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Health Expenditure and Infant Mortality in Nigeria

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Abstract: This study examined the impact of public and private health expenditure on infant mortality in Nigeria using annual data from 1986 to 2024. Motivated by persistently high infant mortality despite rising health spending, the study employed Dynamic Ordinary Least Squares (DOLS), alongside Wald and Granger causality tests, to estimate long-run relationships and causal direction. The results show that public health expenditure significantly reduces infant mortality, with a 1% increase associated with a 0.063% decline in infant deaths. Private health expenditure also has a significant negative effect, as a 1% rise reduces infant mortality by 0.050%. Per capita GDP exerts the strongest impact, with a 1% increase reducing infant mortality by 0.157%. Granger causality results indicate that public health expenditure and per capita GDP drive reductions in infant mortality, while private health expenditure is less predictive and more reactive. The study concludes that reducing infant mortality in Nigeria depends on sustained public health investment, supportive private financing, and inclusive economic growth. It recommends increased and efficient government health spending, policies that improve access to private healthcare, and broader economic measures that enhance household welfare and living standards.

Keywords: *Infant mortality; Public health expenditure; Private health expenditure; Per capita GDP; Nigeria*

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Introduction

Infant mortality remains one of the most sensitive indicators of a country's health system performance and socio-economic development. It reflects not only the availability and quality of medical services but also broader structural conditions such as maternal education, household income, nutrition, sanitation, and access to safe water. Globally, the infant mortality rate (IMR) declined from over 60 deaths per 1,000 live births in 1990 to fewer than 30 per 1,000 in recent years, a progress largely attributed to expanded immunization programs, improved maternal healthcare, and sustained increases in health expenditure (WDI, 2024). Evidence suggests that countries with higher and more efficiently managed health expenditure tend to record lower IMRs, as increased funding enhances skilled birth attendance, immunization coverage, and timely treatment of preventable childhood diseases (Pandey, 2024; Ray & Ganguly, 2024). However, the magnitude of spending alone does not guarantee improved outcomes; the structure, allocation efficiency, and governance of such expenditure are equally critical determinants of its effectiveness.

In Sub-Saharan Africa, infant mortality remains disproportionately high relative to global averages, constrained by limited fiscal space, high out-of-pocket payments, and institutional weaknesses that diminish the effectiveness of health spending (Bétila, 2025; Kouadio & Njong Mom, 2025). Within this regional context, Nigeria presents a particularly important case. Despite being one of Africa's largest economies, Nigeria recorded an IMR of approximately 56.2 deaths per 1,000 live births in 2022, far above the global average and well short of the Sustainable Development Goal (SDG) target of 25 deaths per 1,000 live births by 2030 (World Bank, 2024; Adesuyi et al., 2024). Although this represents an improvement from over 120 deaths per 1,000 live births in the early 1990s (WDI, 2024), the pace of decline has been comparatively slow.

Nigeria's health financing landscape reveals critical structural challenges. Public health expenditure as a share of GDP has consistently remained below internationally recommended benchmarks, with health sector budget allocations fluctuating between 4% and 6% of total government expenditure, well below the 15% Abuja Declaration target (CBN, 2024). Compounding this underfunding is a heavy reliance on out-of-pocket payments, which account for over 70% of total health expenditure, creating substantial financial barriers for vulnerable households seeking maternal and infant healthcare (Cyril & Mathias, 2022). Delays in budget releases, procurement inefficiencies, weak accountability mechanisms, and uneven distribution of healthcare infrastructure further limit the impact of health spending on service delivery (Adekanmbi et al., 2024; Adesete et al., 2022). In rural and conflict-affected areas, shortages of skilled health personnel and inadequate infrastructure compound these challenges (Umole et al., 2025). Nigeria's rapid population growth further intensifies pressure on an already strained health system, as demand for maternal, neonatal, and infant healthcare services continues to expand without commensurate improvements in effective health spending.

The persistence of high infant mortality in Nigeria, despite modest increases in health expenditure, raises important empirical and policy questions about the nature and efficiency of this relationship. Existing studies suggest that in Nigeria, systemic inefficiencies and socio-economic disparities dilute the expected benefits of public investment, making the expenditure-mortality

relationship inconsistent (Elijah et al., 2024; Babawulle, 2024). Against this backdrop, this study examines the relationship between health expenditure and infant mortality in Nigeria from 1986 to 2024, disaggregating health spending into public and private components to provide a more nuanced understanding of how each affects infant survival outcomes.

Specifically, the study addresses the following objectives: (i) to assess the impact of public health expenditure on IMR in Nigeria; (ii) to evaluate the influence of private health expenditure on IMR; and (iii) to examine the impact of per capita GDP on IMR. The findings are intended to provide evidence-based guidance for more efficient, equitable, and outcome-oriented health financing strategies in Nigeria.

Literature Review

Conceptual Clarifications

(a) Infant Mortality

Infant mortality refers to the death of children under one year of age, measured as the number of deaths per 1,000 live births annually. It is widely recognized as a composite indicator of healthcare system effectiveness, maternal wellbeing, nutritional conditions, environmental quality, and broader socio-economic circumstances (WHO, 2024; UNICEF, 2023). Conceptually, infant mortality is disaggregated into neonatal mortality (deaths within the first 28 days) and post-neonatal mortality (deaths between one and eleven months). Neonatal deaths are primarily associated with prematurity, birth asphyxia, low birth weight, and inadequate obstetric care, while post-neonatal deaths are more closely linked to malnutrition, poor sanitation, infectious diseases, and limited immunization coverage. Scholars emphasize that infant mortality captures both clinical and non-clinical determinants of child survival, including income, education, sanitation, and public health infrastructure (Okeke et al., 2022; Mensah et al., 2023; Ibrahim & Bello, 2024). In Nigeria, despite modest improvements, the IMR remains approximately 56.2 deaths per 1,000 live births (World Bank, 2024), reflecting persistent structural weaknesses in maternal and neonatal healthcare, healthcare accessibility, and financing.

(b) Public Health Expenditure

Public health expenditure encompasses all government spending on health services, programs, and infrastructure, including budgetary allocations, social health insurance contributions, and capital investments (WHO, 2023). It is central to ensuring equitable healthcare access, particularly for vulnerable populations. Scholars highlight its dual function: recurrent expenditures, such as staff salaries and operational costs, have immediate service delivery effects, while capital expenditures, including hospital construction and equipment, contribute to long-term health system capacity (Adeyemi & Musa, 2022; Eze & Umeh, 2023). However, the effectiveness of public health spending is conditioned on governance quality, allocation efficiency, and accountability mechanisms (Okoro & Nwankwo, 2024; Abubakar & Shittu, 2024). In Nigeria, public health allocations have consistently fallen below the 15% Abuja Declaration target, constraining the health system's capacity to deliver essential services effectively (CBN, 2024).

(c) Private Health Expenditure

Private health expenditure covers all non-governmental health spending, including out-of-pocket payments, private insurance, non-governmental organization contributions, and corporate health investments (WHO, 2023; World Bank, 2024). In Nigeria, out-of-pocket payments account for over 70% of total health expenditure, placing a heavy financial burden on households and discouraging timely utilization of maternal and child health services (Cyril & Mathias, 2022; World Bank, 2024). While private spending can improve service access among those with financial means, it frequently reinforces socio-economic inequalities, with vulnerable populations unable to afford private care, leading to delayed treatment and poorer health outcomes (Chukwu & Obasi, 2023; Mensah & Boateng, 2023).

Theoretical Framework

This study is anchored on Grossman's Health Capital Model, developed by Michael Grossman in 1972, which conceptualizes health as a form of capital that individuals and societies invest in and manage over time. According to Grossman, health is not only a consumption good that provides immediate satisfaction but also an investment good that enhances an individual's productivity and well-being over the long term (Grossman, 1972). The model posits that individuals are born with an initial stock of health capital, which depreciates over time but can be replenished through investments such as medical care, healthy behaviors, and, importantly, public health expenditures.

Grossman's framework provides a robust theoretical basis for analyzing the impact of public health spending on health outcomes, particularly infant mortality rates. It underscores how capital expenditures (such as building healthcare infrastructure) and recurrent expenditures (such as salaries for health workers and purchase of essential drugs) contribute to maintaining and improving the health stock of a population. This investment in health capital is expected to reduce mortality rates by enhancing access to quality healthcare services, improving prenatal and postnatal care, and expanding immunization coverage, all critical factors in infant survival. While the model primarily focuses on individual health choices, its extension to public health spending emphasizes the government's role in facilitating and supplementing individual health investments through policies and budgetary allocations. It allows for the evaluation of how variations in public health expenditure influence health outcomes over time, providing a dynamic view of health as a capital stock subject to investment and depreciation (Grossman, 1972; Cawley, 2015).

The model's strength lies in its ability to link health expenditure directly to health outcomes through the concept of health capital accumulation, making it particularly suited for this study's objective of examining the relationship between public health expenditure and infant mortality in Nigeria. However, it also recognizes that other factors such as governance quality, efficiency of health systems, and socio-economic conditions, can moderate this relationship, which aligns with observed complexities in Nigeria's health sector (Kouadio & Njong Mom, 2025).

Empirical Literature

Empirical evidence on the health expenditure–infant mortality nexus is mixed and context-dependent. At the regional level, Kouadio and Njong Mom (2025) demonstrated, using

feasible generalized least squares across fifteen West African countries, that governance quality significantly amplifies the positive impact of health expenditure on infant mortality and other health outcomes, underscoring the importance of institutional reforms. Bétila (2025), analyzing 48 African countries via system-GMM estimation, found that ICT development enhances the effectiveness of public health expenditure in reducing infant and under-five mortality, highlighting the complementary role of digital infrastructure. Adekanmbi et al. (2024) applied threshold regression across 45 sub-Saharan African countries and found that public health spending reduces infant mortality only beyond a critical expenditure threshold, while private health expenditure adversely affects both low- and high-income populations due to the financial burden of out-of-pocket costs.

In the Nigerian context, Elijah et al. (2024) employed an ARDL model and found that recurrent health expenditure, per capita income, and the National Health Insurance Act significantly reduced infant mortality in the long run. Similarly, Babawulle (2024) confirmed that a unit increase in public health expenditure reduces infant mortality by approximately 2.26 units, with per capita GDP also exerting a significant negative effect. Sado and Ogirima (2022) found that both recurrent and capital health expenditures significantly reduced infant mortality in Kogi State. Conversely, Adesete et al. (2022) found that neither public health expenditure nor macroeconomic uncertainty significantly affected health outcomes; instead, public income emerged as the most influential determinant. Adesuyi et al. (2024) found mixed effects across short- and long-run horizons, with recurrent expenditure positively associated with child mortality and public health and capital expenditures yielding inconsistent results. Cyril and Mathias (2022) identified private health expenditure, per capita income, and immunization coverage as significant determinants of infant mortality, recommending stronger public-private collaboration.

Beyond Nigeria, Pandey (2024) found no significant causal relationship between public health expenditure and IMR in an Indian state, attributing this to systemic inefficiencies in fund utilization. Haque and Farid (2025) confirmed a strong inverse relationship between GDP and infant mortality, particularly pronounced in low-income countries. Boundioa and Thiombiano (2024) found that public health expenditure reduces maternal mortality in the WAEMU region, while private expenditure exacerbates risks, reinforcing the case for expanded public financing.

Gap in Literature

Critical gaps remain, despite the growing body of evidence. Most Nigerian-focused studies have not comprehensively disaggregated health expenditure into public and private components within a single analytical framework, nor have they systematically examined Granger causality or long-run cointegration between these components and infant mortality. Several studies relied on OLS or basic ARDL frameworks without adequately addressing dynamic interdependence (Eboh et al., 2022; Umaru et al., 2022). Furthermore, few studies extend their analysis to 2024, omitting the effects of recent health reforms and post-COVID-19 fiscal adjustments. This study addresses these gaps by providing a disaggregated, theory-informed, and up-to-date analysis of public and private health expenditure and infant mortality in Nigeria from 1986 to 2024, incorporating Granger causality testing to establish directional relationships among key variables.

Methodology

Research Design and Data

This study adopted an ex post facto research design, appropriate for analyzing historical relationships between variables that cannot be experimentally manipulated (Pandey, 2024). Secondary annual time-series data covering 1986–2024 were sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin, the World Bank World Development Indicators, and the WHO database. The dependent variable is the infant mortality rate (IMR), measured as the number of deaths per 1,000 live births. The independent variables are public health expenditure (PUEX), measured in billions of naira at constant prices; private health expenditure (PREX), measured in per capita current US dollars; and per capita GDP (PCGDP), included as a control variable for broader economic conditions. All financial variables are expressed in natural logarithms to allow elasticity interpretation of coefficients.

Model Specification

Grounded in Grossman's Health Capital Model, this study conceptualizes infant mortality as an outcome of health capital accumulation influenced by public and private health investments. Following Adesuyi et al. (2024), the functional relationship is specified as:

$$IMR = (PUEX, PREX, PCGDP) \quad 1$$

The econometric model is specified as;

$$IMR_t = \alpha_0 + \alpha_1 PUEX_t + \alpha_2 PREX_t + \alpha_3 PCGDP_t + \alpha_{4t} + \mu_t \quad 2$$

The log-linear form of the model, which allows coefficients to be interpreted as elasticities, is specified as:

$$IMR_t = \alpha_0 + \alpha_1 \ln(PUEX_t) + \alpha_2 \ln(PREX_t) + \alpha_3 \ln(PCGDP_t) + \mu_t \quad 3$$

Where IMR_t is the infant mortality rate; $\ln(PUEX_t)$, $\ln(PREX_t)$, and $\ln(PCGDP_t)$ are natural logarithms of public health expenditure, private health expenditure, and per capita GDP respectively; α_0 is the intercept; $\alpha_1, \alpha_2, \alpha_3$ are long-run elasticity coefficients; and μ_t is the stochastic error term. Based on theory and prior empirical evidence, all three explanatory variables are expected to exert a negative influence on infant mortality ($\alpha_1, \alpha_2, \alpha_3 < 0$), as higher public spending, private investment, and income levels are expected to improve health outcomes.

Estimation Technique

The study employed the Dynamic Ordinary Least Squares (DOLS) technique to estimate long-run relationships. DOLS corrects for regressor endogeneity and serial correlation by augmenting the regression with leads and lags of the first differences of explanatory variables, producing consistent and efficient long-run parameter estimates even in small samples (Stock & Watson, 1993). The DOLS specification is:

$$IMR_t = \alpha_0 + \alpha_1 \ln(PUEX_t) + \alpha_2 \ln(PREX_t) + \alpha_3 \ln(PCGDP_t) + \sum_{i=-p}^{p} \beta_i \, \Delta \ln(X_{t-i}) + \mu_t \quad 4$$

Where $\Delta\ln(X_{t-i})$ represents leads and lags of first differences of the explanatory variables to correct for endogeneity; p is the number of leads and lags; and all other terms are as previously defined. This approach is particularly suited for this study given the potential reciprocal relationship between health spending and mortality outcomes. All estimations were conducted using EViews version 12.

Pre-estimation Tests

Unit Root Test: The Augmented Dickey-Fuller (ADF) test was employed to assess stationarity of all series, testing the null hypothesis of a unit root against the alternative of stationarity. Non-stationary variables were differenced to achieve stationarity prior to estimation:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta Y_{t-i} + \epsilon_t \quad 5$$

Cointegration Test: The Johansen cointegration test was applied to determine whether a stable long-run equilibrium relationship exists among IMR, PUEX, PREX, and PCGDP, based on the rank of the long-run impact matrix Π in the Vector Error Correction Model (VECM) framework. Confirmed cointegration justifies the application of DOLS.

Multicollinearity Test: The Variance Inflation Factor (VIF) was used to detect multicollinearity among regressors, with $VIF > 10$ indicating serious multicollinearity.

Post-estimation Diagnostics

Following DOLS estimation, the study conducted a battery of diagnostic tests to validate model reliability. The Jarque-Bera test assessed normality of residuals. The Breusch-Godfrey test examined serial correlation. The Breusch-Pagan test detected heteroskedasticity. The Ramsey RESET test evaluated functional form misspecification. The CUSUM and CUSUMSQ **tests** assessed parameter stability over the sample period, with stability confirmed when plotted statistics remained within 5% significance bounds.

Granger Causality Test

To examine the direction of causality between health expenditure and infant mortality, the Pairwise Granger Causality test was employed within a VAR framework:

$$IMR_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i IMR_{t-i} + \sum_{i=1}^{p} \beta_i HEX_{t-i} + \epsilon_t \quad 6$$

$$HEX_t = \gamma_0 + \sum_{i=1}^{p} \gamma_i HEX_{t-i} + \sum_{i=1}^{p} \delta_i IMR_{t-i} + \nu_t \quad 7$$

Where HEX_t represents either PUEX or PREX. The null hypothesis that health expenditure does not Granger-cause infant mortality is rejected when past values of health expenditure significantly improve the prediction of IMR. This test complements DOLS by capturing dynamic lead-lag relationships and potential feedback effects between health financing and infant mortality outcomes in Nigeria.

Results and Discussion

Table 1: Descriptive Statistics Results

	IMR (%)	PUEX (₦'b)	PREX ($)	PCGDP
Mean	85.33846	124.8090	34.69067	342512.1
Median	83.70000	55.70000	36.04638	159442.3
Maximum	105.9000	423.3298	92.98604	1602302.
Minimum	58.50000	0.041315	0.410000	2271.118
Std. Dev.	16.85350	145.7567	29.57985	429087.4
Skewness	-0.026080	0.893632	0.175888	1.442123
Kurtosis	1.416975	2.328138	1.562936	4.129054
Jarque-Bera	4.076620	5.924286	3.556963	15.58966
Probability	0.130249	0.051708	0.168894	0.000412
Observations	39	39	39	39

Source: Researcher's computation using Eviews (2026)

Table 4.1 presents the descriptive statistics for all variables over the study period. The mean IMR of 85.34 deaths per 1,000 live births, with a median of 83.7, indicates a fairly symmetric distribution. The decline from a maximum of 105.9 to a minimum of 58.5 reflects substantial progress over time, while the standard deviation of 16.85 suggests moderate variability. The Jarque-Bera test (p = 0.13) confirms approximate normality, supporting standard parametric analysis. Public health expenditure averaged 124.81 billion Naira, but the right-skewed distribution (skewness = 0.89) and wide range of 0.041 to 423.33 billion Naira reveal considerable year-to-year variability and occasional large spending surges, as further confirmed by the high standard deviation of 145.76. Private health expenditure averaged $34.69 per capita, ranging from $0.41 to $92.99, with a near-symmetric distribution (skewness = 0.18) and a Jarque-Bera p-value of 0.17, indicating normality. Per capita GDP averaged 342,512 Naira but exhibited strong right skewness (1.44), leptokurtosis (4.13), and significant

non-normality (Jarque-Bera p = 0.0004), reflecting the uneven pace of economic growth in Nigeria, with rapid expansion in recent years relative to the earlier study period.

Table 2: ADF and PP Unit Root Test Results

ADF Unit Root Result					
Variables	**At Level**		**At First Difference**		**Order of integration**
	T – statistics	**P-value**	**T – statistics**	**P-value**	
IMR	0.2166	0.9697	-3.1164	0.0347	I(1)s
LNPUEX	0.3358	0.9772	-6.4410	0.0000	I(1)
LNPREX	0.5574	0.9866	-4.2850	0.0017	I(1)
LNPCGDP	5.6394	1.0000	-2.5561	0.0122	I(1)
PP Unit Root Result					
Variables	**At Level**		**At First Difference**		**Order of integration**
	T – statistics	**P-value**	**T – statistics**	**P-value**	
IMR	0.5040	0.9847	-2.9521	0.0042	I(1)
LNPUEX	0.8307	0.9933	-6.5421	0.0000	I(1)
LNPREX	0.0647	0.9586	-4.4434	0.0011	I(1)
LNPCGDP	21.984	1.0000	-3.7839	0.0066	I(1)

Source: Researcher's computation using EViews (2026)

ADF and PP tests show that all variables are non-stationary at levels but become stationary after first differencing, indicating integration of order one, I(1). This confirms the suitability of applying cointegration-based techniques, particularly DOLS, to estimate the long-run relationship without spurious regression.

Table 3: Johansen Cointegration test Results

Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.748591	94.17010	47.85613	0.0000
At most 1 *	0.546628	43.08516	29.79707	0.0009
At most 2	0.311267	13.81660	15.49471	0.0881
At most 3	0.000520	0.019259	3.841466	0.8895

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

Source: Researcher's computation using Eviews (2026)

The Johansen trace test reveals two cointegrating relationships among infant mortality, public and private health expenditure, and per capita GDP. Since the "None" and "At most 1" hypotheses are rejected at 5%, the variables share a stable long-run equilibrium relationship, justifying the use of DOLS estimation.

Table 4: Variance Inflation Factor Results

Variable	**Variance**	**VIF**	**VIF**
C	0.238261	2375.720	NA
LNPUEX	0.000439	2.885498	2.669747
LNPREX	0.001073	6.640038	5.946362
LNPCGDP	0.000558	2.619940	2.418969

Source: Researcher's computation using EViews (2026)

The results indicate that LNPUEX has a VIF of 2.89, LNPREX has a VIF of 6.64, and LNPCGDP has a VIF of 2.62. These values are all below the commonly used threshold of 10, suggesting that multicollinearity is not a serious concern among the explanatory variables. The results confirm that the model is well-specified for estimation, and the coefficient estimates can be interpreted with confidence.

DOLS Estimation

Table 5: DOLS Estimation Results

Dependent Variable: IMR

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Remark
C	6.002919	0.488120	12.29805	0.0000	*Significant*
LNPUEX	-0.062773	0.029149	-2.153542	0.0430	*Significant*
LNPREX	-0.050451	0.012781	-3.947186	0.0007	*Significant*
LNPCGDP	-0.157395	0.051414	-3.061291	0.0055	*Significant*
R-squared	0.937596				
Adjusted R-squared	0.905038				
F-statistic	28.79738	Durbin-Watson stat		2.316201	
Prob(F-statistic)	0.000000				

Source: Researcher's computation using Eviews (2026)

The DOLS results indicate that all explanatory variables, public health expenditure (LNPUEX), private health expenditure (LNPREX), and per capita GDP (LNPCGDP), have a statistically significant negative effect on infant mortality in Nigeria, consistent with theoretical expectations.

Specifically, Public health expenditure shows that a 1% increase reduces infant mortality by approximately 0.06%, supporting Grossman's Health Capital Model and the Public Goods Theory, which emphasize that government investment in health infrastructure and services enhances the stock of health capital and lowers mortality. These findings are consistent with empirical studies such as Babawulle (2024) and Sado and Ogirima (2022), which also found that increased public spending significantly reduces infant mortality in Nigeria, and partially reflect Adesuyi et al. (2024), who highlighted the importance of recurrent government health spending for child survival.

Private health expenditure, while slightly smaller in magnitude, also exerts a significant negative impact on infant mortality, suggesting that increased household and private sector spending improves access to maternal and child health services and complements public health efforts. This outcome aligns with studies such as Bétila (2025) and Ray and Ganguly (2024), which emphasize that greater investment in health, whether public or private, contributes to improved health outcomes. However, it contrasts with findings like Boundioa and Thiombiano (2024), who reported that private spending could be positively associated with maternal mortality, likely reflecting inefficiencies or inequities in healthcare access.

Per capita GDP has the largest negative coefficient, indicating that economic growth is a crucial determinant of infant survival. A 1% increase in per capita income is associated with a 0.16% reduction in infant mortality, consistent with Haque and Farid (2025) and Babawulle (2024), which show that higher income improves nutrition, living conditions, and access to healthcare, particularly in resource-constrained settings. This result also resonates with Human Capital Theory, which links economic resources to enhanced health and productivity outcomes.

The model demonstrates strong explanatory power, with an adjusted R-squared of 0.905, indicating that over 90% of the variation in infant mortality is captured by the included variables. The F-statistic confirms the overall significance of the model, and the Durbin-Watson statistic suggests no serious autocorrelation problems.

Table 6: Wald Joint Test Results

Null Hypothesis: C(2)= C(3)=0

Test Statistic	Value	df	Probability
F-statistic	11.90171	(2, 35)	0.0001
Chi-square	23.80342	2	0.0000

Source: Researcher's computation using Eviews (2026)

The Wald joint test rejects the null hypothesis that public and private health expenditure coefficients are jointly zero ($F = 11.90$, $p = 0.0001$; $\chi^2 = 23.80$, $p = 0.0000$). This confirms that both expenditure types jointly exert a significant effect on infant mortality in Nigeria.

Table 7: Granger Causality Test Results

Null Hypothesis:	Obs	F-Statistic	Prob.
LNPUEX does not Granger Cause IMR	37	3.58064	0.0395
IMR does not Granger Cause LNPUEX		2.73389	0.0801
LNPREX does not Granger Cause IMR	37	0.37124	0.6928
IMR does not Granger Cause LNPREX		6.24719	0.0051
LNPCGDP does not Granger Cause IMR	37	9.09474	0.0007
IMR does not Granger Cause LNPCGDP		0.11479	0.8919

Source: Researcher's computation using Eviews (2026)

Granger causality results in Table 7 show unidirectional causality from public health expenditure and per capita GDP to infant mortality, implying that government spending and economic growth significantly drive reductions in infant deaths. By contrast, private health expenditure does not cause infant mortality; rather, infant mortality Granger-causes private spending, suggesting that household health spending is largely reactive to worsening child health conditions.

Post Estimation Test

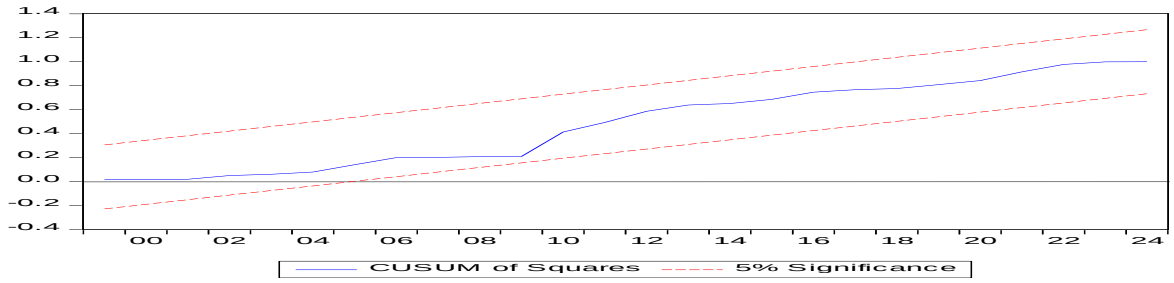
Table 8: Summary of Diagnostic Test Results

Diagnostic Test	Test Statistic	Value	Probability
Histogram Normality Test	JB	0.567917	0.752798
Serial Correlation (Breusch–Godfrey LM Test)	F-statistic	1.366946	0.2708
Heteroskedasticity (Breusch–Pagan–Godfrey Test)	F-statistic	1.355162	0.2589
Ramsey RESET Test	F-statistic	0.706026	0.4074

Source: Researcher's computation using EViews (2026)

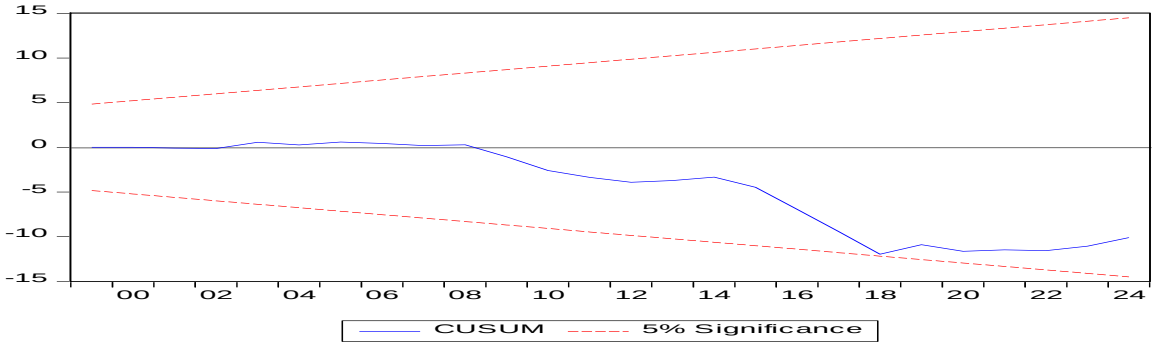
Post-estimation tests confirm the robustness of the model. The residuals are normally distributed (Jarque-Bera p = 0.753), with no serial correlation (Breusch-Godfrey p = 0.271) or heteroskedasticity (Breusch-Pagan-Godfrey p = 0.259). The Ramsey RESET test indicates correct model specification, while CUSUM and CUSUMSQ confirm coefficient stability.

Figure 4.5: CUSUM Results



Source: Researcher's computation using Eviews (2026)

Figure 4.6: CUSUM of Squares Results



Source: Researcher's computation using Eviews (2026)

Discussion of Findings

The findings show that public health expenditure, private health expenditure, and per capita GDP all exert significant negative effects on infant mortality in Nigeria, implying that improved health financing and economic conditions enhance child survival. The negative effect of public health expenditure supports Grossman's Health Capital Model and Public Goods Theory, indicating that government spending on health infrastructure, immunization, maternal care, and skilled personnel reduces infant deaths. This aligns with Babawulle (2024), Sado and Ogirima (2022), Umaru et al. (2022), and Elijah et al. (2024), though it contrasts with studies reporting weak or adverse effects, likely due to differences in study periods, model specification, and short-run inefficiencies.

Private health expenditure also reduces infant mortality, suggesting that household and private spending improves access to essential health services. This agrees with Cyril and Mathias (2022), but the causality results show that infant mortality predicts private spending rather than the reverse, implying that such spending is largely reactive. Thus, while private financing may support infant survival, it cannot substitute for strong public provision.

Per capita GDP has the largest negative coefficient, showing that higher income improves nutrition, living conditions, and healthcare access, thereby lowering infant mortality. This is consistent with Human Capital Theory and studies such as Haque and Farid (2025). Overall, the results suggest that reducing infant mortality in Nigeria depends primarily on sustained public health investment and inclusive economic growth, supported by but not reliant on private health expenditure..

Conclusion and Recommendations

Conclusion

This study concludes that public health expenditure, private health expenditure, and per capita GDP are significant determinants of infant mortality in Nigeria over the period 1986–2024. Increased public health expenditure contributes meaningfully to reducing infant mortality, confirming the importance of sustained government investment in healthcare delivery, infrastructure, and essential services. Private health expenditure also contributes to lower infant mortality, although its role appears more supportive than primary. Per capita GDP exerts the strongest effect, indicating that broader economic improvement is crucial for enhancing infant survival.

The study further concludes that the relationship between health expenditure and infant mortality in Nigeria is both statistically significant and policy relevant. Public health spending and economic growth are stronger and more consistent drivers of improved child survival, while private spending plays a complementary role. Overall, reducing infant mortality in Nigeria depends on strengthening public health financing, improving the effectiveness of health expenditure, and promoting inclusive economic growth capable of improving household welfare and access to quality healthcare.

Recommendations

Based on the findings of this study, the following recommendations were proposed:

i. The government should increase and sustain public health funding, especially recurrent spending on maternal and child health services, infrastructure, and personnel, while improving efficiency, accountability, and equitable resource distribution to ensure better health outcomes and reduce waste, corruption, and service gaps in underserved areas.

ii. Policies should promote private health investment through subsidies, insurance, and regulation that improve affordability, quality, and access, while broader efforts to reduce poverty and stimulate inclusive economic growth should be prioritized, given the strong role of income in improving child survival.

This study provides updated long-run and causal evidence for Nigeria, showing that public and private health expenditure significantly reduce infant mortality, though private spending is largely reactive, while per capita GDP has the strongest effect. It also establishes that coordinated public and private financing is essential for sustained reductions in infant deaths.

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