Healthcare Inflation and Life Expectancy in Nigeria: The Moderating Role of GDP Growth

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Abstract

This study investigated healthcare inflation and life expectancy in Nigeria focusing on the moderating role of GDP per capita growth within a macroeconomic framework. This study used Autoregressive Distributed Lag (ARDL) technique and covers from 1985 to 2023. The short-run dynamics reveal that life expectancy is highly persistent, with past values exerting a dominant influence on current outcomes. Healthcare inflation exerts a delayed but negative effect on life expectancy. The health expenditure improves life expectancy only after a lag. GDP per capita growth shows weak and inconsistent short-run effects. However, the moderating variable becomes significant in the lagged period. The long-run results confirm a stable equilibrium relationship between life expectancy and its determinants. In the long-run, healthcare inflation has a negative and statistically significant effect on the life expectancy while the moderating variable has a negative but statistically insignificant effect. The interaction variable and healthcare expenditure have positive and statistically significant effects on the life expectancy. Hence the significant of interaction variable in the long-run confirms that the GDP per capita growth serves as a strong moderator in the relationship. To strengthen life expectancy outcomes, government must curb healthcare inflation, expand public health investment, and ensure equitable income distribution.

Keywords*: Healthcare Inflation, Life expectancy, GDP per capita Growth, Health Expenditure*

JEL Classification: *I10, I12, I15, E31, O47, C22*

1. Introduction

Healthcare sector in Nigeria is bedeviled with persistent healthcare inflation (Vincent, et al., 2023). This places significant pressure on households and the government. Out-of-pocket expenditure accounts for over 70% of total healthcare expenditure as a result of rising costs of medical services, pharmaceuticals, and hospital care (World Bank Group, 2023). Consequently, the access and affordability to essential health services especially among low-income earners is constrained (World Bank Group, 2023).

Globally, life expectancy of men and women are 76.1 years and 70.7 years respectively (World Health Organisation, 2025). Thus women live longer than men as the global average stands at 73.4 years (World Health Organisation, 2025). In Africa, Chad and the Central African Republic have life expectancy of 55.2 years and 57.7 years respectively; while Algeria and Mauritius post life expectancy exceeding 76 years (World Health Organization, 2025). The continent's life expectancy is 64.2 years (World Health Organisation, 2025). Comparatively, Nigeria continues to be ranked among Africa's poorest in terms of health metrics; females have

life expectancy of 54.9 years, slightly longer than males who have life expectancy of 54.3 years (World Health Organisation, 2025).

This comparative analysis shows significant differences in health outcomes among the countries of the world (Abdulkarim, et al., 2025) . Poor health, education, and living conditions make more than 63% of Nigerians vulnerable (Nnamdi & Ngwu, 2025) . Between 1985 and 2023, Nigeria's life expectancy rose modestly from approximately 46.2 years to 55 years which lags behind many countries with similar economic profiles (World Health Organisation, 2025). Scholars argue that inflationary pressures in healthcare contribute to this significant differences in health outcomes (Ataboh, Oniore, & Aigbedion, 2025).

The sustained and incremental rise in the cost of healthcare services over time and usually measured at the level of the individual or household defines healthcare inflation (Rude, 2022). This encompasses the upward trajectory in the prices of medical goods and services such as medications, hospital care, diagnostic procedures, and health insurance premiums (Shameek, Emma, Paul, Cythia, & Krutika, 2024). Unlike general inflation which reflects broad increases in the cost of living; healthcare inflation is sector-specific. This divergence between healthcare costs and general inflation places mounting pressure on both households and governments. As medical expenses rise faster than incomes, families face increasing difficulty in affording essential services, while public budgets struggle to keep pace with the demand for care.

As the naira depreciates, the price of these necessities rises sharply and renders many pharmaceuticals unaffordable for large segments of the population (Business Day, 2021) . Foreign exchange volatility directly translates into higher costs for healthcare delivery as a result of heavy reliance on foreign pharmaceuticals. This creates affordability crisis and is further compounded by soaring costs of healthcare product development and research which makes local production prohibitively expensive and limit the growth of domestic pharmaceutical capacity (CSL Research, 2023).

Over the past four decades, healthcare inflation has been rising excessively compared to other sectors (Ibikunle, Oyerinola, & Tosin-Amos, 2022). The composite consumer price index (CPI) for all goods increased to 31.26% while the rural and urban healthcare inflation increased to 25.9% and 23% respectively (National Bureau of Statistics, 2024) . Despite decades of health sector reforms, Nigeria continues to face significant challenges in relation to life expectancy which remains below the global and Africa's averages (Lawal, Opeloyeru, & Adegbola, 2023) . One critical but underexplored factor which has consistently eroded the affordability of medical services and pharmaceuticals is healthcare inflation (Ibikunle, Oyerinola, & Tosin-Amos, 2022). Rising healthcare costs disproportionately affect vulnerable households (Vincent, et al., 2023).

Studies such as (Ipinnimo, et al., 2023), (Lawal, Osinusi, & Bisiriyu, 2021) and (Zhang, et al., 2025) had investigated how general inflation, economic growth, and government expenditure affect health outcomes. However they have largely overlooked the specific dynamics of healthcare inflation as a distinct macroeconomic variable (Lawal, Osinusi, & Bisiriyu, 2021) . These challenges are made worse and obscure the true economic pressures faced by households and the healthcare system as a result of using general inflation as a proxy for healthcare specific inflation. In the same vein, the moderating role of GDP per capita remains underexplored despite its potential to condition the impact of healthcare inflation. All these put together give partial insight and ignore how these factors interact to shape life expectancy. Therefore, this study is designed to fill these gaps.

2. Literature Review

Several empirical studies have examined the relationship between macroeconomic variables and life expectancy in Nigeria. (Agu, Ogu, & Mgbodichima, 2025) found that government healthcare expenditure was

negatively but insignificantly related to life expectancy; while mortality rate had a significant negative effect and literacy rate has a positive correlation. Other studies expanded the scope by integrating broader economic and institutional factors. (Zhang, et al., 2025) analyzed determinants of life expectancy across 20 high-income countries and found GDP, health expenditure, and education as the most critical predictors with institutional quality also playing a role.(Ogundipe & Anagun, 2024) highlighted that rising unemployment and depreciating exchange rates significantly undermine health outcomes while other variables demonstrated varying degrees of influence. Similarly, (Lawal, Opeloyeru, & Adegbola, 2023) confirmed that economic growth is statistically significant and has a positive effect on the life expectancy while healthcare expenditure showed a weak negative relationship with economic growth.

Inflation and housing dynamics also emerged as important determinants of health. (Bao, Tao, Afzal, & Dördüncü, 2022) found housing rent improved life expectancy but increased infant mortality, while inflation worsened health outcomes. (Ibikunle, Oyerinola, & Tosin-Amos, 2022) showed food price inflation significantly reduced life expectancy and increased child mortality across six African countries. (Lawal, Osinusi, & Bisiriyu, 2021) found no causal link between inflation and life expectancy in Nigeria but identified exchange rate fluctuations as a significant determinant.

Similarly, (Ataboh, Oniore, & Aigbedion, 2025) showed that inflation had an insignificant negative effect, interest rates has a significant negative impact, and unemployment has a negative but insignificant effect. Exchange rates and GDP were found to positively and significantly influence life expectancy. The income-health gradient suggests that higher income levels can buffer households' finance against rising healthcare costs while lower income levels exacerbate vulnerability (Lenhart, 2018). These findings underscore the role of income as a determinant of health through both consumption and insurance channels. In contrast, (Larrimore, 2011) found limited evidence that change in incomes has a significant effect on morbidity among low-income populations.

Rising GDP per capita acts as a buffer. Higher incomes improve access to healthcare, insurance coverage, and preventive services which offsets the negative effects of healthcare inflation and amplifying the benefits of public health investment and equitable income distribution. Some studies show reports of no direct relationship between general inflation and life expectancy that is, macroeconomic price changes may not uniformly translate into health outcomes. However, healthcare-specific inflation differs in its impact. Unlike general prices, rising healthcare inflation directly constrains affordability, access to medical services, insurance coverage, and preventive care. This distinction explains why healthcare inflation may exert measurable effects on life expectancy even when overall inflation does not.

3. Methods and Materials

Grossman, 1972 conceptualized health as a durable capital stock that generates healthy time for both productive labor and leisure. Inputs such as medical care, education, lifestyle, and environmental conditions influence the stock. Healthcare inflation limits individuals' ability to invest in the health capital. Consequently, this forces individuals to make trade-offs between healthcare and other essential needs. The model viewed individuals as a rational actors who strategically allocate resources to maximize lifetime utility (Grossman, 1972) . This is posited to balance the marginal benefits of health investments versus healthcare costs while considering (Ibikunle, Oyerinola, & Tosin-Amos, 2022).

3.1 Data and Econometric Procedure

This study utilizes secondary time-series data from 1985 to 2023. Life expectancy and GDP per capita growth were found from the World Bank Development Indicators (WDI). Healthcare-specific consumer price index data was sourced from the National Bureau of Statistics (NBS). Health expenditure as percentage of GDP

data was from the World Health Organization (WHO) and UNICEF. These international and national datasets provide strong foundation for this study.

Healthcare inflation (HI) is operationalized as the independent variable and measured by the annual percentage change in the Health Consumer Price Index (CPI). The dependent variable is life expectancy (AL) at birth and in years. Health expenditure expressed as percentage of GDP (HE) is introduced as a control variable. (Kang, Chiang, Huangthanapan, & Dowing, 2015) asserted that a moderation analysis requires deliberate identification and integration of a suitable moderating variable (MO. This process involves a critical assessment of literature to determine how potential moderators can meaningfully influence the relationship between healthcare inflation and life expectancy (Kang, Chiang, Huangthanapan, & Dowing, 2015).

Jetter, Laudage, & Stadelmann, 2019 established a strong link between national income levels and life expectancy. Hence, this study integrated GDP per capita growth as a moderating variable. This study therefore employs a moderation model to assess whether the strength and direction of the relationship between healthcare inflation life expectancy depend on the level of GDP per capita growth based on (Baron & Kenny, 1986).

Methodologically, this is achieved through the introduction of an interaction term which is derived by multiplying the mean-centered values of healthcare inflation and GDP per capita growth. The process of mean-centering serves a crucial role to reduce the risk of multicollinearity between predictor and moderator variables and at the same time improving precision of the estimates (Namazi & Namazi, 2016).

$$HI_c = HI - \overline{HI} \qquad\qquad 1$$

$$GC_c = GC - \overline{GC} \qquad\qquad 2$$

Multiply the centered HI variable by the centered GC, to create the interaction variable and include it in the ARDL model,

$$IT = IT_c \times GC_c \qquad\qquad 3$$

If the interaction variable (IT) coefficient (φ_l) is statistically significant, it means GDP per capita growth moderates the relationship between healthcare inflation and life expectancy.

This analysis begins with the application of the Augmented Dickey–Fuller (ADF) test to validate the stationarity properties of the time-series data (Gujarati & Porter, 2009). Establishing whether the variables are integrated at levels or at first differences is a critical step. Then the Autoregressive Distributed Lag (ARDL) model is used after the integration characteristics are confirmed as mixed orders of integration (at level and first difference). The ARDL framework is useful in this context because it accommodates variables with mixed orders of integration.

The model for this work is a linear model as stated in Eq. 4.

$$LE_t = a_0 + \theta_i \sum_{i=1}^{a} AL_{t-i} + \beta_j \sum_{j=0}^{b} HI_{t-j} + \delta_k \sum_{k=0}^{c} MO_{t-k} + \varphi_l \sum_{l=0}^{d} IT_{t-l} + \gamma_m \sum_{m=0}^{e} HE_{t-m} + u_t \qquad 4$$

Where:
LE_t = Life expectancy
HI_t = Healthcare inflation
MO_t = GDP per capita growth (moderator)
IT_t = Interaction variable
HE_t = Health expenditure expressed as percentage of GDP
u_t = Error term

4. Results and Discussion
The descriptive statistics in Table 1 reveal a stable but low life expectancy compared against volatile

healthcare inflation and inadequate health expenditure. Moderator remains low and volatile and offers limited resilience against rising healthcare costs. The moderating variable is highly unstable and underscores the need for robust econometric modeling to disentangle its effects.

Table 1: Descriptive Statistics

Statistics	LE	HI	MO	IT	HE
Mean	49.1304	11.4761	1.4927	-1.2746	3.2561
Median	49.1480	11.2860	1.4972	-2.2935	3.18947
Maximum	54.4620	40.8639	12.2104	314.9697	5.0536
Minimum	45.4830	-17.5128	-4.5972	-138.3520	0.3594
Std. Dev	3.03127	10.4957	3.5786	59.3576	0.7747
Skewness	0.1621	-0.4912	0.51674	3.6385	-0.7522
Kurtosis	1.4729	5.3234	3.7167	22.5931	6.8105
Jarque-Bera	3.9606	10.3397	2.5702	709.8719	27.2720
Probability	0.1380	0.0057	0.2766	0.0000	0.000001
Observations	39	39	39	39	39

Source: Author's Computation (2026)

Table 2 contains the results of Augmented Dickey-Filler (ADF) unit roots test which shows that life expectancy (LE), moderator (MO) and the interaction variable (IT) are stationary at level while healthcare inflation (HI) and healthcare expenditure as percentage of GDP (HE) are stationary only after first differencing. This mixture of integration orders confirms that the dataset is suitable for the ARDL model.

Table 2: Augmented Dickey-Fuller (ADF) Unit Root Test

Variable	Exogenous	ADF Test Statistics	Critical Value	Probability	Order of integration
LE	Intercept and Trend	-3.9494	-4.2627(1%) -3.5530(5%) -3.2096(10%)	0.02909	I(0)
HI	None	-12.4027	-2.6308(1%) -1.9504(5%) -1.6112(10%)	0.0000	I(1)
MO	None	-3.9132	-2.6272(1%) -1.9499(5%) -1.6115(10%)	0.0003	I(0)
IT	None	-6.1459	-2.6299(1%) -1.9501(5%) -1.6114(10%)	0.0000	I(0)
HE	Intercept	-2.8657	-3.6156(1%) -2.9411(5%) -2.6091(10%)	0.0589	I(1)

Source: Author's Computation (2026)

Table 3 contains the Life Expectancy (LE) short-run dynamics which reveals strong persistence in life expectancy, with the lagged dependent variable (LE(-1)) exerting a highly significant and positive effect. Healthcare inflation in the present period (HI) is positive but statistically insignificant, while its lagged value (HI(-1)) shows a significant negative effect. The moderating variable (MO) is positive but insignificant, while its lagged value exerts a marginally significant negative effect. The interaction term (IT) is insignificant in the present but significantly positive in the lagged period. Healthcare expenditure (HE) is insignificant in the current period but significantly positive in the previous period. Both the constant and trend terms are significant. The model exhibits an excellent fit (R^2 = 0.9989; Adjusted R^2 = 0.9985), with robust overall significance (F-statistic

= 2594.07, p < 0.001), no evidence of autocorrelation (Durbin-Watson = 1.72), and normally distributed residuals (Jarque-Bera p = 0.80).

Table 3: Life expectancy (LE) Short-Run Dynamics

Variable	Coefficient	Standard Error	t–Statistic	Probability
LE(-1)	0.8765	0.0275	31.8267	0.0000
HI	0.0029	0.0029	0.9852	0.3333
HI(-1)	-0.0107	0.0037	-2.9295	0.0068
MO	0.0120	0.0076	1.5711	0.1278
MO(-1)	-0.0140	0.0075	-1.8704	0.0723
IT	-0.0006	0.0007	-0.8608	0.3967
IT(-1)	0.0029	0.0007	4.3750	0.0002
HE	0.0026	0.0301	0.0879	0.9306
HE(-1)	0.2173	0.0543	3.9978	0.0004
C	4.9686	1.2686	3.9166	0.0006
@TREND	0.0339	0.0078	4.3451	0.0002
R-squared	0.9989			
Adjusted R-squared	0.9985			
F-statistic	2594.07			
Prob. (F-statistic)	0.0000			
Durbin-Watson stat	1.7182			
Jarque-Bera	0.4433			
Probability	0.8012			

Source: Author's Computation (2026)

In Table 4 for F-Bounds test, the computed F-statistic is higher than the upper critical bound values at all significant levels. This finding indicates that the variables are co-integrated. For the t-Bounds Test, the t-statistic is greater than the upper critical bound at 5%. This provides further evidence that the variables are cointegrated and confirmed the existence of a stable long-run equilibrium relationship.

Table 4: Bounds Test for Eq. 4

Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	14.0647	10%	3.374	4.512
K	4	5%	4.036	5.304
		1%	5.606	7.172

t-Bounds Test

Test Statistic	Value	Significance	I(0)	I(1)
t-statistic	-4.4854	10%	-3.13	-4.04
		5%	-3.41	-4.36
		2.5%	-3.65	-4.62
		1%	-3.96	-4.96

Source: Author's Computation (2026)

Table 5 contains Life expectancy (LE) ARDL Long Form for Eq. 4. This reveals that healthcare inflation (HI) has a negative and statistically significant effect on life expectancy, while the moderating variable (MO) is negative but statistically insignificant. The interaction term (IT) exerts a positive and significant effect, and healthcare expenditure (HE) has a positive and statistically significant effect. The error-correction term

(CoinEq(-1)) is negative and highly significant.

Table 5: Life expectancy (LE) ARDL Long Form for Eq. 4

Variable	Coefficient	Standard Error	t–Statistic	Probability
HI	-0.0636	0.0285	-2.2316	0.0341
MO	-0.0163	0.0839	-0.1943	0.8475
IT	0.0183	0.0084	2.1786	0.0389
HE	1.7802	0.6939	2.5655	0.0162
CoinEq(-1)	-0.1235	0.0134	-9.0146	0.0000
EC = LE – (-0.0636*HI–0.0163*MO + 0.0183*IT + 1.7802*HE				

Source: Author's Computation (2026)

Table 6 (Test-Bresch-Pagan-Godfrey – Heteroskedasticity) shows that F-statistic has a p-value far above the significant level of 5%. Therefore, the null hypothesis (homoscedasticity) cannot be rejected. Table 7 (Bresch-Godfrey Serial Correlation LM Test) shows that F-statistic has a p-value well above significant level of 5%. Hence, the null hypothesis of no serial correlation cannot be rejected. Table 8 (Ramsey RESET Test) shows that F-statistic has a p-value well above significant level of 5%. Hence the model is correctly specified.

Table 6: Test-Bresch-Pagan-Godfrey – Heteroskedasticity

F-statistic	0.4533	Prob. F(10,27)	0.9052
Obs*R-squared	5.4624	Prob. Chi-square (10)	0.8582
Scaled explained SS	2.0811	Prob. Chi-square (10)	0.9957

Source: Author's Computation (2026)

Table 7: Bresch-Godfrey Serial Correlation LM Test

F-statistic	0.6244	Prob. F(4,23)	0.6498
Scaled explained SS	3.7222	Prob. Chi-square (4)	0.4449

Source: Author's Computation (2026)

Table 8: Ramsey RESET Test

	Value	Df	Probability
t-statistic	0.6174	26	0.5424
F-statistic	0.3811	(1,26)	0.5424
Likelihood ratio	0.552970	1	0.4571

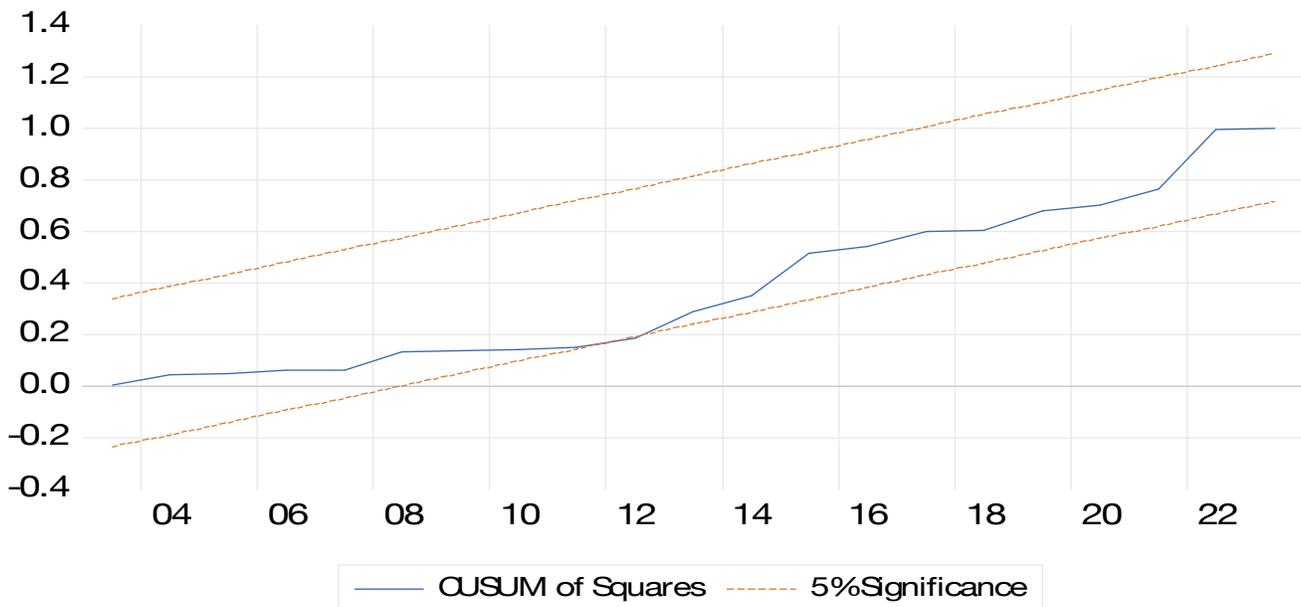*Source: Author's Computation (2026)*

Figure 1: Cumulative Sum (CUSUM) Test
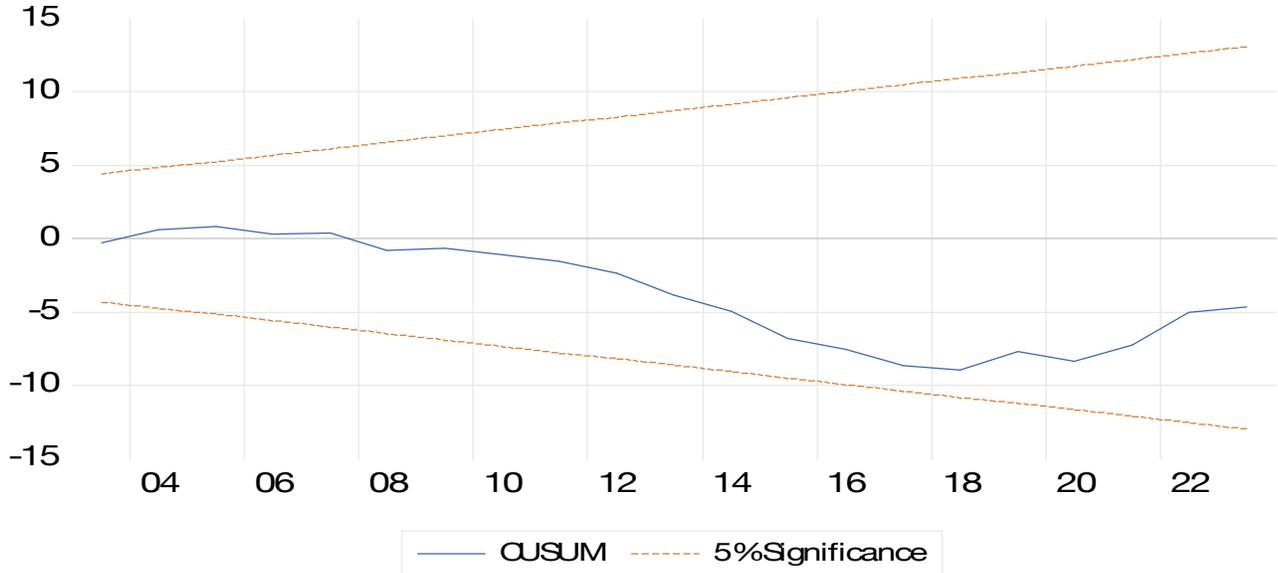
Source: Author's Computation (2026)

Figure 1 show that the CUSUM line remains within the 95% confidence bands and reveals that the estimated parameters are stable over time.

Figure 2: Cumulative Sum of Squares (CUSUMQ) of Recursive Residuals Graph

Source: Author's Computation (2026)

Figure 2 indicates that CUSUMQ line stays within the critical bounds that is, the model is stable and the estimated parameters are reliable over the sample period. This supports the validity of long-run relationship findings from the bounds test.

In the short-run, life expectancy is highly persistent as shown by the significant positive coefficient of its lagged values. This suggests reflects the slow pace of change in health outcome. Healthcare inflation does not

exert a significant immediate effect on life expectancy in the current period. However, its lagged value is negative and statistically significant. This reveals the delayed but harmful impact of healthcare inflation on health outcomes as households and the health system struggle to adjust to rising costs. Moderator is not statistically significant in the current period, and its lagged value is negative and marginally significant. This indicates that short-run income growth does not directly improve life expectancy and may even have destabilizing effects in the following period possibly due to uneven distribution of economic gains or short-run macroeconomic shocks (Lenhart, 2018) . The interaction variable has a positive but statistically insignificant value in the current period but becomes highly significant when lagged. This indicates that the moderating effect of income in the relationship between healthcare inflation and life expectancy is realized over time. Healthcare expenditure as percentage GDP shows no significant instant effect on life expectancy but its lagged value is positive and highly significant. Increase in health spending improve life expectancy over time and reflects the reality that investments in healthcare infrastructure, personnel, and services take time to translate into measurable improvements in population health (Nnamdi & Ngwu, 2025). Both the constant and trend terms are significant and further confirms that life expectancy has been gradually improving over the study period despite the short-run shocks.

In the long-run, healthcare inflation has a negative and statistically significant effect the life expectancy. This means that rising healthcare inflation reduces life expectancy in the long-run. The moderator has a negative but statistically insignificant coefficient that is, economic growth does not directly guarantee improvements in life expectancy in isolation without equitable distribution of income (Larrimore, 2011) . Consequently, it challenges the assumption that economic growth expansion automatically improves population health (Patterson, 2023) . The interaction variable has a positive and statistically significant effect on the life expectancy. This signals the existence of the strong moderating role of GDP per capita growth in the relationship between healthcare inflation and life expectancy. This indicates the importance of inclusive economic growth in strengthening resilience against inflationary shocks in the health sector. Health expenditure expressed as a percentage of GDP exerts a positive and statistically significant effect on life expectancy. This indicates that continuous investment in healthcare infrastructure, personnel, and services contributes meaningfully to long-run improvements in population health. The coefficient error correction term suggests that at least 12 percent of short-run disequilibrium is corrected in each period.

5. Conclusion and Policy Recommendations

The analysis shows that healthcare inflation has a significant negative short-run effect on life expectancy, while healthcare expenditure and interaction effects contribute positively. The moderating variable shows no meaningful influence. The error correction term is negative and highly significant that is, deviations from equilibrium are corrected over time. The interaction variable is statistically significant and has a positive effect on life expectancy. In moderation analysis, the statistically significant of the interaction variable confirms the existence of the moderation. Hence, GDP per capita growth is a strong moderator in the relationship between healthcare inflation and life expectancy.

The findings from this study suggest that government should address the problem of healthcare inflation with utmost priority. Measures such as price regulation, targeted subsidies, long-term investment in healthcare system, insurance coverage, and income buffers are most effective when linked together to create positive synergies that amplify their impact.

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