COMPARATIVE ANALYSIS OF PUBLIC HEALTH EXPENDITURE AND POST-NEONATAL MORTALITY: A CROSS-INCOME GROUP STUDY IN SELECTED SUB-SAHARAN AFRICAN COUNTRIES

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ABSTRACT
Sub-Saharan Africa (SSA) continues grappling with disproportionately high post-neonatal mortality despite economic progress. With competing budget priorities, increasing health expenditures' value for accelerating reductions remains contested yet understudied specifically for post-neonatal child health. This analysis aimed to fill this gap by investigating public health spending's impact on post-neonatal mortality stratified by country income levels. Applying the Health Expenditure-Outcome framework, the study analyzed recent panel data across 15 SSA countries, categorized into low, lower-middle and high & upper-middle income groups. Poisson regression modeled country-specific post-neonatal mortality rates as a function of public health expenditure, adjusting for economic, institutional, social and environmental confounders. The study's descriptive analysis showed stark disparities in post-neonatal deaths, health spending, and related correlates across poorer vs wealthier SSA countries. The Poisson models demonstrated significant mortality reduction per extra unit of public health expenditure across all income categories. However, the mortality lowering effects were substantially greater in higher resourced health systems. The study thus concludes that public financing for health significantly curtails post-neonatal deaths regardless of economic development levels. Yet returns on investment increase considerably as health systems strengthen over time in transitioning income groups. Sustaining long-term increases in health budgets, prioritizing women and child programs, could accelerate progress. As such, SSA finance/health ministries should develop incremental roadmaps raising budget allocations aligned with Abuja targets given high returns. Improving spending efficiency through governance reforms and integrated investments tackling socioeconomic mortality drivers can further maximize gains.

Keywords: Post-neonatal mortality, Public health expenditure, Health financing, Health outcomes, Sub-Saharan Africa
JEL Classification: I12, I15, I18, O55, H51.

1.1 INTRODUCTION
Improving child health outcomes remains a pressing concern in Sub-Saharan Africa (SSA), which continues to experience disproportionately high rates of under-five mortality compared

to other regions (Ayipe & Tanko 2023; Popoola & Mohammed, 2023). In particular, according to the World Health Organization [WHO] (2022), the post-neonatal period, defined as the time between 1 month to 1 year of age, carries heightened vulnerability. In 2017 alone, post-neonatal disorders accounted for over 550,000 under-five deaths in SSA (UN IGME, 2019). Tackling preventable mortality in the post-neonatal period is therefore critical for achieving Sustainable Development Goal 3.2, which calls for ending preventable deaths of newborns and children under 5 years of age by 2030 (WHO, 2021).

A complex web of socioeconomic, environmental, political and health systems factors underlie the persistently high post-neonatal mortality rates across many SSA countries (Mouteyica & Ngepah, 2023). However, public health expenditure has emerged as a key modifiable factor that may hold promise for unlocking greater gains (Gabani et al., 2023; Alimi et al., 2023; Senke et al., 2023). Public health spending encompasses government expenditure on health promotion, disease prevention and population health initiatives. As low- and middle-income SSA countries continue on development trajectories, they face policy choices regarding resource allocation across competing priorities. The past two decades has seen several SSA countries ramp up their national health budgets (Alimi et al., 2023) (*See Figure 1 for context*). Particularly, over the past two decades, data from ONE Data & Analysis (2023) shows that global spending on healthcare has grown substantially from $4.4 trillion in 2000 to $9.8 trillion in 2021. A significant majority of this expenditure, almost 80%, has occurred in high-income nations. However, lower-middle and low-income countries, which account for over half the world's population and burden of disease, represent less than 4% of total global healthcare spending. In 2021, healthcare expenditure in low-income countries was $22.8 billion, representing a 3.9% increase from 2020. For lower-middle income countries, healthcare spending was $351.1 billion last year, marking a 9.8% rise from the previous year. The proportion of GDP dedicated to healthcare grew across all income levels between 2020 and 2021, likely attributable to the COVID-19 pandemic. At an average of just 6-7% of total government spending, most SSA countries remain far below the 15% target set by the 2001 Abuja Declaration in health spending (WHO, 2016). This raises pressing questions regarding the role increased public health expenditure could play in accelerating reductions in post-neonatal mortality, especially for lower-income SSA nations working within tight fiscal constraints.

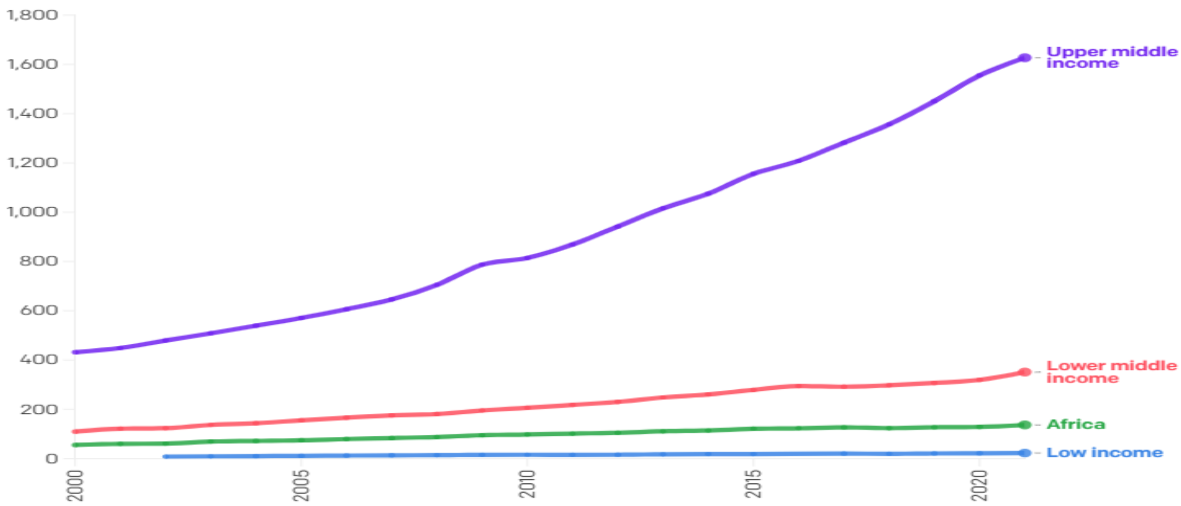

Figure 1: *Health Spending* ($US billion) (ONE Data & Analysis (2023)

Furthermore, a review of existing literature reveals mixed evidence on the linkage between public health spending and child mortality outcomes specifically in the post-neonatal period. Several cross-country analyses using aggregate data have identified public health expenditure as a statistically significant predictor of reduced under-five mortality (Ayipe & Tanko 2023; Houeninvo, 2022; Farag et al, 2013; Bokhari et al, 2007). However, these studies have largely relied on a broad child mortality indicator combining both neonatal (first 28 days of life) and later post-neonatal mortality. This potentially masks differential effects across ages. Additionally, the existing literature provides little insight into whether health spending translates into similar mortality gains across SSA countries at different income levels. Governments in low income nations likely face greater trade-offs regarding investments in basic public health infrastructure like water, sanitation and healthcare access relative to lower middle or upper middle-income countries (Oburota & Obafemi, 2023; Akintunde & Olaniran, 2022; Okwu et al., 2023). Testing this empirically requires income-stratified analyses which existing aggregate cross-country studies have not conducted.

In order to address these gaps, the proposed study will examine the impact of public health expenditure on post-neonatal mortality across low, lower-middle and upper middle and high income SSA countries using recent panel data spanning 2010-2021. By leveraging within-country variation over time, country-level fixed effects estimation will help isolate the effect of changing health expenditures from time-invariant confounders. Separate models by income group will then reveal if marginal health spending yields differential percentage reductions in mortality for poorer nations relative to their higher income regional peers. Findings will provide more nuanced evidence to inform ongoing policy dialogues around optimal health financing towards achieving SDG child mortality targets.

2.1 LITERATURE REVIEW

2.2 The relationship between health expenditures and health outcomes has been studied through various theoretical lenses. The ***Health Expenditure-Outcome*** theory posits that increased spending on healthcare leads to better health outcomes at the population level (Newhouse, 1977). This theory was first proposed in the 1970s by Joseph Newhouse and focused specifically on the impact of healthcare spending on mortality rates. In contrast, the ***Grossman Model*** views health as a durable capital stock that individual consumers invest in (Grossman, 1972). Developed by health economist Michael Grossman, this model sees health as determined by various factors including medical care, diet, exercise, genetics, and the external environment. An individual's demand for health is derived from their desire to be healthy to participate in other utility-generating activities. The ***Social Determinants of Health Framework*** moves beyond just medical and lifestyle factors to argue that population health is largely shaped by the structural conditions in which people live and work (Marmot & Wilkinson, 2005). Introduced in the 2000s, this approach highlights socioeconomic variables like poverty, education, housing, and employment as fundamental drivers of morbidity and mortality.

While the health expenditure theory suggests increasing healthcare spending improves outcomes, the Grossman model views medical spending as only one input into producing health. The social determinants perspective further foregrounds non-medical societal factors as critical for understanding public health (Krieger, 2001).

2.3 Empirical Review

This review analyzed a number of recent studies investigating the relationship between public health expenditure and mortality outcomes, with a focus on post-neonatal mortality, across

SSA countries categorized by income level. The review compares the scope, methodology, variables, and findings of these studies in depth, while also identifying limitations and gaps.

Scope and Timeframe of Reviewed Studies- The set of reviewed studies vary substantially in geographic scope and timeframe. Ayipe and Tanko (2023), Mouteyica and Ngepah (2023), Houeninvo (2022), and Rahman et al. (2022) focus exclusively on SSA countries over approximately 20-year spans ending in 2018 or 2019. Eze et al. (2022) also concentrates on SSA but covers 31 nations from 2000-2020. Meanwhile, Garcia et al. (2023), Anwar et al. (2023), Gabani et al. (2023), Singh et al. (2022), Mao et al. (2023), Alimi et al. (2023), and Kamanga et al. (2022) examine wider global datasets or single African countries over long time horizons spanning up to 37 years.

Methodological Approaches- Most studies utilize econometric analyses of panel data including fixed effects, random effects, and generalized method of moments models (Ayipe & Tanko, 2023; Mouteyica & Ngepah, 2023; Houeninvo, 2022; Rahman et al., 2022). Eze et al. (2022) employs a systematic review and meta-analysis approach while Garcia et al. (2023) uses an ecological design with propensity score modeling. Singh et al. (2022), and Alimi et al. (2023) apply autoregressive distributed lag models to assess short and long-term expenditure impacts. Sample sizes range from single countries (Nigeria and Zambia) to massive multi-nation datasets spanning upwards of 100+ countries globally.

Variables Examined- Regarding outcomes, most studies focus on broad mortality measures like infant, child, and under-five mortality rates rather than post-neonatal-specific indicators. Exceptions include Garcia et al. (2023) separating neonatal and post 28 days as well as under-5-year mortality and Eze et al.'s (2022) examination of under-5 catastrophic health expenditures. Key predictors uniformly include variations of health expenditures (public, private, domestic, governmental etc). Confounders cover health system factors, socioeconomic indicators, demographics, and other expenditures across sectors.

2.4 Gaps in Literature and Value Addition

Significant heterogeneity exists across the methodologies, samples, variable definitions, and analytical strategies employed in these studies. Nonetheless, the preponderance of evidence supports a link between increased public health spending and improved mortality outcomes (Ayipe & Tanko, 2023; Houeninvo, 2022; Rahman et al., 2022). Yet inadequate focus on analyzing post-neonatal indicators specifically inhibits the formulation of targeted policy recommendations from existing research. While Garcia et al. (2023) examines neonatal mortality, the broader study across over 100 countries makes country-income-level specific conclusions difficult. Similarly, though Eze et al. (2022) analyzed financial catastrophe for under-5 child deaths, the multi-country scope spanning 31 SSA nations reduces generalizability. Issues arising from study's primary emphasis on U5MR rate hampers its capacity to implement targeted policies for addressing post-neonatal deaths separately, and further constraining the literature's ability to guide health spending decisions and reforms (Anwar et al., 2023; Gabani et al., 2023). The single country analyses also face limitations in terms of broader applicability (Mao et al., 2023; Alimi et al., 2023; Kamanga et al., 2022). Thus, substantial gaps remain both in country income-level-specific analyses as well as research focused on upper-middle and high-income SSA nations. While the body of evidence generally affirms the importance of public health expenditure for promoting survival in SSA, current research does not effectively examine post-neonatal mortality as a distinct outcome.

Addressing these limitations related to post-neonatal mortality and health spending should constitute a priority for the region to accelerate progress.

3.1 METHODOLOGY

3.1 Theoretical Framework

The study's theoretical framework is based on the Health Expenditure-Outcome theory. This theory was first proposed in the 1970s by Joseph Newhouse and focused specifically on the impact of healthcare spending on mortality rates (Newhouse, 1977). The theory was further developed through macro-level application to population health production functions (Grossman, 1972; Mosley and Chen, 1984; Fayissa & Gutena, 2005). Over decades, the theory has undergone empirical testing and refinement, demonstrating relevance across developing country contexts, including for child health priorities (Bokhari et al., 2007).

The theory posits that greater investment in health systems and services enhances capacity and accessibility, thereby leading to improved health indicators (Bokhari et al., 2007). As applied to maternal and child health, increased health spending enables workforce expansion, more facilities, updated technologies, surveillance systems, medications, equipment and health promotion to curb mortality (WHO, 2000). This theory is highly relevant for examining public health expenditure's impact on post-neonatal deaths in SSA. Unlike competing frameworks, the Health Expenditure-Outcome theory distinctly emphasizes health system strengthening as the causal pathway between spending inputs and mortality outputs (Novignon & Lawanson, 2017). This matches the context of SSA countries needing infrastructure and capacity advancements to deliver life-saving child health interventions. Additionally, the theory incorporates economic, social and environmental factors into the macro health production function (Fayissa & Gutena, 2005)- aligning with this study's model incorporating health spending, GDP, institutions, literacy, medical access and sanitation as predictors.

Furthermore, the Health Expenditure-Outcome theory Posits non-linear effects between spending and outcomes, allowing for diminishing returns- an important consideration for the complex child mortality problem (Bokhari et al., 2007). The ability to detect variation in expenditure effects between low, middle and high-income Sub-Saharan countries also benefits this study's comparative analysis. Finally, existing literature demonstrates successful application of this theory for child mortality research in developing countries, supporting its utilization (Kiross et al., 2020). Therefore, this study applies the Health Expenditure-Outcome theory by adopting post-neonatal mortality as the health outcome and public health spending as the key economic input into each country's 'macro health production function'. The theory frames analysis of how public health spending affects the proximal goal of health system enhancement versus more distal mortality impacts. It also grounds interpretation of expenditure effects relative to other economic, social and environmental predictors in the model. Most crucially, differentiating countries by income group allows assessment of variation in spending returns between lower and higher resourced health systems.

The Health Expenditure-Outcome theory provides a well-suited, empirically grounded framework for investigating complex post-neonatal health spending pathways in SSA. It facilitates important analysis of returns on investment across varied health system capacities needed to inform efficient resource allocation and targeted policies to curb preventable newborn deaths in the region.

3.3 Nature and Sources of Data

This study uses secondary panel data from 2010-2021 from the World Bank and World Governance Indicators. The 12-year period allows for analysis of long-term post-financial crisis trends in public health spending and post-neonatal mortality across SSA. The World

Bank provided datasets on mortality, health expenditure, GDP, literacy, prenatal care, medical density, and sanitation. The World Governance Indicators supplied data on institutional quality.

3.3 Methodology and Criterion for Selection of Countries

This study categorizes SSA countries into three income groups- low, lower-middle, and upper-middle, based on World Bank (World Bank, 2023) classifications. Five countries are selected per income level. Comparing equal-sized samples across development levels accounts for economic differences between countries. The balanced design with sufficient countries per group provides robust data to quantitatively assess income-stratified expenditure-mortality patterns over time.

Table 3.1: *Selected Countries in Sub-Saharan Africa*

Low Income ($1,135 or less GNI per capita)	**Lower Middle Income ($1,136 to $4,465 GNI per capita)**	**High (over $13,846 GNI per capita) & Upper Middle Income $4,466 to $13,845 GNI per capita)**
Chad	Côte d'Ivoire	Botswana
Ethiopia	Ghana	Mauritius
Malawi	Kenya	Namibia
Niger	Nigeria	Seychelles
Uganda	Tanzania	South Africa

Source: *Authors' compilation using information from the World Bank (2023a)*

3.4 Estimation Technique

This study utilized Poisson regression models to analyze the non-linear, count-based infant mortality rate variable (Coxe et al., 2009). Poisson regression accommodates the skewed distribution and overdispersion in mortality rate data better than linear models (Hilbe, 2014), and provides incidence rate ratios for expenditure-mortality relationships (Gani, 2009). Extensions like Negative Binomial regression further address overdispersion issues (Gardner et al., 1995). Poisson regression has been extensively applied in similar past research on determinants of infant and child mortality (Fitri et al., 2021; Gani, 2009; Buor, 2003). By appropriately modeling the functional mortality rate form, Poisson regression aligned with assessing nonlinear health expenditure effects and comparing rate ratios across countries.

3.5 Model Specification

This study adapted the model from Garcia et al. (2023) but captured different variables to align with the research objectives on public health spending and post-neonatal mortality. Rather than Garcia et al.'s outcome of overall infant mortality, this study modeled post-neonatal mortality specifically as a function of public health expenditure, per capita GDP, institutional quality, female literacy, prenatal care, medical density, and sanitation. This enabled isolation of the relationships between these predictors and post-neonatal mortality over time across SSA countries, differentiated by income level. The functional and eeconometrics forms of the model are given in Equations 3.1 and 3.2 respectively below:

$$PNM=f(PHE,PCG,INQ,FEL,PRC,MED,SAN) \qquad 3.1$$

$$lnPNM_{it} = \alpha_0 + \alpha_1 PHE_{it} + \alpha_2 PCG_{it} + \alpha_3 INQ_{it} + \alpha_4 FEL_{it} + \alpha_5 PRC_{it} + \alpha_6 MED_{it} + \alpha_7 SAN_{it} + \varepsilon_{it} \qquad 3.2$$

where, α_0 is the intercept; $\alpha_1$and α_7 are the coefficients of the variables; while ε_t represents the error term.

3.6 Estimation Procedure

The study performed comprehensive descriptive analysis on the dataset using statistics like means and standard deviation to establish foundational understanding of the variables. Poisson regression was then utilized, which models the response variable Y as following a Poisson distribution with its expected value represented as a log-linear combination of parameters.

The Poisson model assumes the variance equals the mean. However, Negative Binomial regression provides more flexibility by allowing the variance to exceed the mean (overdispersion). It incorporates extra-Poisson variation through a Poisson-gamma mixture distribution, introducing unobserved heterogeneity. Wooldridge's (1997) test assesses over/under-dispersion; where an insignificant t-value supports Poisson.

Diagnostic checks assessed the fitted models. The overdispersion test evaluates whether the variance significantly differs from the mean. Non-significant results support the Poisson equidispersion assumption. The Likelihood Ratio Test compares maximized log likelihoods between the full and restricted models. Non-significant findings indicate the constrained model aligns reasonably well with the observed data.

4.1 RESULTS AND DISCUSSION OF FINDINGS

4.2 Descriptive Statistics

The descriptive statistics for the low-, lower middle-, and high & upper middle-income countries are reported on Table 4.1

Table 4.1: *Descriptive Statistics*

				Low Income Country				
STATISTICS	***PNM***	***PHE***	***PCG***	***INQ***	***FEL***	***PRC***	***MED***	***SAN***
Mean	24441.70	6.268898	677.9353	24.25150	25.41404	76.35583	0.073402	14.35776
Maximum	50953.00	10.48070	1017.788	40.28436	40.56944	97.70000	0.402200	44.14582
Minimum	7559.000	2.091145	335.4385	3.791469	10.43872	30.10000	0.002000	4.560500
Std. Dev.	9520.881	2.042821	169.5255	10.70759	9.085130	20.04320	0.065763	10.54214
J.B Stats.	1.334931	2.714486	2.329288	5.186919	4.797458	5.635656	327.8158	20.74184
Probability	0.513007	0.257369	0.312034	0.074761	0.090833	0.059736	0.000000	0.000031
Observation	60	60	60	60	60	60	60	60
				Lower Middle-Income Country				
Mean	75726.58	6.647223	1785.822	29.01456	45.03851	88.25000	0.196677	21.09766
Maximum	300688.0	12.07416	3200.953	53.08057	74.78017	98.50000	0.465800	31.28785
Minimum	8634.000	2.702931	730.8133	6.698565	26.12908	54.10000	0.021000	8.795342

Std. Dev.	108948.1	2.148970	585.4007	12.69528	12.98225	12.52058	0.127746	7.184827
Jarque-Bera	22.20645	0.952897	1.074498	2.618738	2.282084	20.46986	4.949234	5.622166
Probability	0.000015	0.620985	0.584354	0.269990	0.319486	0.000036	0.084195	0.060140
Observations	60	60	60	60	60	60	60	60
High & Upper Middle-Income Country								
Mean	4696.950	11.25891	8572.567	66.80254	87.98329	96.94527	1.107922	61.81921
Maximum	26889.00	15.86284	16851.12	84.61539	117.6371	98.52669	2.892400	74.50297
Minimum	5.000000	7.362204	4252.042	50.00000	66.48757	93.52669	0.363800	42.21040
Std. Dev.	8663.548	2.239292	3370.792	8.384716	14.75311	1.117467	0.761151	9.920690
Jarque-Bera	25.13675	4.817699	9.679423	2.274684	3.559635	10.44459	9.299340	4.540989
Probability	0.000003	0.089919	0.007909	0.320670	0.168669	0.005395	0.009565	0.103261
Observations	60	60	60	60	60	60	60	60

Source: *Authors' computation using E-views.*

The data on Table 4.1 reveals sizable disparities in child health outcomes and influencing health system factors between the income groups. The mean number of post-neonatal deaths is over 5 times higher in poorer low-income nations, averaging 24,441 compared to just 4,697 in wealthier counterparts. Public health spending displays similar staggering contrasts, with low-income countries investing only 6.27% of GDP versus 11.26% for high/upper-middle income on average. Economic prosperity supports greater potential health investments, with per capita GDP averaging $677, $1,786, and over $8,500 for low-, lower-middle, and higher-middle income categories respectively. Meanwhile, weaker governance inhibits health policy effectiveness, with institutional quality scores averaging 24 for low-income nations versus 67 for wealthier groups. Female literacy rates incrementally rise across country income levels from just 25% to 45% to 88%, impacting maternal health behaviors. Only 76% of mothers receive prenatal care in poorer countries compared to near universal 97% coverage in high/upper-middle income nations, directly influencing child mortality prospects. There are only 0.07 physicians per 1,000 people in low-income countries, 1.11 in upper-middle, indicative of severe health worker shortages in poorest areas. And access to basic sanitation to prevent infectious diseases grows from just 14% to 62% between income extremes. The data clearly exhibits linkages between post-neonatal mortality, public health expenditures, economic resources, governance, gender empowerment, prenatal service availability, medical staffing, sanitation access, and other health system factors - with poorer nations facing greater challenges across the board. Comparing descriptive statistics highlights inequalities in healthcare access, delivery, and child outcomes based substantially on country income level disparities.

4.3 Poisson Regression Estimates

The Poisson Regression Estimates for the low-, lower middle-, and high & upper middle-income country categories are presented on Table 4.2.

Table 4.2: *Poisson Regressions and Negative Binomial Estimates*

Variable	**Low Income**	**Lower Middle-Income**	**High & Upper Middle-Income**
C	10.37027*	15.08282*	-7.078681*
	(0.005778)	(0.008767)	(0.433797)
	[0.0000]	[0.0000]	[0.0000]
PHE	-0.013141*	-0.022684*	-1.018214*
	(0.000567)	(0.000624)	(0.003027)
	[0.0000]	[0.0000]	[0.0000]
PCG	0.000533*	2.11E-05*	-0.000183*
	(6.69E-06)	(1.47E-06)	(2.89E-06)
	[0.0000]	[0.0000]	[0.0000]
INQ	0.015937*	-0.021253*	0.085278*
	(0.000130)	(0.000157)	(0.000853)
	[0.0000]	[0.0000]	[0.0000]
FEL	-0.003025*	-0.015622*	-0.049779*
	(0.000137)	(0.000126)	(0.000441)
	[0.0000]	[0.0000]	[0.0000]
PRC	-0.009835*	-0.050678*	-0.028421*
	(7.82E-05)	(8.63E-05)	(0.004188)
	[0.0000]	[0.0000]	[0.0000]
MED	0.720246*	1.539919*	-1.323496*
	(0.016398)	(0.008756)	(0.016930)
	[0.0000]	[0.0000]	[0.0000]
SAN	-0.028247*	0.032264*	0.107684*
	(0.000159)	(0.000153)	(0.001093)
	[0.0000]	[0.0000]	[0.0003]
Restr. log likelihood	-116097.5	-3489851.	-362872.9
Avg. log likelihood	-161.7971	-2271.602	-609.2742
LR statistic	212779.3	6707110.	652633.0
Prob(LR statistic)	0.000000	0.000000	0.000000
Overdispersion Test Result			
PNM	7.19E-05	7.61E-05	0.000914
	(8.79E-05)	(6.53E-05)	(0.000542)
	[0.4171]	[0.2484]	[0.0973]

Figures in parenthesis () represents the Std. Error; Brackets [] represents the prob. Values; * represents 5% significance level.
Source: *Authors' Computation using E-views.*

For the coefficient of Public Health Expenditure (PHE)- the PHE coefficient is -0.013141 in low income countries, -0.022684 in lower middle-income countries, and -1.018214 in high & upper middle-income countries. Though significant across all income groups, public health investments reduce mortality more sharply in higher income nations. The studies by Ayipe and Tanko (2023) and Houeninvo (2022) align with the Poisson regression findings, showing public health spending has a statistically significant negative association with under-five/infant/child mortality across low, lower-middle and upper-middle income African countries. However, the country-specific study by Alimi et al. (2023) found no significant short or long run impact of PHE on infant mortality in Nigeria over 1984-2020. This contrasts the Poisson model which showed PHE reduces mortality.

Similarly, for the coefficient of Per Capita GDP (PCG)- the PCG coefficient is 0.000533 (positive effect) in low income; 0.0000211 (positive) in lower middle income; and -0.000183 (negative effect) in high & upper middle-income countries. Economic growth often fails to trickle down and improve child health outcomes in poorer economies. The Poisson regression indicates higher GDP per capita raises post-neonatal mortality in low & lower-middle income nations, while reducing it in upper middle-income countries. This squared with Mouteyica & Ngepah (2023) who found real per capita GDP differences explain divergence in health outcomes between African countries. But Rahman et al. (2022) show rising GDP lowers infant and child mortality universally across 14 African states. This contrasts the Poisson findings.

Also, for the coefficient of Institutional Quality (INQ)- the INQ coefficient is 0.015937 (weaker institutions increase deaths) in low income; -0.021253 (strong institutions lower deaths) in lower middle income; and 0.085278 (weaker institutions raise deaths again) in high & upper middle-income groups. This indicates institutional transitions across development stages play a complex role. For the variable of Female Literacy (FEL)- the FEL coefficient is consistently negative across income levels: -0.003025 in low income countries, -0.015622 in lower middle-income countries, and -0.049779 in high & upper middle-income countries. Female education unambiguously mitigates mortality over time. The FEL coefficient is consistently negative across low, middle- and high-income groups in the Poisson models, aligning with the marginal effects results in Mouteyica & Ngepah (2023) highlighting female education's significance in determining health outcome convergence clubs. On the other hand, Rahman et al. (2022) did not find education levels to significantly affect infant/child mortality in their 14 country African study.

Furthermore, for the coefficient of Pre-Natal Care (PRC)- similar to female literacy, the PRC coefficient is negative across all income groups: -0.009835 in low income, -0.050678 in lower middle income, and -0.028421 in high & upper middle-income nations, proving quality maternal healthcare access invariably reduces mortality. Also, for the coefficient of Medical Density (MED)- the MED coefficient transitions from 0.720246 (positive effect) in low income countries to 1.539919 (positive effect) in lower middle-income groups to -1.323496 (negative effect signaling over-servicing) for high & upper middle-income nations at peak levels of economic development. Additionally, for Sanitation (SAN)- the SAN coefficient also varies- from -0.028247 (positive impact on lowering mortality) in low income countries; to 0.032264 (indicating wider infrastructural deficiencies offsetting benefits) for middle income groups; to 0.107684 (similar deficiencies) in higher income economies.

In the case of the diagnostic tests- the overdispersion test statistics are statistically insignificant across all three income groups- with p-values of 0.4171 (low income); 0.2484 (lower middle income); and 0.0973 (high & upper middle income). This validates the Poisson regressions by showing no evidence of overdispersion bias. Similarly, the LR test statistics of 212779.3 (low income); 6707110 (lower middle income); and 652633.0 (high & upper middle income) are highly significant, with p-values approximating 0. This confirms the joint significance of the explanatory variables in determining post-neonatal mortality in each model. The diagnostic examinations support the adequacy of the Poisson models across the income groups. The regressions demonstrate strong explanatory power without overdispersion or coefficient bias.

5.1 CONCLUSION AND RECOMMENDATION

This study conducted an in-depth comparative analysis investigating public health expenditure's impact on post-neonatal mortality across low, lower-middle, and upper-middle income Sub-Saharan African nations over 2010-2021. Aligning with the Health Expenditure-Outcome theoretical framework, the analysis modeled country-specific reductions in preventable newborn deaths as a function of greater governmental health spending controlling for economic, institutional, social and environmental factors.

The descriptive findings revealed sizable disparities in post-neonatal mortality rates, health financing, economic conditions, medical access, sanitation, and other correlates across poorer versus wealthier SSA country income levels. The Poisson regression results demonstrated that marginal increases in public health spending as a share of GDP are associated with significant curtailing of post-neonatal deaths universally across low, middle, and high-income groups. However, the degree of mortality reduction per extra unit of health expenditure was substantially higher in upper-middle income countries compared to poorer counterparts. This indicates health system strengthening interventions enabled through public financing translate into greater measurable gains in child survival as institutional capacity grows. Still, increasing health budgets pays dividends towards saving newborn lives regardless of income status. Alongside health spending, the models reaffirmed the significance of social investments like female literacy and maternal healthcare access in mitigating post-neonatal deaths consistently over time across all income groups. Hence balanced policy attention towards economic, institutional as well as social development is vital.

These findings carry salient implications for health financing policy dialogues underway in several Sub-Saharan African countries. With narrow fiscal space, governments face difficult trade-offs regarding public budget allocations. This analysis provides evidence supporting the high return-on-investment from sustained investments in the health sector, while leveraging synergies with education, gender equity, water/sanitation and integrated policy efforts. Specifically, ministries of finance and health should collaboratively develop national roadmaps to incrementally raise public health spending to meet Abuja targets. Earmarking funds for maternal, newborn and child health interventions as part of an essential package could accelerate mortality reductions. Particularly for lower income SSA nations, increasing external aid flows targeted at health system strengthening, alongside budgetary reallocation, can expand fiscal space.

Furthermore, ensuring efficient utilization of health finances requires governance reforms strengthening public financial management, transparency, and removing wastages that hamper optimal translation of expenditures into quality service delivery and better outcomes. Beyond ministerial investments, cross-sectoral engagement on social determinants of health spanning clean water access, girls' education, and community infrastructure represents a sustainable path to reaching SDG child mortality reduction goals through greater health equity.

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