

It was observed from the hypothesis tested that health immunization programme has negative and significant impact under-five child mortality (t-statistic -2.8988 < Sig-value; 0.05; *p*-value; 0.0092). The health immunization programme has 16 percent negative and significant impact on under-five child mortality in Nigeria. A percent change in health immunization programme results to 16 percent decrease in under-five child mortality in Nigeria.

The finding of this study was not in line with study of Yohanna and Ezie, (2025) [25] that investigated the impact of government health spending on under-5 mortality rates in Nigeria from 1999 to 2024. The specific objectives of the study were determine the impact of public health expenditure on under-five child mortality in Nigeria; ascertain the impact of capital expenditure on under-five child mortality in Nigeria and assess the impact of recurrent expenditure on under-five child mortality in Nigeria. The paper adopted an ex-post facto research design using annual time series data. Data on government health spending were sourced from the Central Bank of Nigeria (CBN) and National Bureau of Statistics (NBS), while under-5 mortality data were obtained from the World Bank. The paper estimated both long-run and short-run dynamics using the Autoregressive Distributed Lag (ARDL) model. Findings showed that Government Recurrent Health Expenditures and Health Insurance Expenditures had significant negative effects on under-5 mortality in the long run, suggesting that increases in these spending categories contributed to reduced child deaths. Conversely, Government Capital Health Expenditure had an insignificant impact, indicating that infrastructure-related spending alone was not sufficient to drive improvements in child health outcomes during the period under review.

4.3.3 Impact of hospital bed space on under-five child mortality in Nigeria

It was observed from the hypothesis tested that coefficient of hospital bed space has negative and significant impact under-five child mortality (t-statistic 17.5220 < Sig-value; 0.05; *p*-value; 0.0000). The hospital bed space has 43 percent negative and significant impact on under-five child mortality in Nigeria. A percent change in hospital bed space results to 43 percent decrease in under-five child mortality in Nigeria.

The finding of this study was not in line with study of Erhuotor and Agor, (2024) [6] that 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 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.

Summary of the Study, Conclusion and Policy recommendations

5.1 Summary of the study

The following are the major findings of the study**:**

- The empirical result shows that stock of health practitioners have negative and significant impact under-five child mortality (t-statistic -2.1518< Sig-value; 0.05; *p*-value; 0.0445). The stock of health practitioners have 17 percent negative and significant impact on under-five child mortality in Nigeria. A percent change in stock of health

practitioners results to 17 percent decrease in under-five child mortality in Nigeria

- The empirical result shows that health immunization programme has negative and significant impact under-five child mortality (t-statistic -2.8988 < Sig-value; 0.05; *p*-value; 0.0092). The health immunization programme has 16 percent negative and significant impact on under-five child mortality in Nigeria. A percent change in health immunization programme results to 16 percent decrease in under-five child mortality in Nigeria.
- The empirical result shows that hospital bed space has negative and significant impact under-five child mortality (t-statistic 17.5220 < Sig-value; 0.05; *p*-value; 0.0000). The hospital bed space has 43 percent negative and significant impact on under-five child mortality in Nigeria. A percent change in hospital bed space results to 43 percent decrease in under-five child mortality in Nigeria.

5.2 Conclusion

This study concludes that health infrastructure has negative and significant impact on under-five child mortality rates in Nigeria. Stock of health practitioners, health immunization programme and hospital bed space are health infrastructure measures that reduce infant mortality rate in Nigeria. The analysis reveals that optimum availability of health infrastructure contributes to reduction of under-five child mortality rates following considerable financial investments in the health sector. The findings indicate that availability of physicians, nurses, and midwives, health immunization programme and hospital bed space negatively impacts mortality rates. In order to promote health infrastructure in Nigeria, 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.

5.3 Recommendations

Based on the findings of this study, the following recommendations were made.

- Nigeria government at all levels from the federal, state and local to massively invest in the provision of health infrastructure which is a strong viable means of reducing mortality incidence in Nigeria. Nigeria's share of government expenditure to the health sector falls massively below the minimum standard of 16% as recommended by UNESCO for a developing country.
- Immunization programs for children should be further promoted and expanded to increase the coverage and effectiveness of vaccinations, this can be done through NGOs and International health agencies.
- Nigeria Government should continue to invest in the training and deployment of healthcare professionals to improve the accessibility and availability of healthcare services, particularly in rural and underserved areas.

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