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Impact of Human Capital and Income Inequality on Life Expectancy in Nigeria

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Abstract

The study examines the impact of human capital and income inequality on life expectancy in Nigeria from 1985 to 2023, utilising secondary data from the World Development Indicators and employing the Autoregressive Distributed Lag (ARDL) model. Evidence reveal that income inequality exerts a significant negative long-run effect on life expectancy, while human capital shows a robust positive impact. Critically, cointegration among variables is validated through bounds testing, and diagnostic checks confirm model robustness. The study recommends that sustainable improvements in Nigeria's life expectancy require integrated policies prioritising equitable wealth distribution alongside strategic investments in education and healthcare infrastructure to enhance human capital, offering policymakers evidence-based pathways to bridge health disparities and advance socio-economic development.

Keyword: *Human Capital, Income Inequality, and Life Expectancy*

1. Introduction

The relationship between human capital development, income inequality, and life expectancy has attracted considerable attention in the development and health economics literature. Human capital, captured through investments in education, health, and skills, plays a central role in improving population well-being and supporting long-term socio-economic progress. Countries with higher levels of human capital typically record better health outcomes and longer life expectancy because educated populations are more likely to adopt healthy behaviours, access healthcare services, and earn higher incomes, thereby improving living standards. Empirical studies have consistently shown that investments in education and healthcare significantly enhance life expectancy and overall quality of life (Castelló-Climent & Doménech, 2008; Guzel et al., 2021). In contrast, income inequality remains a major constraint on health outcomes. High inequality often leads to uneven access to essential services such as healthcare, nutrition, sanitation, and education, thereby widening health disparities and reducing average life



expectancy. Evidence indicates that societies with more equitable income distribution tend to achieve higher life expectancy and better public health outcomes (Deaton, 2013; Freeman et al., 2020; Wilkinson & Pickett, 2013). The experience of low-inequality countries, particularly in Scandinavia, demonstrates how inclusive social policies and broad access to public services contribute to superior health indicators.

In the African context, human capital formation has been identified as a key determinant of life expectancy. Improvements in educational attainment, healthcare infrastructure, and public health expenditure have been associated with longer life spans and better health outcomes across the region (Adeleye, 2023; SenGupta, 2024). However, high levels of income inequality continue to undermine these gains by limiting access to quality healthcare and education for large segments of the population. Nigeria presents a compelling case for examining these relationships. Despite modest improvements in life expectancy from about 43 years in 1980 to approximately 55.7 years in recent years, the country still lags behind the Sub-Saharan African average and global benchmarks (WHO, 2023; World Bank, 2022). At the same time, human capital indicators remain relatively weak, with slow growth in tertiary enrolment and persistent gaps in healthcare access. Nigeria also faces high and rising income inequality, which further constrains improvements in population health and longevity. Existing empirical studies in Nigeria highlight the importance of socio-economic factors, such as education, healthcare expenditure, and income distribution, in shaping life expectancy outcomes (Ogunleye, 2014). However, there remains limited long-run evidence that jointly examines the roles of human capital and income inequality in determining life expectancy. Addressing this gap is essential for designing integrated policies that improve health outcomes while promoting inclusive development.

Against this background, this study investigates the impact of human capital and income inequality on life expectancy in Nigeria over the period 1985–2023. By utilising an ARDL framework, the study provides empirical evidence on the influence of investments in human capital and changes in income distribution on growth.

2. Empirical Review

2.1 Human capital and life expectancy

Ali (2022) examined the links among human capital development, poverty, and income inequality in Nigeria from 1985 to 2020 using an Error-Correction Model. Findings show that human capital investment positively impacts poverty reduction in both the short and long term, but its long-term effect on income inequality is negative, indicating it alone cannot address inequality. The adjustment rate from short-term to long-term equilibrium is slow at 1.2% annually, reflecting the persistent nature of these challenges. The study recommends increased funding for education and health, empowerment programs for skill acquisition, and targeted policies such as progressive taxation and social safety nets to complement human capital investments. Similarly, Adeleke and Ehinomen (2022) analysed the relationship between human capital development and income inequality in Nigeria from 1990 to 2020 using a Vector Error Correction Model. They found that education and health investments significantly reduce inequality in both the short and long term,



with the long-term effect being more pronounced. Granger causality tests revealed a bidirectional relationship, indicating mutual influence between human capital development and income inequality. The study recommends improving access to quality education, increasing healthcare funding, and implementing vocational training programs to enhance employability and promote a more equitable income distribution.

Ogunbadejo and Kanwanye (2020) assessed the effects of life expectancy and schooling on Nigeria's economic growth from 1970 to 2017 using a Two-Stage Least Squares approach. They found that longer life expectancy and higher secondary and tertiary school enrollments significantly boost economic growth, while primary school enrollment and average years of schooling have no significant effect. The study suggests prioritising health sector funding to improve life expectancy, focusing on secondary and tertiary education to build a skilled workforce, and maintaining quality in primary education alongside higher education development. Similarly, Ogundari and Awotuse (2018) analysed the role of education and health in driving Nigeria's economic growth from 1980 to 2015 using the Generalised Method of Moments. They found that education expenditure has a strong positive effect on growth, while health expenditure also contributes positively, but to a lesser extent. Higher labour force participation further boosts growth, emphasising the need for both investment in human capital and active workforce engagement. The study recommends increased funding for education, improved access to healthcare, and policies that encourage greater labour force participation, particularly among women and youth.

Furthermore, Olaoye (2022) examined the impact of human capital on sustainable development in Nigeria from 1981 to 2017, utilising an Error Correction Mechanism. Evidence indicates that life expectancy and secondary school enrollment positively influence GDP, while lagged primary and tertiary enrollments, as well as current and past health expenditures, negatively affect GDP, suggesting inefficiencies in these areas. Capital stock positively impacts growth. The study recommends increasing and better managing funding for primary and tertiary education, boosting health sector investment, and ensuring efficient resource allocation to maximise human capital's contribution to sustainable development. Also, Praise and George-Anokwuru (2018) analysed determinants of human capital formation in Nigeria from 1981 to 2017 using a Three-Stage OLS approach. Evidence suggests a bidirectional positive link between health expenditure and economic growth, with higher health spending associated with reduced mortality. In contrast, education expenditure showed a bidirectional negative relationship with growth, suggesting inefficiencies despite increased funding. Enrollment rates positively influenced education spending. The study recommends increasing health funding to strengthen human capital and ensuring transparent, effective use of education funds to improve outcomes and support economic growth.

2.2 Income Inequality and Life Expectancy

Hill and Jorgenson (2018) analysed state-level data from 2000 to 2010 to examine the link between income inequality and life expectancy in the U.S., using two-way fixed effects models across all 50 states and D.C. They found a robust inverse relationship for both males and females, consistent across four measures of inequality, including the Gini coefficient and 90/10 income ratio. The



study recommends reducing inequality through policies like progressive taxation and social welfare programs to improve life expectancy. Similarly, Luo and Xie (2020) examined the effects of economic growth and rising income inequality on life expectancy in China from 2000 to 2010 using two-way fixed effects models. They found a strong inverse relationship between income inequality and life expectancy for both genders, consistent across multiple inequality measures, including the Gini coefficient and the 90/10 income ratio. The study concludes that reducing inequality through policies like progressive taxation and social welfare can improve population health and extend life expectancy.

Also, Bronnum-Hansen, Foverskov, and Andersen (2021) used Danish nationwide register and SHARE survey data to examine how income inequality affects life expectancy and disability-free life expectancy (DFLE). They found a steep social gradient, with men and women in the highest income quartile living 8.0 and 5.0 years longer, respectively, than those in the lowest, and enjoying 11.8 and 10.3 more DFLE years. Differences were driven by both mortality and disability effects, with disability contributing more. The study urges policies to address these disparities, such as adjusting pensions for socioeconomic differences and improving financial security for those with health issues. Similarly, Blázquez-Fernández et al. (2018) analysed data from 26 European countries (1995–2014) using fixed effects models to examine the link between rising income inequality and life expectancy. They found no significant negative impact of inequality on life expectancy, a result consistent across country clusters by income level and welfare regime. While challenging the view that inequality directly harms longevity in developed societies, the study cautions that it may still affect health in other ways and urges policymakers to address its broader health implications through effective healthcare policies.

3. Methodology

3.1 Model Specification

Following the study's theoretical and empirical structure, life expectancy at birth is specified as a function of human capital development, income inequality, and selected macroeconomic control variables. The functional relationship is expressed as:

$$LEB_t = f(HCD_t, IE_t, INF_t, TO_t)$$

The linear econometric model is specified as:

$$LEB_t = \beta_0 + \beta_1 HCD_t + \beta_2 IE_t + \beta_3 INF_t + \beta_4 TO_t + \mu_t$$

where life expectancy at birth (LEB) represents the dependent variable, human capital development (HCD) captures the level of education and health outcomes, and income inequality (IE) reflects the distribution of income, inflation (INF) controls for macroeconomic stability and trade openness (TO) accounts for external sector dynamics. where β_0 is the intercept, β_1 – β_4 are the long-run parameters, and μ_t is the stochastic error term.



3.2 Unit Root Test

The study conducted unit root tests prior to model estimation. Verifying the stationarity using the **Augmented Dickey–Fuller (ADF)** unit root test. These tests are widely used in empirical macroeconomic studies and are appropriate for determining the order of integration of time-series variables. The ADF test extends the simple Dickey–Fuller procedure by incorporating lagged differences of the dependent variable to control for serial correlation in the error term. The general ADF regression equation is expressed as:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^p \delta_i \Delta Y_{t-i} + \varepsilon_t$$

where Δ denotes the first difference operator, t represents a time trend, and p is the number of lagged difference terms included to ensure white-noise residuals. The null hypothesis of the ADF test states that the series contains a unit root ($\gamma = 0$), implying non-stationarity, while the alternative hypothesis indicates stationarity ($\gamma < 0$).

3.3 Autoregressive Distributed Lag Technique (ARDL)

Due to the mixed order of integration, the ARDL technique is employed. The general ARDL (p, q_1, q_2, q_3, q_4). The model is specified as:

$$\begin{aligned} \Delta LEB_t = & \alpha_0 + \sum_{i=1}^p \alpha_1 \Delta LEB_{t-i} + \sum_{i=0}^{q_1} \alpha_2 \Delta HCD_{t-i} + \sum_{i=0}^{q_2} \alpha_3 \Delta IE_{t-i} \\ & + \sum_{i=0}^{q_3} \alpha_4 \Delta INF_{t-i} + \sum_{i=0}^{q_4} \alpha_5 \Delta TO_{t-i} + \lambda_1 LEB_{t-1} + \lambda_2 HCD_{t-1} + \lambda_3 IE_{t-1} \\ & + \lambda_4 INF_{t-1} + \lambda_5 TO_{t-1} + \varepsilon_t \end{aligned}$$

where Δ denotes first difference, the α parameters capture short-run dynamics, and the λ Coefficients represent the long-run relationship. Error Correction Representation, once cointegration is established, the error correction model (ECM) is derived as:

$$\begin{aligned} \Delta LEB_t = & \gamma_0 + \sum_{i=1}^p \gamma_1 \Delta LEB_{t-i} + \sum_{i=0}^{q_1} \gamma_2 \Delta HCD_{t-i} + \sum_{i=0}^{q_2} \gamma_3 \Delta IE_{t-i} \\ & + \sum_{i=0}^{q_3} \gamma_4 \Delta INF_{t-i} + \sum_{i=0}^{q_4} \gamma_5 \Delta TO_{t-i} + \phi ECM_{t-1} + \varepsilon_t \end{aligned}$$

where ECM_{t-1} is the lagged error correction term and ϕ measures the speed of adjustment toward the long-run equilibrium. A negative ϕ , confirms cointegration and indicates convergence to the long-run equilibrium. This specification enables the estimation of both short-run and long-run



effects of human capital development and income inequality on life expectancy while controlling for macroeconomic conditions.

4. Estimation Results

4.1 Descriptive Statistics

The descriptive summary provides an overview of the variables' central tendency, dispersion, and range.

Table 1

Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max	Obs
LEB	49.29568	3.025041	45.483	54.462	37
IE	0.399224	0.054193	0.336237	0.519223	38
HCD	0.470184	0.064322	0.367	0.563	38
INF	20.28852	17.09509	5.388008	72.8355	38
TO	38.1423	11.61323	12.63415	65.72316	38

Source: Author's computation 2025.

As observed in Table 1. Life Expectancy at Birth (LEB) has a mean value of 49.30 years with a relatively low standard deviation of 3.03, indicating that life expectancy values are clustered closely around the mean, ranging from 45.48 to 54.46 years. Income Equality (IE) has an average of 0.399 with a standard deviation of 0.054, indicating limited variability and a range of 0.336 to 0.519, suggesting a relatively consistent level of income equality across observations. The Human Development Index (HDI) averages 0.470 with a moderate standard deviation of 0.064 and ranges from 0.367 to 0.563, reflecting moderate differences across development indicators. Inflation Rate (INF) shows the highest variability, with a mean of 20.29, a standard deviation of 17.10, and a wide range between 5.39 and 72.83, indicating substantial fluctuations in price stability over the period. Finally, Trade Openness (TO) has a mean of 38.14, a standard deviation of 11.61, and values ranging from 12.63 to 65.72, suggesting substantial variation in the degree of economic openness across observations.

4.2 Correlation Analysis

The correlation results show varying degrees and directions of association among the variables.

Table 2

Correlation Results

Variable	IE	HCD	INF	TO
IE	1			
HCD	-0.8092	1		
INF	0.4014	-0.4334	1	
TO	-0.0944	0.3809	-0.1476	1

Source: Author's computation 2025.

Income Equality (IE) has a strong negative correlation with Human Capital Development (HCD) (-0.8092), suggesting that as income equality improves, HCD tends to decline, or vice versa, possibly reflecting structural inequalities in resource distribution. IE shows a moderate positive



correlation with Inflation (INF) (0.4014), suggesting that higher inflation may be associated with greater income equality in the short term, perhaps due to wage adjustments or redistribution effects. The relationship between IE and Trade Openness (TO) is weak and negative (-0.0944), suggesting little linear association. HCD has a moderate negative correlation with INF (-0.4334), suggesting inflationary pressures could undermine investments in human capital. It shows a moderate positive correlation with TO (0.3809), suggesting that greater trade openness may support human capital development, possibly by enabling access to resources, skills, and technology. Finally, INF and TO have a weak negative correlation (-0.1476), suggesting minimal direct interaction between inflationary trends and trade openness.

4.3 Unit Root Test

The Augmented Dickey-Fuller (ADF) unit root test results indicate the stationarity properties of the study variables.

Table 3

Augmented Dickey-Fuller Unit Root Test

Variable	Level Zt-bar	First Difference Zt-bar	Order of Integration 0 or 1
LEB	-3.915563**	-5.0879***	I(0)
IE	-3.434458*	-3.528610**	I(0)
HDI	-1.091970	-3.575029**	I(1)
INF	-11.4777***	-2.3224**	I(0)
TO	-2.252435	-6.379257***	I(1)

Source: Author's computation 2025.

The variable LEB is stationary, with a Zt-bar statistic of -3.915563, significant at level. Similarly, Income Equality (IE) is also stationary at level. Also, the variable The Inflation Rate (INF) is stationary at level. However, the variables Human Development Index (HDI) and trade openness (TO) are stationary at the first difference. These results show a mixture of I(0) and I(1) variables, making the dataset suitable for the ARDL technique.

4.4 ARDL Bound Test

Table 4

ARDL Bounds Test result

F-statistic	7.640866	
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.50%	3.25	4.49
1%	3.74	5.06

Source: Author's computation 2025.

The ARDL Bounds Test result shows an F-statistic of 7.6409, which is well above the upper bound critical values (I1 Bound) at all significance levels: 3.52 at 10%, 4.01 at 5%, 4.49 at 2.5%, and 5.06 at 1%. This indicates strong evidence of a long-run association in the model.



4.5 ARDL Short-run Estimation Coefficients

Table 5: ARDL Short-run Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IE)	-12.888254	3.360627	-3.835075	0.0007
D(HCD)	12.939866	2.508080	5.159272	0.0000
D(INF)	0.005310	0.001507	3.522983	0.0015
D(TO)	0.006458	0.002014	3.207087	0.0033
CointEq(-1)	-0.314099	0.062495	-5.025974	0.0000

Source: Author's computation 2025.

As observed in Table 5. The estimation result of IE suggests a negative and significant coefficient. This means a one-unit increase in income inequality leads to a decrease of approximately 12.89 per cent in life expectancy. This implies that Inequality reduces access to quality healthcare, nutrition, and education for large segments of the population, thereby worsening health outcomes. Similarly, the HCD result indicates a positive, significant effect at the 1 per cent level. An increase in human capital development through better education, skills, or health services leads to a 12.94 per cent rise in life expectancy in the short run. This result highlights human capital as a powerful policy lever for improving public health outcomes. It also reflects the synergy between education and health; better-educated individuals often make healthier lifestyle choices and access care more efficiently.

In addition, the INF result shows a positive and significant effect at the 1% level. Surprisingly, inflation shows a small but positive short-run effect on life expectancy. A 1-unit increase in inflation is associated with a 0.0053-year increase in life expectancy. Similarly, the TO estimation results suggest a significant and positive association. This means that a 1-unit increase in trade openness (e.g., as a percentage of GDP) is associated with a 0.0065-year increase in life expectancy in the short run. Increased trade openness may enhance access to medicine, health technologies, and nutritious food imports, while also boosting economic efficiency and employment. The error-correction term is negative and statistically significant, confirming the existence of a long-run equilibrium relationship between life expectancy and the independent variables.

4.6 ARDL Long-run Estimation Coefficient

Table 6: ARDL Long-run Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IE	-15.156011	2.335817	-6.488525	0.0000
HCD	41.196729	1.927877	21.368959	0.0000
INF	0.024540	0.008182	2.999162	0.0056
TO	0.020561	0.006431	3.197223	0.0034
C	35.300801	1.641079	21.510722	0.0000

Heteroskedasticity Test

0.7437

Breusch-Godfrey Serial

0.9872

Source: Author's computation 2025.



The estimation results for IE indicate a significant and negative coefficient. In the long run, a one-unit increase in income inequality reduces life expectancy by approximately 15.16 per cent. This aligns with global findings that unequal income distribution worsens health outcomes by reducing access to education, healthcare, nutrition, and housing among lower-income groups. This implies that long-term improvements in life expectancy require deliberate efforts to reduce inequality through inclusive education, progressive taxation, health subsidies, and job creation for marginalised groups. The result supports Pickett and Wilkinson (2015) and Ogbuabor and Malaolu (2022), who found a negative association between income inequality and life expectancy. Similarly, HCD indicates a positive and significant coefficient. This means that a one-unit increase in human capital development results in a 41.2 per cent increase in life expectancy in the long run. This coefficient is very large and significant, emphasising that investments in human capital (especially education and healthcare) are central to improving longevity. This implies that sustainable improvements in life expectancy must be grounded in long-term investments in education, primary healthcare access, and skills development. The result is consistent with Odubunmi et al. (2021) and Barro and Lee (2013), who all reported a positive impact of human capital on life expectancy.

Furthermore, the INF coefficient is positive and significant. In the long run, a one-unit rise in inflation leads to a 0.025 per cent increase in life expectancy. This counterintuitive result may suggest that mild and stable inflation reflects an active economy with increased fiscal spending and wage growth, which, in turn, could indirectly improve access to health care. The result supports Goryakin et al. (2017). Similarly, the TO result indicates a positive, significant coefficient at the 1% level. This means that A one-unit increase in trade openness raises life expectancy by about 0.021 per cent in the long run.

5. Conclusion

This study analysed the effects of human capital development and income inequality on life expectancy in Nigeria from 1985 to 2023 using the ARDL framework. The results confirm the existence of a long-run relationship among the variables. Human capital development has a significant positive impact on life expectancy, while income inequality exerts a significant negative effect, indicating that unequal income distribution constrains access to health-enhancing resources. Macroeconomic stability and trade openness also contribute positively to life expectancy in the long run. The error-correction term indicates a stable adjustment toward equilibrium following short-run shocks. Overall, the findings suggest that improving life expectancy in Nigeria requires sustained investment in education and healthcare alongside policies that reduce income inequality and promote inclusive access to social services.



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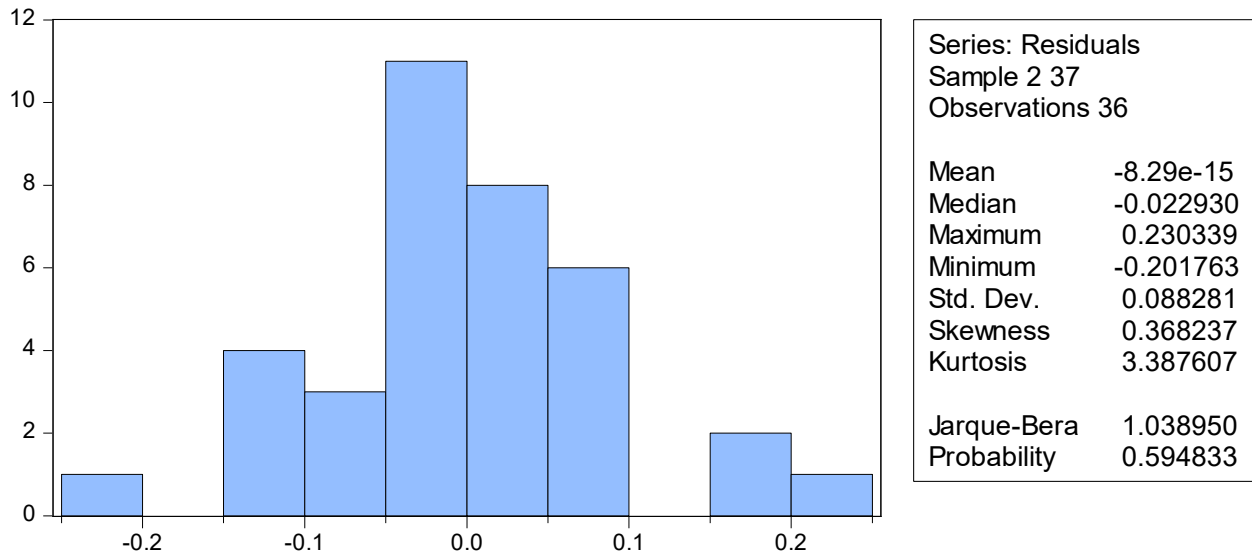
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Appendix

Normality Test



Stability Test

The study assesses model stability using the CUSUM and CUSUMSQ tests. The CUSUM stability line should lie within the line bounds; then we say the model is stable at the 5 per cent level.

