تحليل للعلاقة بين الصحة والنمو في نيجيريا

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الملخص:

في حقبة ما بعد جائحة فيروس كورونا العالمي ، لم تدرس الدراسات الحالية بشكل كاف تأثير المؤشرات الصحية على النمو الاقتصادي ، لا سيما في نيجيريا ، حيث فشل نظام الرعاية الصحية ، وهاجر العاملون الصحيون بأعداد كبيرة ، وارتفاع التكاليف الصحية. وهكذا ، فحصت هذه الدراسة العلاقة السببية بين المؤشرات الصحية والنمو الاقتصادي في نيجيريا بين عامي ١٩٩٠ و ٢٠١٩ باستخدام بيانات السلاسل الزمنية الفصلية. استخدمت الدراسة تقديرات **ARDL** قصيرة المدى وطويلة المدى وتصحيح الخطأ ووجدت أن هناك علاقة مهمة بين المتغيرات الصحية والنمو الاقتصادي في نيجيريا. أيضا، وخلصت الدراسة إلى أن التحسينات في النتائج الصحية من شأنها أن تعزز النمو. لكن قدرة المؤشرات الصحية على تحقيق فوائد نمو مستدامة تتوقف على مستوى التعليم والاحتفاظ بالقوى العاملة القطاع الصحي. نظرًا لأن النتائج الصحية المحسنة تعزز النمو، فإننا نوصي بشدة بتوجيه السياسات الصحية نحو تحسين متوسط العمر المتوقع، وتقليل وفيات الرضع، وتقليل معدل الوفيات. يمكن تحقيق ذلك من خلال الاستثمار في قطاع الصحة، وينبغي أن تنظر الحكومة والأسر إلى هذا الاستثمار كمصدر حقيقي للنمو الاقتصادي من خلال الوصول إلى خدمات الرعاية الصحية الجيدة بتكلفة معقولة.

الكلمات المفتاحية: النمو الاقتصادي، متوسط العمر المتوقع، معدل الوفيات، وفيات الأطفال، الإنفاق الصحي.

AN ANALYSIS OF THE RELATIONSHIP BETWEEN HEALTH AND GROWTH IN NIGERIA

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Abstract:

In the post global corona virus pandemic era, existing studies have adequately examined the impact of health indices on economic growth, especially in Nigeria, where healthcare system is failing, health workers emigrating in droves and health cost surging. Thus, this study examined the causal relationship between health indices and economic growth in Nigeria between 1990 and 2019 using quarterly time series data. The study employed the ARDL short run, long run, and the error correction estimators and found that a significant relationship exists between health variables and economic growth in Nigeria. The study concluded that improvements in health outcomes would be growth-enhancing. But, the ability of health indices to sustainably yield growth benefits, hinges on the level of education and manpower retention in the health sector. Since improved health outcomes are growth-enhancing, we strongly recommend that health policies should be directed at improving life expectancy, reducing infant mortality, and minimizing crude death rate. This could be achieved by investing in the health sector and such investment should be regarded by the government and households as a veritable source of economic growth through access to quality health care services at affordable cost.

Keywords: ***Economic Growth, Life expectancy, Crude death rate, Infant mortality, health expenditure.***

1. Introduction

The empirical nexus and dynamic linkages between health indices and economic growth have remained a subject of intense debate, rejuvenated in the wake of the coronavirus pandemic that has devastated global health stock and changed the dynamics of health-economic relations. However, there are theoretical and empirical shreds of evidence that have established these nexuses in both country-specific and cross-country studies. Despite the theoretical and empirical plausibility and efforts towards improving the stock of health globally, countries (especially within the sub-Saharan Africa region) continue to encounter a plethora of challenges. Worst still, the SSA region (where Nigeria belongs) is rated poorly in all health indices, with Nigeria as the largest contributor to the region's depleting health performance (World Bank, 2020). This is provides the justification for selecting Nigeria as the case study.

More so, the average infant mortality rate of Nigeria between 2019 and 2021 stands at 59 deaths per 1000 live births, while at the regional level, it is 51 deaths per 1,000 live births within the same period. Also, the crude death rate stands at 11.42 per 1,000 population for Nigeria and 8.42 per 1000 population for the region. Nigeria also recorded a maternal death rate of 512 per 100,000 in 2020, which is the worst in the world. Life expectancy is also very low at 55.02 years in Nigeria, which is lower than the average of 61.62 years for the SSA region (World Bank, 2020). The abysmal failure of health indices in Nigeria is attributed by Modibbo, Jalingo, and Jalingo (2019) to weak health infrastructure, inadequate health practitioners and health financing, high incidence of infectious diseases, communicable and non-communicable diseases, and high cost of healthcare

services. In addition, the novel coronavirus pandemic has further depleted the already dilapidated Nigerian health system, and the incessant industrial conflict between the government and the National Association of Resident Doctors (NARD) has given the health system a deathly blow. Unfortunately, this has resulted in mass exodus of medical personnel out of Nigeria. This could have enormous socio-economic consequences.

The consequential impact is seen in low life expectancy rate, worst infant and maternal mortality rates, high crude death rate, and other associated health problems, which has been established to have a consequential incidence on economic growth (Bhargava et al., 2001; Edeme, 2018; Lotfalipour, Falahi & Borji, 2012; Modibbo, Jalingo & Jalingo, 2019; Ogundari & Awokuse, 2018; Sarpong, Nketiah-Amponsah & Owoo, 2020). Thus, it follows that the economic growth potentials of Nigeria could be tremendous with an incremental enhancement in health indicators of Nigerians.

In this limelight, existing studies have documented the nexus between economic growth and health indicators such as life expectancy (Biyase & Maleka, 2019; He & Li, 2020); mortality rates (Bilal et al., 2017; Rocco et al., 2021); and crude death rate (Maiti & Jadhav, 2021).

Nevertheless, despite the foregoing arguments, the nexus between health indices and economic growth in Nigeria has not been adequately discussed, as most of the studies were conducted for developed countries, which cannot be used to infer health-economic relations in Nigeria due to heterogeneity.

Also, the studies above focused on health outputs as proxies for health indices, thereby ignoring the causal linkage between health inputs and economic growth. These prior

discussions, therefore, provides the rationale and justification for further empirical studies that would establish the specific pathways of connectivity between growth and health. The main objective of the study is to ascertain the relationship between health indicators and economic growth in Nigeria.

To attain the main objective of this study, the following hypotheses were formulated:

1. H_0: There is no significant relationship between health indices and economic growth in Nigeria
2. H_0: There is no causal nexus between health indices and economic growth in Nigeria

The remaining part of this paper is structured as follows: Part 2 is theoretical and empirical literature; Part 3 presents the methodology; Part 4 is data analysis, and Part 5 is the conclusion.

2. Literature Review

The increasing research attention towards the linkage between health and economic growth is recently propelled by the global health pandemic, which has disrupted economic variables, including growth. As rightly noted in literature, there is an incontestable nexus between health indices and economic growth, as it is a veritable source of growth. From the foregoing, various studies have analyzed the relationship between health indicators and economic growth; their results are much far from unanimity. Thus, there are three strands of literature; health and growth are positively related, health indices have a negative relationship with economic growth, and health indicators and growth have no relationship.

Essentially, Huang, Fulginiti, and Peterson (2010) employed the Overlapping General Model to using cross-country

data for 38 African economies to establish that HIV/AIDS and related diseases retard economic growth. The mechanism is such that HIV/AIDS and related diseases worsen life expectancy, reduces educational attainment, weakens labour productivity, and slows the momentum of economic growth.

Also, Dauda (2011) utilized the error correction mechanism to analyze the impact of health components on economic growth in Nigeria. The study analyzed annual time-series data that spanned 1970 to 2009 and concluded that health indices have a significant impact on economic growth in Nigeria. Although the study established that health components matter for economic growth, the use of an error correction mechanism limits the study's findings to short-run dynamics while neglecting the long-run relationship, which is more important for sustainable growth.

In recent times, studies have continued to expand the scope of the health-economic relations to incorporate the dynamic linkages. In this regard, Modibbo, Jalingo, and Jalingo (2019) examined the long-run relationship and the causal nexus between health indices and economic growth in West African economies. The study employed the Panel co-integration and Granger causality tests to analyze the Panel data that spanned 1970-2016 to document a robust long-run relationship between health indices and economic growth, and on the other hand, a unidirectional causality from health indices to growth. Despite the novelty of the study, its outcome cannot be used to generalize Nigeria, because of peculiarity and endogeneity issues that were not corrected in their econometric analyses.

However, Sarpong, Nketiah-Amponsah & Owoo (2020) found a bidirectional relationship between health indices and economic growth in SSA. The study employed the dynamic

panel ordinary least square estimation technique, the Granger causality test, and panel co-integration analyses on 35 countries in the SSA region. This position disagrees with the finding reported earlier by Modibbo, Jalingo, and Jalingo (2019), an indication that the debate is still lively.

In addition, He and Li (2020) provided new empirical dimensional evidence to buttress the argument on the decisive relationship and linkages between health and growth. Using the panel co-integration technique, the study reported a significant positive long-run relationship between life expectancy and economic growth. However, the result of the causal linkages was inconclusive, as causality runs from health to growth in countries with an aging population, but runs from growth to health indices for economies with a less aging population. The conclusion reached by He and Li (2020) has further opened the third argument in the literature, which claims that the nexus between health and growth is mediated by demographic variables.

In Wang et al. (2020), they analysed the dynamic relationship between economic growth and life expectancy in Pakistan considering what roles financial development and energy consumption plays in their relationship. The study found a positive relationship between life expectancy and growth in Pakistan. However, energy consumption lowered life expectancy by contributing to environmental degradation and financial development had an adverse effect on life expectancy.

Extending the health-growth relationship, Rocco et al. (2021) analyzed panel data for 135 countries between 1990 and 2014. The result of the study revealed that the impact of health on economic growth is not negligible. Specifically, reduction in mortality and morbidity, moderately accelerate the economic growth rate.

In a similar investigation in Turkey, Rjoub et al. (2021) employed the Bayer–Hanck cointegration test, wavelet coherence, Fourier Toda–Yamamoto, and Breitung–Candelon frequency-domain spectral causality tests to establish a positive relationship between life expectancy and growth in Turkey.

Wang et al. (2022) examined the impact of life expectancy on economic growth and air pollution in 134 countries using the Bayesian Probability modeling approach. The study found that Africa recorded the strongest positive impact of life expectancy on economic growth and the least averse effect of life expectancy on air pollution.

Mahalik et al. (2023) investigated the impact of gender life expectancy on environmental degradation from the BRICS countries. The study established that male gender life expectancy and growth drive environmental sustainability, implying the possibility of a positive nexus between life expectancy and economic growth.

Given the literature, it is obvious that a research gap on health and growth nexus still exists. It is certainly clear that the nexus between health and growth is inconclusive and requires health academics to navigate the pathways. This lends credence to this study.

3. Methodology

- ***Sources and Method of Data collection***

The quarterly time series data employed in the study was generated from the annual time series using the data splicing method on Eviews. The annual component of the data was sourced from the 2020 publications of the World Development

Indicators (WDI, 2020) by the World Bank. The data spanned Q1: 1990 to Q4:2019 for Nigeria.

- ***Method of Data Analysis***

The result of the pre-estimation tests supports the use of the autoregressive distributed lag (ARDL) estimation technique to address hypothesis 1. However, hypothesis 2 was analyzed using the Granger causality test. Before the series of econometric tests, a summary of descriptive statistics, correlation tests, unit root, and the co-integration tests were conducted. However, to ascertain the stability, reliability, and validity of the estimated results, post estimation tests for serial correlation, model stability, normality, and heteroscedasticity were carried out.

- ***Theoretical Framework and Model Specification***

The study's theoretical model stems from the dynamic adjustment of health-growth (DAHG) framework developed by Preston (1975) and extended by Cutler et al. (2006) and Weil (2014). The DAHG framework posits that health indices and growth or income are positively related in the short-run and the long run. Emphatically, the theory states that causality runs from health indices to growth, and reverse causation is least expected. However, the theory further identified technology and education as the candidates that propel the positive relationship between health indices and economic growth in individual countries (Weil, 2014). Thus, the model specification of the study evolved from the DAHG theory (See Weil, 2014 for further readings).

$$GDPR = f(HLT) \quad 1$$

$$GDPR = f(GDPR_{t-1}\ IFM_t, LER_t, CDR_t, GHE_t, PHE_t) \quad 2$$

$$GDPR = \vartheta_0 + \emptyset_0 GDPR_{t-1} + \emptyset_1 IFM_t + \emptyset_2 LER_t + \emptyset_3 CDR_t + \emptyset_4 GHE_t + \emptyset_5 PHE_t + \varepsilon_t \quad 3$$

Table 1: Description of variables

Variable	***Identity***	***Description***	***Unit***	***Source***	***Theoretical Expectation***
GDPR	GDP growth rate	This measures the rate at which economic activities expand annually.	%	WDI, 2020	$\emptyset_0 > 0$; positive relationship
IFM	Infant Mortality	Health indicator that measures the number of deaths recorded per thousand infants.	Per 1,000	WDI, 2020	$\emptyset_1 < 0$; Negative relationship (Demetriou & Tzitziris, 2017)
LER	Life expectancy	A popular measure of health performance that recognizes the number of years a child born today is expected to last.	Year	WDI, 2020	$\emptyset_2 > 0$; Positive relationship (He & Li, 2020)
CDR	Crude death rate	Health indicator that measures at midyear the number of deaths per thousand of the population	Per 1,000	WDI, 2020	$\emptyset_3 < 0$; Negative relationship (Rocco et al.,2021)
GHE	Government health expenditure	This is a health input measured by the domestic government per capita health expenditure in current international US$	Dollar	WDI, 2020	$\emptyset_4 > 0$; Positive (Alhassan et al., 2020; Yang, 2020)
PHE	Private health expenditure	Health input that shows out-of-pocket expenditure by household. It is also measured per capita in current international US$.	Dollar	WDI, 2020	$\emptyset_5 > 0$; Positive relationship (Sirag & Nor, 2021; Stepovic, et al., 2020).

Source: Authors' presentation

- ***Granger causality Model***

In pursuance of the second hypothesis, the study employed the Granger causality estimation technique to discern the direction of causality between health indices and economic growth. Recall equation 1, where health indices are represented jointly as (HLT), while economic growth is GDPR, and following the earlier work of Granger (1969) to determine the nature and direction of causality between health indicators and growth variables using the models below:

$$\Delta GDPR_t = \alpha_i + \sum_{i=1}^{m} \beta_i \, \Delta GDPR_{t-1} + \sum_{i-1}^{n} \pi_i \Delta HLT_{t-1} + \varepsilon_t \quad (4)$$

$$\Delta HLT_t = \alpha_i + \sum_{i=1}^{p} \emptyset_i \, \Delta HLT_{t-1} + \sum_{i-1}^{q} \theta_i \Delta GDPR_{t-1} + k_t \quad (5)$$

Where HLT depicts health indices that included infant mortality, life expectancy, and crude death rate, government expenditure on health and private health expenditure; ε_t and k_t represent the omnibus global variable characterized by the normality assumptions of zero mean and constant variance; the optimal lag lengths are shown by m, n, p, and q; while t is the time-variant of the model, and t-1 implies the dynamic feature of the causality model.

Nevertheless, the statistical significance or insignificance of the coefficients of the Granger causality model- β, π, $\emptyset$ and θ have implications for the study's result as stipulated in Table 2 below.

Table 2: Expected implications of causality estimates

If $\pi_i = 0$	HLT does not Granger cause GDPR	Shreds of empirics
If $\pi_i \neq 0$	HLT Granger causes GDPR	Modibbo, Jalingo, and Jalingo (2019)
If $\theta_i = 0$	GDPR does not Granger cause HLT	
If $\theta_i \neq 0$	GDPR Granger causes HLT	He and Li (2020)
If $\pi_i = 0$ & $\theta_i = 0$	Causality does not exist	
If $\pi_i \neq 0$ & $\theta_i \neq 0$	Bidirectional/Bilateral causality exists	Sarpong, Nketiah-Amponsah & Owoo (2020)

Source: Author's presentation

4. Empirical Results

In this section, the paper presents the pre-estimation, estimation, and post-estimation results.

- ***Pre Estimation Tests***

The study examined the basic nature and statistical properties of the variables. It used the summary of descriptive statistics (see Table 4) to determine the average points of the observations, the standard deviation to ascertain the degree of variation in the data points, and skewness and kurtosis coefficients to discern the shape of the distribution in terms of the degree of peakedness or flatness. The result of the Jarque-Bera statistic revealed that GDPR and GHE satisfied the normality assumption of the variables at the expense of other variables. Also, to examine the direction and degree of relationship among the variables, the correlation coefficients in Table 3 revealed a mixed direction and degree of correlation, the outcome implies that there are strong and weak positive and negative relationships among the variables. To further ascertain the stationarity of the variables and to determine the most suitable estimation

technique, the study employed the Phillips-Perron unit root test as presented in Table 5.

In addition, the unit root results for each variable showed a mixed order of integration. For instance, the endogenous variable is stationary at level- I(0). However, the exogenous variables are stationary in their first difference- I(1). The outcome supports a plethora of econometric methods, but the study followed the most suitable- Autoregressive Distributed Lag Models. The choice of this method is found in its ability to simultaneously estimate both the short-run and long-run relationships and the speed of adjustment in the short-run.

Table 3: Correlation Matrix

	GDPR	GHE	CDR	IFM	LER	PHE
GDPR	1.0000					
GHE	-0.0312	1.0000				
CDR	0.03838	-0.5801	1.0000			
IFM	-0.1221	-0.6223	0.9652	1.0000		
LER	-0.0674	0.5671	-0.9982	-0.9486	1.0000	
PHE	0.0669	0.5593	-0.9155	-0.9451	0.9002	1.0000

Source: Authors' computation

Table 4: Summary of Descriptive Statistics

Statistic	GDPR	GHE	CDR	IFM	LER	PHE
Mean	4.546357	26.51415	15.88457	99.12333	48.96567	67.52587
Median	4.823564	26.01174	16.47450	96.65000	47.98600	68.21466
Maximum	15.32916	40.36729	18.57900	124.3000	54.68700	78.22015
Minimum	-2.035119	13.96845	11.63000	74.20000	45.84300	56.83160
Std. Dev.	3.936043	6.323720	2.422995	17.60372	3.100072	6.851839
Skewness	0.430109	0.320458	-0.380058	0.147808	0.484128	-0.020133
Kurtosis	3.313360	2.702714	1.619099	1.467960	1.713129	1.506771

Jarque-Bera	4.190847	2.495757	12.42332	12.17267	12.96778	11.15677
Probability	0.123018	0.287113	0.002006	0.002274	0.001528	0.003779
Sum	545.5629	3181.698	1906.148	11894.80	5875.880	8103.105
Sum Sq. Dev.	1843.599	4758.743	698.6374	36877.01	1143.643	5586.776
Observations	120	120	120	120	120	120

Source: Authors' computation

- ***Unit Root Test***

Table 5: Phillips-Perron Stationarity Test

		At Level		At First Difference		
Variable	Method	t-statistic	P-Value	t-statistic	P-Value	Integration ordering
GDPR	Phillips-Perron	-5.088370	0.0000			I(0)
IFM	Phillips-Perron	-1.700065	0.4285	-11.38182	0.0000	I(1)
LER	Phillips-Perron	-1.609901	0.4743	-11.90681	0.0000	I(1)
CDR	Phillips-Perron	-1.585373	0.4868	-11.85951	0.0000	I(1)
GHE	Phillips-Perron	-1.886417	0.3377	-3.292701	0.0175	I(1)
PHE	Phillips-Perron	-0.916527	0.7799	-3.486472	0.0101	I(1)

Source: Authors' computation

- ***Cointegration Test***

Table 6: ARDL F-Bounds Test for Cointegration

Test Statistic	Value	k
F-statistic	5.317248	5
Critical Value Bounds		
Significance	lower Bound	Upper Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source: Authors' computation

Furthermore, the F-Bounds test results indicating a long-run relationship between the endogenous and exogenous variables are presented in Table 6 above, with an F-statistic of 5.317 greater than the lower and upper bounds of at 1% significance level.

- **ARDL Estimation Results**

In pursuance of Hypothesis 1, the estimates of short-run, long-run, and the error correction mechanism models of the ARDL are presented in Table 7-9. It can be seen that in all the estimated coefficients that health variables have a mixed relationship with economic growth and the impacts are moderately significant. Emphatically, the dynamics are such that in the short run, infant mortality has a significant negative impact on economic growth. Also, life expectancy has a positive relationship with economic growth, but the impact is not statistically significant in the short run. Conversely, one period lag in crude death rate and out-of-pocket health expenditure is inversely related with economic

growth, while the previous period government expenditure on health amplifies economic growth. Since the majority of health indices bear a remarkable influence on economic growth, the study found that health indices (health input and outcomes) are significant determinants for economic growth, and thus, health matters for growth.

This position corroborates the assertions of earlier empirical studies (Dauda, 2011; Demetriou & Tzitziris, 2017; He & Li, 2021; Modibbo, Jalingo & Jalingo, 2019; Rocco et al., 2021).

Interestingly, the goodness of fit of the model shows that 86% of the variations in economic growth are accounted for by variations in health indices for Nigeria. Again, the F-statistic of 57.09 with a p-value of 0.0000 reveals that the model is highly adequate, and the Durbin Watson statistics of 1.906 confirmed the absence of autocorrelation in the estimated model.

Table 7: Short Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDPR(-1)	0.833113	0.081051	10.27883	0.0000
GDPR(-2)	-4.88E-14	0.091181	-5.35E-13	1.0000
GDPR(-3)	4.93E-15	0.091181	5.40E-14	1.0000
GDPR(-4)	-0.317561	0.094282	-3.368206	0.0011
GDPR(-5)	0.277148	0.071402	3.881517	0.0002
GHE	-0.203119	0.053180	-3.819448	0.0002
GHE(-1)	0.132750	0.054850	2.420244	0.0173
CDR	13.68655	5.725333	2.390525	0.0187
CDR(-1)	-4.740804	2.170988	-2.183708	0.0313
IFM	-1.113806	0.318691	-3.494938	0.0007
IFM(-1)	0.732944	0.309918	2.364963	0.0199
LER	5.179278	3.558831	1.455331	0.1487

PHE	-0.078979	0.059483	-1.327741	0.1873
C	-349.8818	247.9359	-1.411179	0.1613

R-squared	0.880222	Mean dependent var	4.331278
Adjusted R-squared	0.864805	S.D. dependent var	3.759920
S.E. of regression	1.382480	Akaike info criterion	3.599301
Sum squared resid	193.0362	Schwarz criterion	3.933467
Log-likelihood	-192.9598	Hannan-Quinn criteria.	3.734937
F-statistic	57.09441	Durbin-Watson stat	1.906187
Prob(F-statistic)	0.000000		

1Source: Authors' computation 1

Table 8: ARDL Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GHE	-0.300015	0.120774	-2.484090	0.0145
CDR	-41.89309	19.022987	-2.202235	0.0297
IFM	-1.758415	0.492901	-3.567480	0.0005
LER	24.058207	12.309846	1.954387	0.0532
PHE	-0.286964	0.261681	-1.096618	0.2752
C	-1637.334706	859.419548	-1.905163	0.0594

Source: Authors' computation

Table 9: ARDL Error Correction Mechanism

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GHE)	-0.252613	0.063717	-3.964619	0.0001
D(CDR)	-11.65024	6.074584	-1.917868	0.0577
D(IFM)	-0.489006	0.173889	-2.812175	0.0058
D(LER)	6.690460	3.858674	1.733876	0.0857
D(PHE)	-0.346255	0.119856	-2.888935	0.0047
ECM(-1)	-0.278095	0.058813	-4.728433	0.0000

Source: Authors' computation

Table 8 presents the long-run estimates of the relationship between health indices and economic growth. The long-run coefficients support the two shreds of arguments in the literature. First, improvement in health outcomes- life expectancy, infant mortality rate, and crude death rate amplify economic growth. And the second argument opposes the first, claiming that health inputs (health expenditures) do not promote economic growth in countries with weak education and technology (Weil, 2014). The empirical result from this study supports both arguments as valid for Nigeria. Thus, in the long run, improvement in infant mortality, life expectancy, and crude death rate accentuate economic prosperity as earlier documented by (Dauda, 2011; Demetriou & Tzitziris, 2017; He & Li, 2021; Modibbo, Jalingo & Jalingo, 2019; Rocco et al., 2021).

Conversely, the study found the in the long run, economic growth is hampered by government expenditure on health and the private health expenditure from households' pockets. The outcome disagrees with earlier studies that reported a significant positive relationship between health variables and economic growth (Alhassan *et al.*, 2020; Sirag & Nor, 2021; Stepovic, *et al.*, 2020; Yang, 2020).

In Table 9, the error correction mechanism and speed of adjustment follow the theoretical expectation and a negative sign, which is statistically significant. The speed of adjustment of 27% per quarter implies the rate at which short-run disequilibrium is restored in the long run between health and economic growth relations.

Thus, effectively, the study accepts the alternative hypothesis 1, that there is a significant relationship between health indices and economic growth in Nigeria.

- **Granger Causality Tests**

The study had established the existence of a significant long-run relationship between health indices and economic growth; it further hypothesized the direction of causality between the variables using the Granger causality estimation technique as presented in Table 10 below.

Table 10: Granger Causality Results

Null Hypothesis	Chi-square stat	P-value	Causality
HLT does not Granger cause GDPR	137.4787	0.0000	Causality
GDPR does not Granger cause	33.95920	0.7380	No causality

Source: Authors' computation

According to the Granger causality result, at a 1% significant level, the causal relationship between health indices and economic growth is unidirectional, running from heath indices to economic growth. Therefore, the results provided some evidence to reject null hypothesis 2 and to accept alternative hypothesis 2, that health indices Granger cause economic growth in Nigeria. The evidence of the unidirectional nexus from health indices to growth in Nigeria is supported by existing literature (Modibbo, Jalingo & Jalingo, 2019; He & Li, 2020), however, the findings of Sarpong, Nketiah-Aamponsah & Owoo (2020)

refutes the conclusion of this study on health indices and economic nexus in Nigeria.

Table 11: Results of Post Estimation tests and Model Validity

Serial correlation test:		*p*-value
F-statistic	3.9604	0.5792
LM Statistic	40.5762	0.1479
Heteroscedasticity test:		*p*-value
F-statistic	0.7548	0.6876
LM Statistic	23.8126	0.4903
Normality Test:		*p*-value
Jarque-Bera	0.3807	0.8266
Linearity Test		*p*-value
t-statistic	1.1862	0.3179
F-statistic	1.0891	0.3179

Source: Authors' computation

To validate the econometric model, the results in Table 11 indicated the absence of serial correlation and heteroskedasticity, while it affirmed normality, linearity and adequate specification of the econometric models.

5. Conclusion and Recommendations

The paper examined the nexuses between health indices and economic growth in Nigeria using the quarterly data that spanned Q1:1990 and Q4:2019. The ARDL short run, long run, and the error correction mechanism results revealed the existence of a significant relationship between health variables and

economic growth in Nigeria. Also, the results of the Granger causality tests established the presence of unidirectional nexus that runs from health indices to economic growth.

Thus, the study concluded that there is a significant relationship between health indices and economic growth in Nigeria. Therefore, improvements in health indicators would be growth-enhancing. But, the ability of health indices to sustainably yield growth benefits hinges on the level of education (He & Li, 2020), and technological advancement (Weil, 2014).

Since improved health outcomes are growth-enhancing, the study strongly suggests that health policies should be directed at improving life expectancy, reducing infant mortality, and minimizing crude death. This could be achieved by investing in the health sector and such investment should be regarded by the government and households as a veritable source of economic growth through access to quality health care services at affordable cost.

Finally, since causality is unidirectional, it is recommended that improvement in education quality and technology adoption in rendering health services are the strategic actions for a bilateral interdependence/linkages/nexuses between health and growth in Nigeria.

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