INCOME INEQUALITY AND HEALTH OUTCOMES IN NIGERIA

OLUWASEUN ADENIRAN SUNDAY[1*]
[1]Federal University Wukari, Taraba, Faculty of Social Science, Department of Economics, Taraba State, Nigeria
Email; adeoluwaseun621@gmail.com, Phone; +234(0)8141917471

IDOWU DANIEL ONISANWA[2*]
[2]Federal University Kashere, Gombe, Faculty of Social Science, Department of Economics Developmental Studies, Gombe State, Nigeria,
Email; onidan@yahoo.com, Phone; +234(0)8036428218

ABSTRACT
Inequality of income represents a substantial disparity in the distribution of income in a country and it might hold adverse consequence for health. Plummeted income can reduce the desire to seek healthcare thereby undermining health outcomes in Nigeria. This study examines the effect of income distribution disparity on life expectancy and determines the causal relationship between health outcomes and income inequality in Nigeria. The income inequality-health theory provided the theoretical framework for the study. Data were obtained from World Bank Database, Central Bank of Nigeria Statistical Bulletin and United Nations Database. The income inequality was measured using Gini coefficient and health outcomes was measured by life expectancy. Autoregressive Distributed Lag model was estimated to examine the impact of income inequality on life expectancy. Toda-Yamamoto causality test was used to determine the causal relationship between life expectancy and income inequality. Income inequality had a negative impact on life expectancy both in the long-run and short-run but only statistically significant in the long-run. There is unidirectional causality running from life expectancy to Gini coefficient. Efforts to reduce income differentials among individuals should be pursued by policymakers. Providing proper budgetary funding of public health care service will reduce the consequences of income distribution disparity and improve health outcome in Nigeria.

Keywords: Income inequality, Life expectancy, Nigeria, Autoregressive Distributed Lag
JEL codes: 114, C22

1. INTRODUCTION
Global economies are being undermined by the current spike in income inequality, which has serious consequences for inclusive growth (Dobuzinskis, 2023). The unequal distribution of income among individuals or households in a society or country can have a negative impact on individual welfare and economic growth. Income inequality may arise from a number of factors, including differences in education, skills, employment opportunities, and social as well as economic structures (Blau & Kahn, 2020). Income inequality can have wide-ranging effects on society, including reduced social mobility, increased levels of poverty, and social unrest. It can also affect the economic growth and stability of the country. Income inequality widens the gap between the rich and the poor, leading to unequal access to health care, limited health education, and increased health risks among vulnerable populations (Chukwudozie. 2015; Bor et al., 2017)
Health outcomes are measurable impact of a medical intervention or policy on the overall health of an individual or population. These outcomes include mortality, morbidity, disability rate, life expectancy, quality of life and the prevalence of diseases (Galvin et al., 2021). Health outcomes provide important information about the effectiveness and impact of interventions, policies and

medical systems in improving or maintaining health. They help evaluate the success of health programmes and policies aims at achieving desired health goals, identify areas for improvement and guide future decision-making (Brownson et al., 2017). According to Wildman (2021), income inequality in a society is associated with reduced health outcome for people of all income levels. Inequitable distribution of Income in the society can reduce or prevent access to healthcare and education which in turn contribute to lower life expectancy. Low-income households have limited access to quality education, preventive interventions and healthcare services, resulting in the prevalence of chronic diseases, and reduced life expectancy (Hayward & Ayeb-Karlsson. 2021). The growing financial disparity between the rich and the poor has adverse effect on developing nations in Africa. Africa has witness tremendous economic progress over the last 20 years, but income inequality has continued to rise (Chancel et al., 2023). In terms of equity in income distribution across the globe, the Sub-Saharan Africa (SSA) is only ahead of Latin America and the Caribbean (World Bank, 2022). The Sub-Saharan Africa has a Gini index of 44.2% (United Nations, 2023).

Nigeria's income distribution and health outcomes mirrored that of other Sub-Saharan African countries (Obute, 2021). The country has been plagued by a high degree of inequality, which has resulted in a significant concentration of wealth within a small number of individuals. The Global Wealth Report of 2021 states that wealth disparity in Nigeria increased between 2000 and 2020. In 2000, the wealthiest 1% of the population held 28.3% of the nation's total wealth, the percentage increased to 44.2% in 2023. Nigeria's global weighting Gini coefficient is 37.5 on a scale of 100 and rated 11th in West Africa and 100th out of 163 nations across the globe (United Nations, 2023). Life expectancy, have remained intriguingly unimpressive in Nigeria. The life expectancy at birth in Nigeria was estimated to be around 53 years in 2022 and varies across regions within the country (World Bank, 2022).

The challenges of income inequality in Nigeria affect health outcomes. Individuals with lower incomes often face limited access to quality healthcare services, poor living condition, inadequate infrastructure, high rate of chronic diseases leading to health disparities. They may struggle to afford essential healthcare, resulting in delayed or inadequate treatment for illnesses (Sanders, 2023). This can lead to poorer health outcomes among lower-income populations. Income inequality also worsens other health determinants such as nutrition, housing and sanitation (Nahian, 2023). There are several challenges that affect health outcomes. Although, there are few studies on income inequality and health outcomes, the results provide mixed conclusions (Matthew & Brodersen, 2018; Ibrahim & Abdulazeez, 2021; Blanco, 2019 and Udoh et al., 2022), especially for developing countries like Nigeria. This study adds value to past studies by incorporating life expectancy into the income-inequality health hypothesis.

Consequently, this study contributes to existing studies by investigating the relationship between income inequality and health outcomes in Nigeria. Income inequality measured by Gini coefficients while health outcomes is measured by life expectancy. The specific objectives are to: examine the impact of income inequality on health outcomes (Life expectancy) and determine the causal relationship between health outcomes (Life expectancy) and income inequality in Nigeria. The remaining sections of the study are organized as follows. Section 2 presents the relevant literature review. The methodology employed and the data utilized are in Section 3. Findings of the study are considered in Section 4. Finally, Section 5 contains the conclusion which includes the implications, contributions, and limitations of the study.

2 LITERATURE REVIEW

2.1 Theoretical Literature

Income-inequality health hypothesis (IIHH)

The income inequality health hypothesis posits a connection between income inequality and health outcomes within a society (Wilkinson, 1992). According to this hypothesis, a higher level of income inequality is linked to poorer health outcomes among individuals and communities. The theory suggests that income inequality can lead to increased stress, social conflict and reduced social cohesion, which in turn can have negative impacts on health. It posit that individuals in societies with high level of income inequality may experience higher level of stress due to social comparisons, feelings of relative deprivation and limited access to resources and opportunities. These stressors can contribute to the development of various health issues, including mental health problems, cardiovascular diseases, obesity and overall reduced life expectancy (Pickett & Wilkinson, 2015).

2.2 Empirical Literature

Numerous empirical studies have been conducted on the relationship between income inequality and health in the developed and developing countries. Momoh et al. (2024) examined the effect of economic welfare on life expectancy in sub-Saharan Africa for a panel dataset of 44 selected countries spanning between 2000 and 2021. They found that panel granger causality test revealed that real GDP, secondary school enrolment rate and carbon dioxide emission had bidirectional causal relationship with life expectancy. Esseau-Thomas et al. (2022) conducted an analysis on the impact of epidemics, pandemics, and income inequality across nations globally throughout the first two decades of this century. They found that the variable representing incidence of epidemic deaths per 100,000 population had a significant positive impact on the Gini coefficient, especially when COVID-19 data was incorporated.

Momoh and Okwu (2022) looked into the effect of income on health outcomes in the Anglophone West African Countries from 2000-2019. The data were sourced from the World Bank's World Development Indicators, and Global Health Expenditure Data bases. The findings revealed that per capita gross domestic product, Out-of-Pocket health expenditure, income inequality, and current health expenditure have a substantial influence on health outcomes within the Anglophone West African Countries.

Ibukun (2021) examined the impact of health expenditures on three specific health outcomes within the West African sub-region, while investigating the effect of the quality of governance in this nexus over the period 2000–2018. The result shows that health expenditures had a significant negative relationship with infant mortality and under-five mortality, and a significant positive relationship with life expectancy at birth.

Blanco et al. (2019) discovered that between 1990-2018 income inequalities was linked to higher healthcare expenditures in United States, with each 1% increase in the Gini coefficient at the county level associated with a US$40,008 rise in annual county Medicare costs. Additionally, this increase in income inequality was associated with a rise of 174.7 total county Medicare inpatient days per year.

Rebeira et al. (2017) conducted an investigation on the effect of income inequality and mortality rates among both genders within a selected group of OECD nations over an extensive timeframe spanning from 1950 to 2008. The results indicate that income inequality had a significant negative effect on mortality rates among both genders in the developing countries.

Neumayer and Plumper (2016) examined inequalities of income and inequalities of longevity in 28 developed nations from 1974-2011. The results demonstrate that income inequality had a significant negative impact on average life expectancy of 28 developed nations. Additionally, their findings suggest that a 1% increase in income inequality between the rich and poor individuals in the 28 developed nations may result in a reduction of longevity by 0.013% in the short-run and by 0.058% in the long-run.

Specifically for Nigeria, the findings are mixed. Ogu (2023) conducted a study on the impact of health inequality on Nigeria's economic growth from 1990 to 2021. The study found that life expectancy at birth has a significant positive relationship with economic growth in Nigeria while the other three independent variables has a significant negative relationship with economic growth in Nigeria. Orekoya (2017) conducted an investigation on the nexus between income inequality and health status in Nigeria, covering the period from 1980 to 2015. The findings demonstrated that qualitative indicators, including life expectancy and the infant mortality rate, suggest that income inequality does not significantly influence health outcomes in Nigeria.

On the contrary, Odusanya and Agboola (2017) conducted a thorough investigation into the effect of income and income inequality on health within Nigeria during the period spanning 1980 to 2014. The findings unveiled an inverse relationship between income inequality and health, both in the long and short term. Fatukasi and Ayeomoni (2015) investigate the effect of income inequality on health indicators in Nigeria from 1980-2014. The result discovered that income inequality had a significant negative relationship with mortality rate. However, the model revealed a direct relationship between income inequality and life expectancy rate. Finally, control variables such as per capita income, education level, and saving level had a positive impact on health indicators in Nigeria.

2.3 Gaps in the Literature and Value Addition

Previous studies on income inequality and health outcomes in Nigeria had the following limitations: First, literatures on income inequality and health outcomes are very scanty. The available studies (Omotola & Kabir 2015; Matthew et al., 2018) focused on socio-economic factors that might not properly depict an emerging economy with rising income inequality. Second, there are gaps in methodological approach concerning income inequality and health outcomes in Nigeria. Previous studies (Matthew et al., 2018 and Vilda et al., 2019) with cross-sectional data relied on logistic regression and time series data (Pasqualini et al., 2017) relied on ordinary least square (OLS). These studies ignored the Toda- Yanmamoto so as to determine the causal relationship between health outcomes and income inequality. Thus, an in-depth enquiry into the probable impact of rising income inequality and health outcomes in Nigeria is critical to policy strategies. As a result, this study used data from World Bank (2023), United Nations (2023) Database and Central Bank of Nigeria Statistical Bulletin (2023) that contains more detailed information on income inequality and health outcome in Nigeria. The dataset provides recent variables of health outcomes in Nigeria. It is expected that the outcomes of the analysis will aid in formulating both health and welfare policies that promote sound, physical and mental health and reduce income inequality and improve health status across various strata in Nigeria.

3. METHODOLOGY

3.1 Theoretical Framework

The underlying theoretical framework for the study is based on Wilkinson's income inequality-health hypothesis. It posits that income serves as a determinant of health status at the individual

level. It is also assumed that the relationship between individual income and health status is concave, such that each additional income raises individual health by a decreasing amount. The concave nature of the relationship between income and health carries significant implications for the broader aggregate-level correlation between income distribution and the overall attainment of health outcomes.

3.2 Model Specification

To examine the impact of income inequality on health outcomes (life expectancy) in Nigeria, the functional form of model is specified as:

$$LEX = f(GINI, LR, GEXH) \quad (1)$$

Where LEX is life expectancy, a measure of health outcome, GINI is the gini coefficient, LR stands for literacy rate, and GEXH represents government health expenditure. The econometric equation for the model is specified as

$$LEX_t = \alpha_0 + \alpha_1 GINI_t + \alpha_2 LR_t + \alpha_3 GEXH_t + \mu_t \quad (2)$$

Where; α_0 is the intercept term, α_1 to α_3 are parameters estimated, and μ_t is the white noise error term.

Theoretically, income inequality is expected to result in reduction in life expectancy. This is in line with the theoretical framework of income inequality-health hypothesis. Hence, Literacy rate and Government health expenditure is expected to be positively related with life expectancy.

The study used Autoregressive Distributed Lag (ARDL) estimator because of its numerous merits. The ARDL approach allows for the inclusion of both stationary and non-stationary variables in the analysis, making it a powerful tool for examining dynamic relationships in time series data. Hence, this study employed the ARDL modeling approach.

The autoregressive distributed lag (ARDL) frameworks are as follows

$$\Delta LEX = \sum_{i=1}^{p} \delta_1 \Delta LEX_{t-i} + \sum_{i=1}^{p} \delta_2 \Delta GINI_{t-i} + \sum_{i=1}^{p} \delta_3 \Delta LR_{t-i} + \sum_{i=1}^{p} \delta_4 \Delta GEXH_{t-i} + \pi_1 LEX_{t-1} + \pi_2 GINI_{t-1} + \pi_3 LR_{t-1} + \pi_4 GEXH_{t-1} + \varepsilon_t \quad (3)$$

The expression π_1 to π_4 depict the Long-run relationship between the series while expression δ_1 to δ_4 with summation notations corresponds to the short-run dynamic of the variables. The following hypotheses are tested with respect to equation (3) following in the ARDL technique.

The null hypothesis is H_0:$\pi_1 = \pi_2 = \pi_3 = \pi_4 = 0$, this states that there is no long-run relationship among the variables. While the alternative is H_0:$\pi_1 \neq 0, \pi_2 \neq 0, \pi_3 \neq 0, \pi_4 \neq 0$

The calculated F-statistic value is compared with the upper and lower critical value advanced by Pesaran et al. (2001). If the calculated F- value is greater than the upper critical then the null hypothesis of no cointegration will be rejected and conclude that cointegration exist among the series irrespective of whether the variable are I (0) or I (1). The long-run relationship is established by estimating the chosen ARDL model using Schwarz Criterion.

The error correction models for equation 3 is specified as:

$$\Delta LEX = \sum_{i=1}^{p} \alpha_1 \Delta LEX_{t-i} + \sum_{i=1}^{p} \alpha_2 \Delta GINI_{t-i} + \sum_{i=1}^{p} \alpha_3 \Delta LR_{t-i} + \sum_{i=1}^{p} \alpha_4 \Delta GEXH_{t-i} + \vartheta ECM_{t-1} + \mu_t \quad (4)$$

Where $\vartheta ECM1_{t-1}$ is the error correction term. Several diagnostic tests were performed to ascertain the goodness of fit of the model. These diagnostic tests include serial correlation, normality (Jarque-Bera) and Heteroskedasticity using Autoregressive Conditional Heteroskedasticity. Furthermore, the cumulative (CUSUM) and cumulative sum of square (CUSUMSQ) are used to check the stability of the model of the regression.

To determine the causal relationship between life expectancy and income inequality in Nigeria, the study employed the Toda-Yanmamoto causality test.

The Toda-Yanmamoto causality test is considered if the series are of different orders of integrated I (0) and I (1). The model is specified as;

$$GINI_t = \alpha_0 + \sum_{i=1}^{k} \theta_{1t}\, GINI_{t-1} + \sum_{j=k+1}^{k+d_{max}} \theta_{2j}\, GINI_{t-1} + \sum_{i=1}^{k} \delta_{1t}\, LEX_{t-1} + \sum_{j=k+1}^{k+d_{max}} \delta_{2j}\, LEX_{t-1} + \mu_{1t}$$

$$LEX_t = \beta_0 + \sum_{i=1}^{k} \varphi_{1t}\, GINI_{t-1} + \sum_{j=k+1}^{k+d_{max}} \varphi_{2j}\, GINI + \sum_{i=1}^{k} \beta_{1t}\, LEX_{t-1} + \sum_{j=k+1}^{k+d_{max}} \beta_{2j}\, LEX_{t-1} + \mu_{2t} \quad (5)$$

Where: k denotes the optimal lag. This is determined by using the information criteria such as AIC and SIC and d_{max} as the maximum order of integration.

The data used in this study is annual time series data covering 1990 – 2022 sample period. The Gini coefficient is the preferred parameter for income. The data pertaining to the Gini coefficient were obtained from the United Nation (2023) Database, while data on life expectancy (LEX), literacy rate (LR) from the World Bank (2023) and government health expenditure (GEXH) were sourced from Central Bank Statistical Bulletin (2023).

4 RESULTS AND DISCUSSION OF FINDINGS

The result of the descriptive statistics is presented in Table 1 below

Table 1 Descriptive statistics of the variables

	LEX	GINI	GEXH	LR
Mean	49.361	43.755	122.738	57.338
Median	49.730	44.000	62.253	55.450
Maximum	55.440	46.800	423.300	68.600
Minimum	45.490	35.100	0.150	50.220
Std. Dev.	3.057	3.277	135.225	4.522
Skewness	0.159	-1.380	0.900	0.500
Kurtosis	1.773	4.461	2.495	2.539
Jarque-Bera	2.212	13.404	4.805	1.668
Probability	0.331	0.001	0.091	0.434

Source: Computed by the Authors

The result reveals that all the series are substantially consistent as their mean and median values are constantly within the minimum, and the maximum values of these series. Given that the skewness of a normal distribution is zero, the skewness statistics for life expectancy is not substantially different from the threshold of zero for a normal distribution. Life expectancy, government health expenditure and literacy rate are positively skewed while Gini coefficient is negatively skewed. Life expectancy have kurtosis value that is less than 3, hence their distribution is flat (Platykurtic) relative to the normal. Furthermore, Gini coefficient, and government health

expenditure have kurtosis values that are greater than 3, hence their distribution is assumed to be peaked (leptokurtic) relative to normal. Meanwhile, the literacy rate can be assumed to be normally distributed since the kurtosis statistic is not substantially different from 3. The Jarque-Bera statistics for life expectancy is higher than the three conventional levels of statistical significance. Thus, we do not reject the null hypothesis of normal distribution. Meanwhile, Gini coefficient, and government health expenditure probability for Jarque-Bera statistics is less than 10% (0.10), an indication that the series are not normally distributed. However, the literacy rate is normally distributed, this is supported by the skewness and kurtosis statistics for the series.

This study tests the stationarity properties of all the variables. The stationarity tests employed were Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) to enhance accuracy, facilitate comparison and boost confidence in the regression result outcomes. The results obtained are summarized in Table 2.

Table 2: Unit root tests of variables

Variable	**Phillips Perron**			**Augmented Dickey Fuller**		
	LEVEL	**1st DIFF.**	**I(d)**	**LEVEL**	**1ST DIFF**	**I(d)**
LEX	-3.3763	-6.3958***	I(0)	0.6330	-6.3664***	I(0)
GINI	-2.1982	-6.1823***	I(1)	-2.1610	-6.2457***	I(1)
LR	-2.2104	-9.9433***	I(1)	-2.3202	-7.5484***	I(1)
GEXH	4.6032	-1.6748*	I(1)	1.6852	-1.6748*	I(1)

(*) indicates significant at the 10%, (**) significant at the 5% and (***) significant at the 1% Source: Source: Computed by the Author

The outcomes of the unit root analysis indicate that life expectancy is stationary at level while the remaining series in the study are integrated of order one I (1). This finding suggests that the variables exhibit a mixed order of integration.

The cointegration test serves as a statistical technique used in determining if two or more time series variables are cointegrated, meaning if they share a long-run relationship. As evidenced in Table 2, the result of the unit root tests reveal that the variables possess different order of integration. As a result, the appropriate co-integration technique is the one suggested by Pesaran and Shin (1999) and Pesaran et al. (2001) known as the bounds co-integration test. Following the determination of the order of integration and the selection of maximum lags based on the Akaike Information Criterion, this study established the long-run relationship among the variables of interest utilizing an Autoregressive Distributed Lag (ARDL) bounds testing approach.

Table 3: ARDL Bound Test Result (life expectancy)

Test Statistic	**Value**	**K**
F-statistic	9.639536	3
	Critical Value Bounds	
Significance Level	**I(0) Bound**	**I(1) Bound**
10%	3.47	4.45
5%	4.01	5.07
2.5%	4.52	5.62
1%	5.17	6.36

Source: Computed by the Authors

Table 3 presents the finding of the ARDL bounds test for cointegration concerning life expectancy. The computed F-statistic (9.347031) exceed the critical value of the upper bound I (1) at the 5% significance level for the life expectancy model. Therefore, the null hypothesis asserting the absence of a long-run relationship among the variables in the equation is rejected. This suggests the presence of a long-run relationship within the model.

Table 4: Cointegration form (short-run results) for life expectancy

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GINI)	0.006362	0.029812	0.213392	0.8333
D(GINI(-1))	0.149005	0.030635	4.863909	0.0001
D(GINI(-2))	0.057431	0.029155	1.969883	0.0636
D(GEXH)	0.700841	0.189138	3.705442	0.0015
D(LR)	-0.057943	0.022118	-2.619691	0.0169
CointEq(-1)*	-0.940118	0.140699	-6.681787	0.0000

Source: Computed by the Authors

The error correction term is negative and statistically significant in line with theoretical expectation. This also confirms the existence of a long-run relationship among the series within the model, indicating the speed at which the model returns to equilibrium following a disturbance. The coefficient of CointEq (-1) is -0.9401, suggests that, assuming other factors remain constant, approximately 94 percent of last year's deviation from equilibrium due to shocks will revert to long-run equilibrium in the present period. Contrary to the long-run results and expectations, the relationship between literacy rate and life expectancy in the short run result indicates that the literacy rate has a significant negative relationship with life expectancy. Conversely, Government health expenditure demonstrates a positive and significant relationship with life expectancy, implying that increases in government health expenditure will lead to an increase in life expectancy. This study conforms to the finding of Edeme et al., (2017) who found that an increase in government health expenditure is associated with improvement in life expectancy.

Table 5: The long-run coefficient results for life expectancy

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GINI	-0.063049	0.030434	-2.071651	0.0522
GEXH	0.877347	0.304723	2.879160	0.0096
LR	0.020078	0.036233	0.554134	0.5860

Source: Computed by the Authors

The income inequality measured by Gini coefficient showed a significant negative relationship with life expectancy in the long-run. This suggest that an increase in income inequality

in Nigeria will reduce life expectancy at birth. In line with the apriori expectations of the study, higher income inequality will reduced social mobility, access to healthcare and reduce life expectancy at birth. This study conform to the findings of Momoh et al. (2024), which report an inverse relationship between income inequality and life expectancy. Conversely, Orekoya (2022) found that income inequality exerts a significantly positive influence on life expectancy. Moreover, Government health expenditure has a positive relationship with life expectancy and statistically significant in the long-run. This indicates that an increase in government health expenditure will lead to an increase in life expectancy. Theoretically, it is expected that rising government health expenditure would translate into improvement in health status, thus rising life expectancy. This may be due to access to healthcare services especially for vulnerable populations, increase in healthcare infrastructure and the availability of healthcare professionals and trained staff to take care of some challenges in the health sector. This study is in line with the findings of Akintunde and Olaniran (2020) and Ibrahim and Ditep (2022) indicating significant positive government health expenditure in determining life expectancy. The outcome is plausible as improved preventive and curative healthcare expenditures is expected to naturally prolong longevity and good health status. On the contrary, Orekoya (2022) revealed government health expenditure is negatively related to life expectancy at birth.

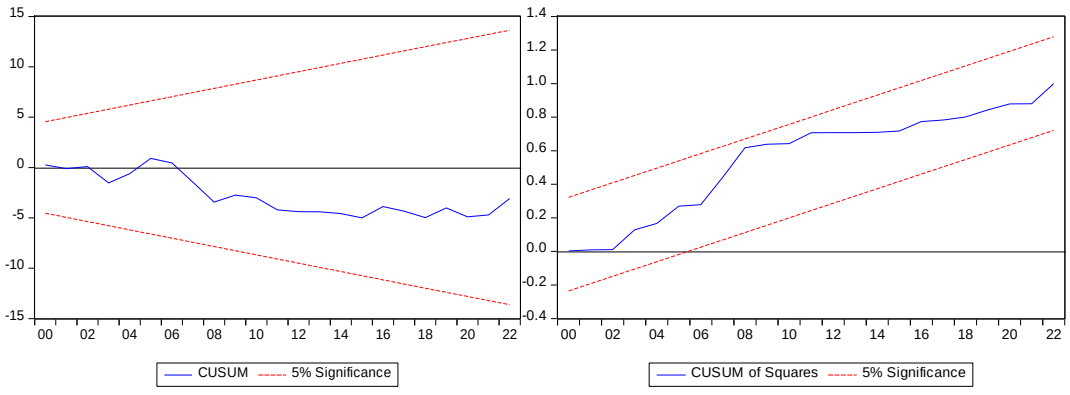
Nevertheless, the literacy rate has a positive relationship with life expectancy though not statistically significant. This result conform to the findings of Momoh et al. (2024) which posited that conventional socio-economic variables such as per capita income and education play a crucial role in influencing life expectancy in developing nations. This is contrasts with the findings of Ibrahim and Ditep (2022) who found a positive and significant relationship between literacy level and health indicator (life expectancy).

Table 6: Results of the Residual Diagnostic test for life expectancy

	Probability
Breusch- Godfrey serial correlation LM test	0.325
Normality test	0.9397
Heteroskedasticity using ARCH	0.4789
Cusum and Cusumsq	Stable

Source: Computed by the Authors

The model has the correct specification, the diagnostics tests revealed that the series are normally distributed and there is an absence of serial correlation or Heteroskedasticity among the residuals, as evidenced by the non-significant probability statistics of the tests. Thus, the model can be relied on for the formulation of policy and future forecasting on the issues related to income inequality and health outcomes in Nigeria.



The plots of CUSUM and CUSUMSQ statistics stay within the critical bound. This implies that the estimated model is stable.

The Toda-Yamamoto (TY) Causality test is employed to examine the causal relationship between health outcomes (life expectancy) and income inequality.

The first step in TY approach entails estimating the maximum order of integration (d_{max}) within the system. The unit root analysis presented in Table 3 indicate that the order of integration is I (0) and I (1). After determining the maximum order of integration, the next step necessitates the determination of the optimal lag length. The optimal lag length was selected based on different lag length criteria such as Akaike's Information Criteria (AIC), Schwarz Information Criteria (SC), Final Prediction Error (FPE), and the Hannan Quinn (HQ) Information Criteria. The results of the different lag length selection criteria are shown in Table 7.

Table 7: VAR Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-511.5284	NA	2.04e+08	33.32441	33.55570	33.39981
1	-348.9233	262.2664	29202.33	24.44666	25.83439	24.89903
2	-268.6807	103.5388*	948.1738*	20.88262*	23.42679*	21.71196*

** indicates lag order selected by the criterion*
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

As illustrated in Table 7, the lag length determined by various selection criteria suggests a lag length of 2. The results of the Causality tests based on the Toda Yamamota estimated by the modified WALD test are presented in Table 8. The findings indicate that the test adheres to the chi-square distribution characterized by 2 degrees of freedom which is consistent with the established lag length.

Table 8: Toda –Yamamoto Causality (modified WALD) Test Results

Cause	Effect	Chi squares	Prob	Decisions	Remarks
LEX	GINI	6.75	0.0343	Reject $\boldsymbol{H_0}$	Unidirectional Causality
GINI	LEX	2.96	0.2274	Do not reject$\boldsymbol{H_0}$	

Source: Computed by the Authors

The Toda Yamamoto result revealed a unidirectional causality running from life expectancy to income inequality. That is, life expectancy at birth gives rise to income inequality and not the other way around.

5 CONCLUSION AND POLICY RECOMMENDATIONS

Income inequality is an impediment to improvement in life expectancy at birth in Nigeria. Therefore, the study affirms the income inequality health-hypothesis that, lower income inequality is associated with improved health conditions. In addition to income inequality, another driver of health outcomes in Nigeria is government health expenditure. A unidirectional causality is observed, flowing from health outcomes to income inequality in Nigeria.

Based on the empirical findings of the study, efforts to reduce income differentials among individuals should be pursued by policymakers. For instance, broadening the spread of the ongoing conditional cash transfer as well as promoting other policies that can raise income such as entrepreneurship, farming and pensions. There is a need for government to provide access to high-quality healthcare services, which is necessary for closing the deficit gap in health outcomes related to life expectancy.

There are possibilities for future research on the relationship of income inequality and health outcomes in Nigeria. The study is by no means an exhaustive treatment of the impact of income inequality on health outcomes in Nigeria, but would serve as a prelude for promoting further insight into the study. Income inequality may vary across regions, with some rural areas facing unique challenges. Even with increased income, healthcare service may be unavailable or of poor quality in certain areas because of limited access to health infrastructure. Future study should examine the relationship between income inequality and health outcomes among rural and urban sample.

REFERENCES

Akintunde, T. S., & Olaniran, O. D. (2020). Financial development, public health expenditure and health outcomes: evidence from Nigeria. *Journal of Economics and Allied Research*, 7(1), 13-24.

Baba, S. S. A. (2023). The crucial role of research midwives: significance and implementation. *Medalion journal: Medical Research, Nursing, Health and Midwife Participation*, *4*(3), 88-93. https://doi.org/10.59733/medalion.v4i3.79

Blanco, I., Diego, I., Bueno, P., Casas-Maldonado, F., & Miravitlles, M. (2019). Geographic distribution of COPD prevalence in the world displayed by Geographic Information System maps. *European Respiratory Journal*, *54*(1), 190-610 https://doi/10.1183/13993003.00610-2019

Blau, F. D., & Kahn, L. M. (2020). The gender pay gap: Have women gone as far as they can? In Inequality *in the United States*, 345-362, Routledge. https://www.taylorfrancis.com/chapters/edit/10.4324/9781003071709-31/

Bor, J., Cohen, G. H., & Galea, S. (2017). Population health in an era of rising income inequality: USA, 1980–2015. *The Lancet*, *389*(10077), 1475-1490. https://doi.org/10.1016/S0140-6736(17)30571-8

Brownson, R. C., Baker, E. A., Deshpande, A. D., & Gillespie, K. N. (2017). *Evidence-based public health*. (3rd ed) Oxford university press.

CBN (2023). Central Bank of Nigeria, Statistic Bulletin, Abuja.

Chancel, L., Cogneau, D., Gethin, A., Myczkowski, A., & Robilliard, A. S. (2023). Income inequality in Africa, 1990–2019: Measurement, patterns, determinants. *World Development*, *163*(1), 106-162. https://doi.org/10.1016/j.worlddev.2022.106162

Chukwudozie, A. (2015). Inequalities in health: the role of health insurance in Nigeria. *Journal of Public Health in Africa*, *6*(1), 2829-9138 https://doi.org/10.4081%2Fjphia.2015.512

Dobuzinskis, L. (2023). *Economic Growth and Inequality: The Economists' Dilemma*. Taylor & Francis.

Edeme, R. K., Emecheta, C., & Omeje, M. O. (2017). Public health expenditure and health outcomes in Nigeria. American Journal of Biomedical and Life Sciences, 5(5), 96-102.doi: 10.11648/j.ajbls.20170505.13

Esseau-Thomas, C., Galarraga, O. & Khalifa, S. (2022). Epidemics, pandemics and income inequality. *Health Economics Review* 12*(7),* 1-22. https://doi.org/10.1186/s13561-022-00355-1

Fatukasi, A. A., & Ayeomoni, I. O. (2015). Effect of Income Inequality on Health Indicators in Nigeria (1980-2014). *International Journal of Academic Research in Business and Social Sciences, 5*(8), 274-285. http:// doi:10.6007/IJARBSS/v5-i8/178

Galvin, A. E., Friedman, D. B., & Hébert, J. R. (2021). Focus on disability-free life expectancy: implications for health-related quality of life. *Quality of Life Research, 30*(8), 2187-2195. https://doi.org/10.1007/s11136-021-02809-1

Hayward, G., & Ayeb-Karlsson, S. (2021). 'Seeing with Empty Eyes': a systems approach to understand climate change and mental health in Bangladesh. *Climatic Change, 165*(29), 1-30. https://doi.org/10.1007/s10584-021-03053-9

Ibrahim, I., & Abdulazeez, A. (2021). The role of machine learning algorithms for diagnosing diseases. *Journal of Applied Science and Technology Trends, 2*(01), 10-19. https://doi.org/10.38094/jastt20179

Ibrahim, T. M., & Ditep, N. R. (2022). The impact of public health expenditure on health indicators in Nigeria. *Journal of Economics and Allied Research*, 7(1), 25–34. Retrieved from https://jearecons.com/index.php/jearecons/article/view/111

Ibukun, C. O. (2021). The role of governance in the health expenditure–health outcomes nexus: insights from West Africa. *International Journal of Social Economics, 48*(4), 557-570. https://doi.org/10.1108/IJSE-06-2020-0404

Matthew, P. and Brodersen, D. M. (2018). Income inequality and health outcomes in the United States. *The Social Science Journal*, 55(4), 432-442. https://doi.org/10.1016/j.soscij.2018.05.001

Momoh, O. A., Ajibola, J. O., & Onakoya, A. B., (2024). Life expectancy in sub-Saharan African Countries: does economic welfare matter? *Journal of Economics and Allied Research 9*(1), 2536-7447.

Momoh, O. A & Okwu, A. T, (2022). Income and health outcomes in the Anglophone West African Countries: a dynamic heterogeneous approach. *Journal of Economics and Allied Research 7*(1), 2536-7447.

Nahian, M. A. (2023). Public health impact and health system preparedness within a changing climate in Bangladesh: A scoping review. *Challenges, 14*(1), 4. https://doi.org/10.3390/challe14010004

Neumayer, E., & Plümper, T. (2016). Inequalities of income and inequalities of longevity: a cross-country study. *American Journal of Public Health, 106*(1), 160-165. http://doi: 10.2105/AJPH.2015.302849

Obute, M. A. (2021). Socio-Economic Challenges of Sustainable Development in Nigeria and the Need for Human Development, Social Inclusion and Government Policies/Programs in Actualizing Sustainable Development Goals by the Year. *Journal of Humanities and Social Science, 26 (11)*, 2279-0845.

Odusanya, I. A., & Agboola, B. (2017). Income, income inequality and health: Evidence from Nigeria. *Izvestiya Journal of Varna University of Economics, 61*(4), 345-361. https://www.ceeol.com/search/article-detail?id=618728

Ogu, C. (2023). Health inequality and economic growth in Nigeria. *African Journal of Social and Behavioral Sciences, 13*(2). https://journals.aphriapub.com/index.php/AJSBS/article/view/2378

Omotola, A.M. & Kabir, K.S. (2015). Assessing Income Inequality in North-Eastern Nigeria. *Journal of Poverty, Investment and Development, 16*(1), 33-39

Orekoya, O. S. (2022). Income Inequality, Health Expenditure and Outcomes in Nigeria. *African Journal of Sustainable Development, 7*(2), 115-139.

Pasqualini, M., Lanari, D., Minelli, L., Pieroni, L., & Salmasi, L. (2017). Health and income inequalities in Europe: What is the role of circumstances? *Economics & Human Biology*, *26*(1), 164-173. http://dx.doi.org/10.1016/j.ehb.2017.04.002

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289-326. https://doi.org/10.1002/jae.616

Pickett, K. E., & Wilkinson, R. G. (2015). Income inequality and health: a causal review. *Social Science & Medicine*, *128*(1), 316-326. https://doi.org/10.1016/j.socscimed.2014.12.031

Razavi, S., Behrendt, C., Bierbaum, M., Orton, I., & Tessier, L. (2020). Reinvigorating the social contract and strengthening social cohesion: Social protection responses to COVID-19. *International Social Security Review*, *73*(3), 55-80. https://doi.org/10.1111/issr.12245

Rebeira, M., Grootendorst, P., Coyte, P. C., & Aguirregabiria, V. (2017). Does rising income inequality affect mortality rates in advanced economies? *Economics*, *11*(1), 2017-0016. https://doi.org/10.5018/economics-ejournal.ja.2017-16

Safiri, S., Mahmoodpoor, A., Kolahi, A. A., Nejadghaderi, S. A., Mansournia, M. A., & Collins, G. S. (2023). Global burden of lower respiratory infections during the last three decades. *Frontiers in Public Health*, *10*(1), 1028-525. https://doi.org/10.3389/fpubh.2022.1028525

Sanders, D. (2023). *The struggle for health: medicine and the politics of underdevelopment*. Oxford University Press.

Udoh, I. E., Effiong, U. E., & Ekpe, J. P. (2022). Globalization and Income Inequality in Nigeria. *International Journal of Management, Accounting & Economics*, *9*(12), 821-846. http://dx.doi.org/10.5281/zenodo.7558266

United Nation (2023). World Income Inequality, Database.

Vilda, D., Wallace, M., Dyer, L., Harville, E., & Theall, K. (2019). Income inequality and racial disparities in pregnancy-related mortality in the US. *SSM-population health*, *9*(1), 100-477. https://doi.org/10.1016/j.ssmph.2019.100477

Wilkinson, R.G. (1992). Income Distribution and Life Expectancy. *British Medical Journal*. *304*(6820), 165-168 http:// doi: 10.1136/bmj.304.6820.165

World Bank, (2022). The World Bank Annual Report 2022.Washington, D.C. *World Bank*. https://openknowledge.worldbank.org/handle/10986/20093

World Health Organization. (2023). *Global oral health status report: towards universal health coverage for oral health by 2030. Regional summary of the African Region*. World Health Organization.