Health Infrastructure and Economic Development Nexus in Nigeria

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ABSTRACT

Nigeria like many other Sub-Saharan African countries has been plagued with lack of functional infrastructure in order to grow the economy. Recent events in Nigeria, such as the COVID-19 pandemic, which emerged in late 2019 and continues to impact Nigeria, has exposed the vulnerabilities and weaknesses in the country's health infrastructure. This study investigates the impact of health infrastructure on economic development in Nigeria. The study employed time series data. Health infrastructure was captured by government recurrent and capital expenditure on health while economic development was proxied by per capita gross national product. 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 and enhancing economic development in Nigeria. Nigeria's share of government expenditure to the health sector ranges between 5-7 percent, which falls immensely below the minimum standard of 16 percent as recommended by UNESCO for a developing country, which calls for emergency intervention in the health sector by increasing the expenditure as this will increase the provision of health infrastructure thereby ultimately reducing the mortality rate in the country. For health spending to positively impact economic development, the investments in health care infrastructure must be supplemented by the quality of institutions.

Key Words: *Infrastructure, Health, Economic development, Recurrent expenditure, Capital expenditure.*

INTRODUCTION

Economic development is believed to be determined by physical capital accumulation, labour, technological advancement and infrastructure to sustain increase in a country's economic wealth and standards of living. (Romer, 2017). Following the assumed exogenous nature of labour and technology, investment in reproducible physical capital accumulation and infrastructure are considered the main driver of economic growth (Solow,2019). In Nigeria, the poor state of health infrastructure poses significant challenges to economic development (Udah & Odey, 2016).

The burden of healthcare expenses on households can lead to increased poverty levels and hinder economic progress. Out-of-pocket healthcare expenses in Nigeria account for a significant portion of household income, pushing many families into poverty (Ololade & Oyinlola, 2019; Ada, Akan, Angioha & Enamhe, 2021). Moreover, the indirect costs associated with morbidity and mortality, such as loss of productivity and reduced educational attainment, have long-term implications for economic development (Acharya, Bell & Lewis 2021).

The contribution of infrastructure to an economy, especially its industrial sector, cannot be over-stressed; this is because, it makes productivity more of a breeze through promotion of investment, movement of products, people and services, and facilitation of information and communication, all these, being salient factors for economic diversification. An adequate supply of infrastructure is a prerequisite factor for economic growth. Intuitively, one would think that various infrastructure development interacts with the economic growth in complex processes as intermediary goods. The improvement in both quality and quantity of infrastructure affects the productivity of overall industries (Oti, Odigbo & Odey, 2016). Nigeria's health infrastructure comprises the physical and organizational structures, resources, and systems necessary for delivering healthcare services. However, the country faces numerous challenges in this regard. Insufficient funding remains a major obstacle, with Nigeria allocating a relatively low percentage of its GDP to healthcare, resulting in inadequate healthcare infrastructure and limited access to services (WHO, 2020). The shortage of healthcare professionals, including doctors, nurses, and midwives, further exacerbates the situation (Ololade & Oyinlola, 2019). The distribution of healthcare resources is also uneven, with urban areas having better access compared to rural regions, leading to significant disparities in healthcare delivery (Oyewole, Smith & Johnson 2021; Ingwe, Ada & Adalikwu, 2013).

Nigeria like many other Sub-Saharan African countries has been plagued with lack of functional infrastructure in order to grow the economy. Recent events in Nigeria, such as the COVID-19 pandemic, which emerged in late 2019 and continues to impact Nigeria, has exposed the vulnerabilities and weaknesses in the country's health infrastructure. The rapid spread of the virus overwhelmed healthcare facilities, revealing critical gaps in capacity, equipment, and personnel. The lack of adequate infrastructure, availability and distribution of healthcare resources, such as medical supplies, vaccines, and essential medications, particularly in rural areas have contributed to preventable deaths and increased mortality rates. This hindered Nigeria's ability to effectively respond to the pandemic, resulting in high mortality rates. Moreover, the ongoing security challenges in various parts of the country, such as insurgency, banditry, and communal conflicts, have further strained an already fragile health infrastructure. These conflicts have led to the displacement of populations, destruction of healthcare facilities, and a disruption in healthcare services, exacerbating the already high mortality rates in the country (Ingwe, Ada & Angiating, 2014).

Government expenditure on health has not been enough to herald remarkable improvement in the sector. The public spending on health in Nigeria averaged N0.22 billion between 1981 and 1990; N5.37billion between 1991 and 2000; N62billion between 2001 and 2010; as well as N261.75billion between 2011 and 2020, respectively. It was N366.24billion in 2021 (CBN, 2022). The continuous decay in health infrastructure due to inadequate budgetary allocation to the health sector had debilitating effect on Nigeria's economic development. This is evidenced in the plummeting drift of the per capita GNI growth which averaged 3.11 percent decline between 1981 and 1990. It declined further on the average of 1.44 percent between 1991 and 2000, but became positive with an average of 5.66 percent from 2001 to 2010, it trended positively to 0.31 percent between 2011 to 2020, and was 0.67 percent in 2021 (WDI, 2022).

Addressing the problem of inadequate health infrastructure and its impact on economic development requires immediate attention and concerted efforts. It necessitates strategic investments in healthcare infrastructure, including the construction and renovation of healthcare facilities, procurement of medical equipment, and the recruitment and training of healthcare professionals. Additionally, improving healthcare financing, strengthening health systems, and implementing evidence-based policies are crucial to ensure equitable access to quality healthcare services across the country (Oti, Effiong & Odey, 2017).

The cycle of poor health outcomes perpetuates poverty and exacerbates socioeconomic disparities, further hindering Nigeria's progress towards sustainable economic development. It is against this backdrop that this study is undertaken to provide the empirical link between health infrastructure and economic development in Nigeria.

REVIEW OF RELATED LITERATURE

Conceptual Overview

Conceptually, health infrastructure refers to the network of facilities, institutions and resources put in place that support and provide healthcare services. Oshikoya *et al.* (1999) defines infrastructure as social (or soft-core), or physical (or hard-core) infrastructure. They contended that soft-core infrastructure had to do with healthcare, governance, education, and accountability, as well as property rights, which are the driving forces of economic activities; whereas, hard-core infrastructure had to do with physical structures such as transport facilities, telecommunication facilities, power, water, and sewage, which they characterized as wheels of economic activities.

In health infrastructure, 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 labor force is also ensured by a sophisticated health infrastructure. Health infrastructure comprises cutting-edge equipment, specialized medical personnel, such as physicians and nurses, as well as established pharmaceutical enterprises. Inadequate capital investment, outmoded technology, poor infrastructure, such as lack of laboratory equipment and medical specialists, make Nigeria's health care system even more difficult to manage. In this study, government expenditure on health will be used as a measure of health infrastructure.

Economic development is concerned with rising output trend and enhancement in the social and political structure of the people. Proponents of dependency model contend that economic development refers to the challenges of developing nations and economic growth to those of developed economies (Jhingan, 2007). Maddison (1970) makes the distinction between the two terms in this sense when he writes: "the rising of income levels is generally called economic growth in rich countries and in poor ones it is called economic development". For Rains, Stewart and Ramirez (2009), economic growth and economic development are bi-directionally linked. They opined that, the primary tenet comprises of economic growth enhancing human improvement since it probably going to cause households and individuals to utilize their increased earnings for expanding the expenditure, hence furthering human wellbeing. Thus, the expansion in consumption and expenditure, wellbeing and schooling alongside infrastructural facilities will develop and therefore, leading to expansion in social and economic progress of the society. Furthermore, with expansion in private earnings, economic growth will likewise generate extra assets that can be utilized to promote social services such as medical services and safe water supply among others.

Economic development plays a vital role in shaping the healthcare landscape and overall well-being of a nation. Nigeria, as one of Africa's largest economies, possesses immense potential for growth and development. However, the country faces notable economic challenges, including high poverty rates, income inequality, and overdependence on oil revenues. To foster sustainable economic development, the Nigerian government has initiated various reforms and diversification strategies. These efforts aim to reduce dependence on oil and promote sectors such as agriculture, manufacturing, and services. By diversifying the economy, Nigeria can create employment opportunities, increase productivity, and improve the standard of living for its citizens. In this study, the macroeconomic indicator per capita GNI will be used to measure economic development in Nigeria.

Theoretical Underpinning

This study is underpinned by the human capital investment theory was postulated by Gary Becker in 1962.The theory developed the various channels in which income and expenditure emits signals on the human capital development process. The theory postulates that people with high per capita income have a higher tendency to invest their resources in health infrastructure and thus will enhance health care performance. However, low-income parents might push their children towards working in the labour market to help in family finance; in the absence of sufficient money transfers from their parents, children from low-income families will opt for working while studying (Dustmann & Micklewright, 2001). The human capital investment theory is premised on the assumption that investment in education and health will have an attendant consequence on the productive capacity of households. Thus, an investment in health including the facilities needed for improvement in the health sector (health infrastructure) will improve the health status of the citizenry and this will thus result in reduction in health crises such as mortality incidence (Psacharopoulos & Woodhall, 1997). In the same vein, investment in education through the provision of educational facilities will improve the efficiency and productivity of workers. This will directly enhance the economic welfare and output of the nation.

The conclusion drawn from the human capital theory is that it is the investment in education and health as well as humans that drive productivity and output growth of the economy. However, this assertion and conclusion have been largely criticized by other theories as they opined that it is difficult to empirically investigate the impact (Almendarez, 2010). They have

attributed the growth and output of the nation to investment in physical capital; proponents of this view are the Solow growth model and the Harrod Domar model just to mention a few.

Applying Becker's human capital theory to health infrastructure and economic development in Nigeria underscores the importance of policy interventions that prioritize investments in health. This includes improving healthcare infrastructure, strengthening primary healthcare systems, enhancing disease prevention and control measures, as well as ensuring equitable access to healthcare services. Policy efforts aimed at improving health outcomes contribute to human capital development and lay the foundation for sustainable economic growth and development. This theory provides valuable insights into the relationship between health infrastructure and economic development in Nigeria. It emphasizes the significance of health as a component of human capital, the positive economic returns of health investments, the interdependence of health and education, and the policy implications for enhancing health infrastructure. Applying this theory helps policymakers recognize the importance of investing in health and underscores the potential economic benefits of improving health outcomes in Nigeria.

Empirical Studies

Ademiluyi and Aluko-Arowolo (2009) studied the infrastructural distribution of healthcare services and economic growth in Nigeria. Using contextual methods of analysis, they examined the biomedical or western orthodox health care with its expansive bureaucratic ethos within the concept of hospitals structure in Nigeria. It was revealed that distribution of medical care delivery in Nigeria is biased towards urban area at the cost of rural settlers. Infrastructure distribution of health care in rural areas of Nigeria are neglected to satisfy the urban areas, where the educated, the rich and government functionaries reside.

Colgrove, Fried, Mary, Northridge and Rosner (2010) investigated the effect of public health and infrastructure on the US economy in the 21st-Century, using battery of econometric techniques. They found that health infrastructure is crucial for public health care and services, and argued that schools of public health are also essential to the nation’s health, security, and well-being.

Kurt (2015) tested the direct and indirect effects of healthcare infrastructure on economic growth using the Feder–Ram model. The period of the study spans from 2006 to 2013 using seasonally adjusted and real monthly data. The author found that in general, the direct impact of government health care infrastructure on economic growth in Turkey was positive and significant but its indirect impact was negative and significant. It was further added that there were no significant differences between the government health sector and other sectors.

The relationships between healthcare infrastructure, life expectancy and economic growth in Iran have been studied by Memarian (2015). The study covered the periods 1989 to 2011, applying the autoregressive distributed lag technique. The study revealed that life expectancy and healthcare infrastructure spending have a significant positive impact on GDP both in the short-term and in the long term.

Ghosh and Dinda (2017) examined different aspects of health care service facilities and health infrastructure available in India. Major health outcomes like life expectancy at birth and infant mortality rate depend on available health facilities like hospitals, beds and health trained personnel. Life expectancy in India has increased and infant mortality rate declines over the

years, except few states like Bihar, Jharkhand, Madhya Pradesh, Uttar Pradesh. Empirical results provided evidence of strong association between health infrastructure and economic development in India.

Adams, Klobodu and Lamptey (2017) examined the effect of health infrastructure on economic growth in 30 Sub-Saharan Africa (SSA) countries over the period 1990-2014. Using modern econometric techniques that account for cross-sectional dependence in panel data, they found that health infrastructure does not have robust impact on economic growth. The results provided sufficient evidence that although capital investment is adequate, the labour force and political environment have not facilitated the health infrastructure in increasing the GDP per capita level in SSA.

Emeka and Ofierohor (2018) examined the nexus between health care infrastructural finance and economic growth in Nigeria over a period of 1990-2016, utilizing secondary data utilizing the co-integration technique. It was found that a long run significant positive relationship exists between capital expenditure on health and gross domestic product with very marginal contribution, significant positive relationship between human health on social services output investment and gross domestic product, insignificant negative relationship between recurrent expenditure on health and gross domestic product in Nigeria. There is clear evidence of inequality in the access to health care services and low-income characteristics of the country in view of the high level of out-of-pocket health expenditure.

Taofik (2019) examined the impact of health infrastructural development on economic development in Nigeria, and found that infrastructural development impacted positively on economic development with structural break. The results also showed that telephone density as a proxy to infrastructure impacted positively on industrial output but with existence of structural break.

Mohapatra (2019) examined the effect of recurrent and capital components of public health expenditure on selected health outcomes in India. The study considered three time periods of 1992-93, 1998-99 and 2005-06. The structural equation modelling technique was employed and it was found that the recurrent component of public health spending significantly affected major health outcomes, while capital components of public spending were found to have a significant effect on only selected health outcomes.

Bashir, Mohammad, Mohammad Rumzi and Riyazuddin (2022) examined the relationship between health infrastructural spending and economic growth and institutions' role in causing health spending to promote growth. The study used longitudinal data in seven MENA countries from 2000 to 2017, and applied the Phillips Perron (PP) Fisher chi-square stationarity test, indicating that the data series is not stationary. Following this, they used the Pedroni test for cointegration, and the results show long-run relationships between the variables. The findings of the study indicated that health spending does not lead to increased economic growth; this could be due to poor institutional quality.

None of the studies to the best of my knowledge have been able to link health infrastructure with economic development in this post-COVID era, giving the endemic nature of the crisis and the need for the government to increase spending on healthcare. Data gap is equally observed in the literature. Cross-country data were mostly used in the studies reviewed. According to Lederman and Malony (2003), results obtained from the use of cross-country data

and panel in studies differs. In this study, annual data is used in the investigation of the relationship between health infrastructure and economic development in Nigeria. Also, the study used the autoregressive distributive lag (ARDL) model as its estimation.

METHODOLOGY

Resign design

The study examines the nexus between health infrastructure and economic development in Nigeria. To achieve this, the study adopted the ex post facto research design. A multiple regression analysis was used which is predicated on various econometric techniques such as Augmented Dickey-Fuller (ADF) unit root test, granger causality test and autoregressive distributive lag model also known as bound testing co-integration test.

Model Specification

To capture the effect of health infrastructure on economic development within the standard Cobb-Douglas growth model the exponential elements in the original production function can be modified to include the effect of health infrastructure on economic development and expressed as:

$$Y = AK^{\alpha}L^{\beta}\omega^{\delta} \quad 3.1$$

Where: Y, K and L are output, capital and labour, and ω is the vector, capturing the effect of health infrastructure on economic development. In equations (3.1), per capita GDP replaces total output. In order to ascertain the impact of health infrastructure on development equation in Nigeria, the model for per capita GNI and health infrastructure is specified in functional form as follows:

$$PCGNI = f(REH, CEH, GFCF, INSQ, EXR) \quad 3.2$$

The log-linear form of the model is specified as follows:

$$lnPCGNI_t = \beta_0 + \beta_1 lnREH + \beta_2 lnCEH_t + \beta_3 lnGFCF_t + \beta_4 INSQ_t + \beta_5 EXR_t + \mu_t \quad 3.3$$

Where;$\beta_0$to β_5 are the long run parameters to be estimated, μ_t is the error term; PCGNI = Per capita gross national income (annual growth rate); REH = Recurrent expenditure on health (in billion naira); CEH = Capital expenditure on health (in billion naira); GFC = Gross fixed capital formation (percentage of GDP); EXR = Exchange rate (exchange rate of naira to United States dollar); INSQ = Institutional quality (index of government effectiveness).

The short run dynamics (in distributed lag form) of equation 3.3 can specified as:

$$\Delta lnPCGNI_t = \beta_0 + \beta_{1i}\sum_{i=1}^{p}\Delta lnREH_{t-i} + \beta_{2i}\sum_{i=0}^{q}\Delta lnCEH_{t-i} + \beta_{3i}\sum_{i=0}^{q}\Delta lnGFCF_{t-i} + \beta_{4i}\sum_{i=0}^{q}\Delta lnINSQ_{t-i} + \beta_{5i}\sum_{i=0}^{q}\Delta lnEXR_{t-i} + \varphi ECM_{t-1} + \mu_t \quad 3.4$$

$\beta_0 \ldots \beta_5$ Represents the short run dynamics for the parameters to be estimated and φ is the coefficient of the error correction term. The coefficient of the error correction term shows the speed of adjustment of the short run disequilibrium towards long run equilibrium. Secondary sources of data were used as the main source of data collection for the study. The relevant data for this study were obtained from the Central Bank of Nigeria (CBN)Statistical Bulletin (2022) and World Development Indicators (2022).

ANALYSIS AND DISCUSSION OF RESULTS

Descriptive statistics and matrix of correlations

The descriptive statistics of the variables is reported in table 4.1a. According to the table, the per capita gross national income (PCGNI) has been abysmally low and negative within the period under review. This is evidenced by the statistics of the mean, median, maximum and minimum of 3.20, 3.40, 14.28 and -10.77 percent. Likewise, government recurrent (REH) and capital (CEH) on health have been low. This is shown with the mean, median and maximum for REH of N97.25billion, N28.89billion and N423.33billion, and for CEH of N587.89billion, N336.35billion and N2522.50billion, respectively.

The skewness result depicts that all the variables are positively skewed meaning the variables are all long right tail, except per capita gross national income (PCGNI). The kurtosis results show that per capita gross national income (PCGNI), recurrent expenditure on health (REH), capital expenditure on health (CEH), gross fixed capital formation (GFCF) and exchange rate (EXR) are all leptokurtic in their distribution since they are greater than three (3). The kurtosis estimates for institutional quality (INSQ) is less than 3 and hence is platykurtic in nature. The Jarque-Bera test shows that all the variables are normally distributed within the period of analysis. The values of the standard deviation depict the variation of the variables from their true values over the period under review.

The correlation matrix represented in table 4.1b shows that a number of the pairwise correlations are moderately high. Given the result, variables that are highly correlated are not included on the same side of an equation to circumvent the issue of multi-collinearity that may affect the reliability of the results.

TABLE 4.1A

DESCRIPTIVE STATISTICS

	PCGNI	*REH*	*CEH*	*GFCF*	*EXR*	*INSQ*
Mean	*3.209524*	*97.25060*	*587.8929*	*35.83619*	*115.6557*	*-0.423095*
Median	*3.405000*	*28.89500*	*336.3500*	*33.58000*	*114.9000*	*-1.065000*
Maximum	*14.28000*	*423.3300*	*2522.500*	*89.39000*	*425.9800*	*0.970000*
Minimum	*-10.77000*	*0.040000*	*4.100000*	*14.17000*	*0.620000*	*-1.560000*
Std. Dev.	*5.347903*	*131.6586*	*664.4652*	*18.78370*	*119.1821*	*1.004127*
Skewness	*-0.170222*	*1.252201*	*1.318430*	*1.061789*	*1.025348*	*0.558668*
Kurtosis	*3.029662*	*3.284579*	*4.067098*	*3.933953*	*3.230170*	*1.374548*
Jarque-Bera	*0.204368*	*11.11777*	*14.16053*	*9.418243*	*7.452079*	*6.808433*
Probability	*0.902863*	*0.003853*	*0.000842*	*0.009013*	*0.024088*	*0.033233*
Sum	*134.8000*	*4084.525*	*24691.50*	*1505.120*	*4857.540*	*-17.77000*
Sum Sq. Dev.	*1172.603*	*710693.1*	*18102072*	*14465.92*	*582379.4*	*41.33910*

Observations	*42*	*42*	*42*	*42*	*42*	*42*

TABLE 4.1B

CORRELATION MATRIX

	PCGNI	***REH***	***CEH***	***GFCF***	***EXR***	***INSQ***
PCGNI	*1*	*0.025163*	*0.131930*	*-0.549130*	*0.121555*	*-0.452103*
REH		*1*	*0.730839*	*-0.502065*	*0.739044*	*-0.511882*
CEH			*1*	*-0.527352*	*0.732598*	*-0.593145*
GFCF				*1*	*-0.575035*	*0.764691*
EXR					*1*	*-0.649031*
INSQ						*1*

Source: Researcher's computation (2023), using E-Views 9.

Lag length selection

The efficiency and validity of an error correction model depends on the lag structure. The study used VAR lag order selection criteria to determine the lag lengths. The study employed the Akaike Information Criterion (AIC) and Schwarz Criterion (SC) and the result shows four optimal lag length for the model as shown in table 4.2. In order to reduce the possibility of underestimation whilst maximizing the likelihood of recovering the true lag, the study used four as the maximum lag lengths for the study.

TABLE 4.2

Optimal lag selection criteria for the model

Endogenous variables: PCGNI REH CEH GFCF EXR INSQ

Lag	***LogL***	***LR***	***FPE***	***AIC***	***SC***	***HQ***
0	*-972.8732*	*NA*	*9.55e+14*	*51.51964*	*51.77821*	*51.61164*
1	*-809.8097*	*266.0511**	*1.22e+12**	*44.83209*	*46.64205**	*45.47606**
2	*-784.5064*	*33.29374*	*2.48e+12*	*45.39507*	*48.75644*	*46.59102*
3	*-749.4720*	*35.03443*	*3.97e+12*	*45.44589*	*50.35865*	*47.19382*
4	*-700.9784*	*33.17983*	*5.50e+12*	*44.78834**	*51.25249*	*47.08823*

Source: Researcher's computation (2023), using E-Views 9.

Unit root test results

The Augmented Dickey Fuller unit root test was conducted to examine the stationarity condition of the variables. As indicated in table 4.3, PCGNI was stationary at level using the ADF test. In other words, the variable is integrated of order zero (i.e., I (0)). However, all other

variables were stationary after first differencing using the ADF test. The aforementioned variables are therefore integrated of order one i.e., they are I (1). Where some of the variables are I (0) while others are I (1) one suggests the problem of unit root in the equation. It becomes imperative to perform co-integration tests to determine the presence of equilibrium relationship amongst the variables in each equation. The study adopts the ARDL bound testing technique for co-integration, as the variables are integrated of diverse orders (i.e., order zero and order one).

TABLE 4.3
ADF unit root test results

	ADF		
Variables	**Level**	**1st Difference**	**Order of integration**
PCGNI	-4.53493**	-	I(0)
REH	-0.715272	-7.008372**	I(1)
CEH	4.522384	-9.919616**	I(1)
GFCF	-1.169391	-3.878576**	I(1)
EXR	2.863191	-4.211250**	I(1)
INSQ	-1.419046	-6.472384**	I(1)

Source: Researcher's computation (2023), using E-Views 9.
Note: Mackinnon critical values for ADF at 1, 5 and 10% levels are -3.60, -2.93 and -2.60 respectively. ** means significant at 5% level.

Co-integration test results

From the bound testing result reported in Table 4.4, long run relationship exists amongst the variables in the estimated equation, given that the value of the F-statistic (7.54) is greater than the critical values at five per cent level in both the upper (3.79) and the lower (2.63) bounds. Therefore, the null hypothesis of absence of co-integration is rejected, while the study proceeds to estimate the long run coefficients of the equation.

TABLE 4.4

Co-integration test results

			5% critical value		
Equations	**K**	**F-Stat**	**I (0)**	**I (1)**	**Outcome**
PCGNI (REH, CEH, GFCF, EXR, INSQ)	*5*	*7.54*	*2.62*	*3.79*	*Co-integration*

Note: K =number of parameters
Source: Researcher's computation (2023), using E-Views 9.

Granger causality test results

From table 4.5, a bidirectional relationship was found between government recurrent expenditure on health, government capital expenditure on health, gross fixed capital formation and per capita GNI, with causality running from these variables to per capita GNI. However, there was a bidirectional relationship between exchange rate, institutional quality and per capita gross national product.

TABLE 4.5
Pair wise Granger causality test results
PCGNI = f(REH, CEH, GFCF, EXR, INSQ)

Null Hypothesis:	Obs	F-Statistic	Prob.
REH does not Granger Cause PCGNI	41	0.03542	0.8517
PCGNI does not Granger Cause REH		0.47862	0.4933
CEH does not Granger Cause PCGNI	41	0.04057	0.8414
PCGNI does not Granger Cause CEH		1.44945	0.2361
GFCF does not Granger Cause PCGNI	41	5.36318	0.0261
PCGNI does not Granger Cause GFCF		0.56859	0.4555
EXR does not Granger Cause PCGNI	41	0.25042	0.6197
PCGNI does not Granger Cause EXR		0.34462	0.5606
INSQ does not Granger Cause PCGNI	41	3.21726	0.0808
PCGNI does not Granger Cause INSQ		0.07255	0.7891

Presentation and analysis of econometric results

The long run equation of health infrastructure and economic development is reported on table 4.6a. From the results and in consonance with theoretical expectations, a positive relationship exists between recurrent expenditure on health (REH) and per capita gross national income (PCGNI) in the long run in Nigeria. The value of the coefficient of 0.046 implies that an increase in government recurrent spending on health by 1 percent will result to an increase in per capita income by 0.046 percent. The p-value indicates that the variable is statistically significant with a value of 0.0165. This simply means that an increase in the recurrent expenditure on health by the government will lead to economic development in Nigeria. Furthermore, the nexus between capital expenditure on health (CEH) and per capita gross national income (PCGNI) is positive, which is consistent with theoretical expectations. Hence, a 1 percent increase in capital expenditure on health will lead to 0.00053 percent increase in per capita gross national income in the long run, ceteris paribus. The p-value shows that the variable is statistically insignificant with a value of 0.8620. According to the result, gross fixed capital formation (GFCF) has a positive and significant long run relationship with per capita gross national income. The magnitude of the coefficient shows that a 1 percent increase in gross fixed capital formation in the long run will lead to about 0.152 percent increase in per capita gross national income. The p-value is statistically significant with a value of 0.0274. These empirical findings reaffirm the important role of capital formation in economic growth and development of Nigeria. The relationship between exchange rate (EXR) and per capita GNI is

negative and statistically insignificant. Hence, a 1 percent rise in exchange rate will lead to 0.053 percent decrease in per capita gross national income in the long run. The p-value shows that the variable is statistically insignificant. A negative and significant relationship exists between institutional quality (INSQ) and per capita GNI in the long run. A 1 percent rise in institutional quality will lead to about 0.113 percent decrease in per capita GNI in the long run.

The short run dynamics result of health infrastructure and economic development equation is reported in table 4.6b. From the results and in contravention of theoretical expectations, a positive relationship exists between recurrent expenditure on health and per capita gross national income (PCGNI) in the short run in Nigeria. The value of the coefficient of 0.051 implies that an increase in government recurrent spending on health by 1 percent will result to an increase in per capita income by 0.051 percent. The p-value indicates that the variable is statistically significant with a value of 0.0150. This simply means that an increase in the recurrent expenditure on health by the government will lead to economic development in Nigeria in both the short and long run. Also, the relationship between capital expenditure on health and per capita gross national income is positive in the short run, which is consistent with theoretical expectations. Hence, a 1 percent increase in capital expenditure on health will lead to 0.00059 percent increase in per capita gross national income in the short run, ceteris paribus. The p-value shows that the variable is statistically insignificant with a value of 0.8611. According to the result, gross fixed capital formation has a positive and significant short run relationship with per capita gross national income. The magnitude of the coefficient shows that a 1 percent rise in gross fixed capital formation in the short run will lead to about 0.168 percent increase in per capita gross national income. The p-value is statistically significant with a value of 0.0352. The relationship between exchange rate at both current and first period lag and per capita GNI is negative but statistically significant after first period lag. Hence, a 1 percent rise in exchange rate will lead to 0.023 and 0.132 percent decrease in per capita gross national income in the short run at current and first period lag, respectively. The p-value shows that the variable is statistically significant after first period lag. The relationship between institutional quality and per capita GNI in the short run is positive and significant. A 1 percent rise in institutional quality will lead to about 0.125 percent increase in per capita GNI in the short run, ceteris paribus.

The error correction mechanism (ECM) has the correct sign and size. The ECM coefficient of -0.604654 indicates that, it takes about 60 percent for the short run disequilibrium to adjust to the long run equilibrium within the year. The p-value of 0.0000 shows that the error correction term is statistically significant at 5 percent level of significance. The R-squared value of 0.797850 and the value of R-squared adjusted of 0.694070 indicates that about 69 percent of the variations in per capita gross national income is explained by the current, first period lag of the explanatory variables and about 31 percent was unexplained which may be accounted for by other variables not included in the health infrastructure-economic development model. The F-statistic of about 15.76071 shows that all the variables in the health infrastructure-economic development model are together as a group statistically significant which means that the model has a good fit. The Durbin-Watson (D-W) statistic of 2.133 indicates no autocorrelation in the model. Therefore, the results can be used for economic forecast and policy simulations.

The stability test using the cumulative sum (CUSUM) test in figures 1a and 1b, further shows that the variables included in the health infrastructure-economic development equation were stable within the period of the study. This is evidenced by the swing of the trends within the CUSUM and CUSUM of squares bound at the ± five percent significance level. The study,

therefore, infers that the equation is stable and consistent to be adopted for economic policies and forecasts.

TABLE 4.6a

Long run coefficients of health infrastructure and economic development equation
Dependent variable: PCGNI

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REH	0.046182	0.018220	2.534618	0.0165
CEH	0.000534	0.003048	0.175308	0.8620
GFCF	0.152522	0.065894	2.314641	0.0274
EXR	-0.053345	0.026303	-2.028066	0.0512
INSQ	0.113373	0.033595	3.374698	0.0020
C	8.551053	2.777202	3.079017	0.0043

TABLE 4.6b

Short run coefficients health infrastructure and economic development equation
Dependent variable: D(PCGNI)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(REH)	0.051015	0.019812	2.575001	0.0150
D(CEH)	0.000590	0.003346	0.176421	0.8611
D(GFCF)	0.168484	0.076495	2.202558	0.0352
D(EXR)	-0.023154	0.041079	-0.563650	0.5770
D(EXR(-1))	-0.132467	0.051593	-2.567522	0.0153
D(INSQ)	0.125238	0.028672	4.367954	0.0001
CointEq(-1)	-0.604654	0.106639	-5.670101	0.0000

R-Squared	0.797850		
Adjusted R-Squared	0.694070		
F-statistic	15.76071		
Prob.(F-statistic)	0.000159	Durbin-Watson stat.	2.133691

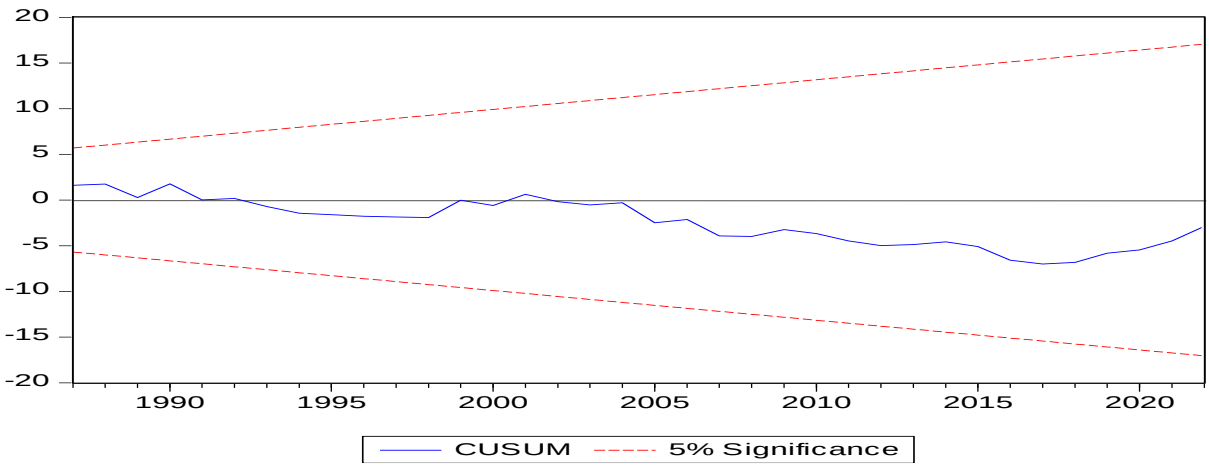

Fig.1a: Health infrastructure-development equation CUSUM

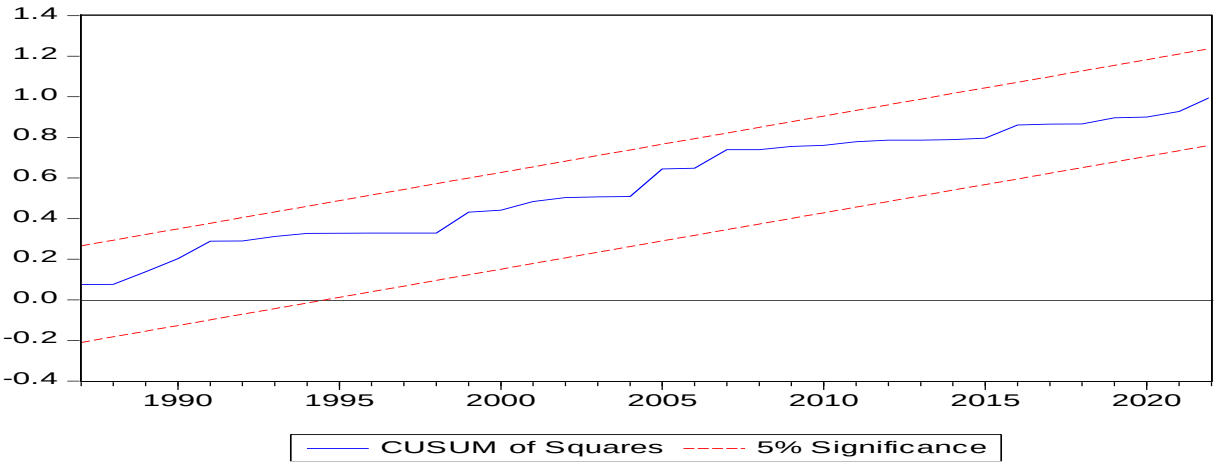

Fig.1b: Health infrastructure-development equation CUSUM of Squares

Discussion of Results

From the granger causality results, a bidirectional relationship was found between government recurrent on health, government capital expenditure on health, gross fixed capital formation and per capita GNI, with causality running from these variables to per capita GNI. The feedback effect of economic development on government recurrent on health, government capital expenditure on health, gross fixed capital formation, portends that economic development enhances the performance of these variables in the Nigerian economy. The bound test result shows that a long run relationship exists among the variables in the estimated equations. Therefore, the null hypotheses of absence of co-integrated is rejected while the alternative hypotheses are retained. This signifies the relevance of these variables in enhancing economic development in Nigeria. These findings are in tandem with the views of Akintunde and Satope (2013), and Taofik (2019) who opined that health infrastructure impacted positively on economic development in Nigeria. They further assert that investment in health care infrastructure could boost economic growth, if government invests more in this aspect of human capital.

The error correction coefficients in the estimated model met the three criteria for its acceptability given that it is negative, fractional and statistically significant. Consequently, the estimated result confirms the presence of long run relationship among the variables in the model. It also shows that the speed of adjustments is high in the estimated model. The values of the adjusted R-squared implies that the model has good fit as the independent variables have high explanatory powers. The Durbin-Watson Statistic connotes absence of autocorrelation in the estimated equations. The study, therefore, accepts the null hypotheses of no serial correlation in the models. This further implies that the error terms of different periods are not serially correlated. The stability test using the cumulative sum tests showed that the variables included in the model were stable within the period of the study.

CONCLUSIONS AND RECOMMENDATIONS

The relationship between health infrastructure and economic development remains inconclusive in the extant literature, hence, it is needful to ascertain these relationships so as to make evidence-based decision that would ameliorate the situation in the health sector of Nigeria. Given the meagre budgetary allocation to the health sector of the Nigerian economy,

it became imperative to examine the empirical link between health infrastructure and economic development to actually see if there is a causal relationship among these key macroeconomic variables in Nigeria. Hence, this study was carried out to examine the relationship as well as the direction of causality among these variables of interest. The ARDL Bounds test approach to cointegration and the Granger causality test were employed in the analysis. Sequel to the empirical findings of this study, this study concludes that health infrastructure plays key roles in influencing economic development in Nigeria. This study further concludes that for the optimal performance of the Nigerian 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 and hence promote economic development.

In line with the findings of the study, there is a need for the 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 and enhancing economic development in Nigeria. Nigeria's share of government expenditure to the health sector ranges between 5-7 percent, which falls massively below the minimum standard of 16 percent as recommended by UNESCO for a developing country. This calls for emergency intervention in the health sector by increasing the expenditure as this will increase the provision of health infrastructure thereby ultimately reducing the mortality rate in the country. Special attention should be focused on the basic health care facilities which are preventive in nature; these are mosquito nets, potable community water facility, conducive sanitation facilities, good drainage system and increase in the ratio of doctors to patients as this is critical in stimulating productivity and decline in mortality for sustainable economic development in Nigeria. For health spending to positively impact economic development, the investments in health care infrastructure must be supplemented by the quality of institutions.

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