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Original Research Article

Interactive Effects of Health Expenditure and Income Inequality on Under-five Mortality in Sub-Saharan Africa

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Abstract: This study examines the interactive effects of health expenditure and income inequality on under-five mortality in Sub-Saharan Africa from 2000 to 2023 using a Generalized Method of Moments (GMM) approach. Utilizing panel data from the World Bank (2025), child mortality is measured per thousand live births, health expenditure is categorized into public and private components, and income inequality is captured via the Gini coefficient. Empirical results indicate that domestic public health expenditure has a negative but statistically insignificant direct effect on under-five mortality, whereas domestic private health expenditure shows a significant negative effect. Conversely, income inequality significantly increases child mortality. Notably, the interaction between public health expenditure and income inequality is negative and statistically significant, demonstrating that equitable public healthcare financing helps mitigate the adverse health impacts of income disparities. In contrast, the interaction between private health spending and income inequality is positive and statistically significant. The study concludes that expanding equitable public health spending and addressing socio-economic inequality are essential strategies for improving child survival outcomes across the region.

Keywords: Under-Five Mortality, Health Expenditure and Income Inequality.

1.0 Introduction

Reducing under-five mortality remains a central objective of global health policy, particularly in Sub-Saharan Africa (SSA), where child mortality rates are still among the highest in the world despite notable progress over recent decades. Under-five deaths have declined from about 12.6 million in 1990 to approximately 4.9 million in 2022**,** reflecting significant improvement over time. However, Sub-Saharan Africa still accounts for about 56% of global under-five deaths**,** despite having a smaller share of the world's child population. The regional under-five mortality rate remains among the highest in the world,

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at roughly 74 deaths per 1,000 live births (2022 estimate)**,** compared to the global average of about 37 per 1,000 live births**.** These deaths are largely driven by preventable conditions such as pneumonia, malaria, diarrhea diseases, and neonatal disorders (UNICEF, 2023; World Health Organization, 2022).

While increased health expenditure has been widely recognized as a critical driver of improved child health outcomes, the broader socioeconomic environment, especially income inequality, plays a fundamental role in shaping the effectiveness of such investments. Income inequality influences access to healthcare services, nutrition, sanitation, and education, all of which are essential determinants of child survival (World Health Organization, 2020).

High levels of income inequality in SSA countries have been associated with uneven distribution of health resources and limited access to quality healthcare among disadvantaged populations. This disparity often leads to worse health outcomes for children from low-income households, thereby increasing under-five mortality rates (United Nations Children's Fund, 2021). Theoretical and empirical literature suggests that even when overall health expenditure increases, its impact on health outcomes may be weakened in highly unequal societies due to inequitable allocation and utilization of resources (Wilkinson & Pickett, 2009; Ouedraogo et al., 2020).

Furthermore, public health expenditure is expected to reduce under-five mortality by improving healthcare infrastructure, expanding access to medical services, and enhancing preventive care (Bokhari et al., 2007). However, the effectiveness of such expenditure is not uniform across countries and often depends on structural factors such as governance quality and income distribution. In contexts where income inequality is high, the benefits of public health spending may be disproportionately captured by wealthier segments of the population, limiting its overall impact on child health outcomes (Gupta et al., 2003).

Despite growing recognition of the role of inequality, existing studies have largely examined the independent effects of health expenditure and income inequality on child mortality, with limited attention to their interactive impact. This creates a gap in understanding how income inequality conditions the effectiveness of health expenditure in reducing under-five mortality in SSA. Addressing this gap is particularly important given the region’s persistent socioeconomic disparities and ongoing efforts to achieve the health-related Sustainable Development Goals.

Against this backdrop, this study investigates the interactive income inequality and Health expenditure on under-five mortality in Sub-Saharan Africa using panel data analysis. By incorporating income inequality as a conditioning factor, the study provides deeper insights into whether increased health spending translates into better child health outcomes across different levels of income distribution.

2.0 Literature Review

2.1 Concept of Health Expenditure

Health expenditure refers to the total financial resources devoted to the prevention, promotion, and restoration of health within a given population. It includes spending by governments, private individuals, insurance schemes, and external donors on medical services, public health programs, and health infrastructure (World Health Organization [WHO], 2020). Broadly, it is categorized into public health expenditure, private health expenditure, and out-of-pocket payments, each reflecting different financing mechanisms and access implications (Dieleman et al., 2016). Higher levels of health expenditure are generally associated with improved health outcomes, including reduced mortality rates and increased life expectancy, although the efficiency of spending is equally important (Novignon et al., 2012).

Moreover, health expenditure is not only a measure of resource allocation but also an indicator of a country's commitment to human capital development. However, disparities in health spending, especially in developing regions, often lead to unequal access to healthcare services and poorer outcomes among vulnerable populations (Orach & Garimoi, 2009). The effectiveness of health expenditure depends on governance quality, institutional efficiency, and equitable distribution of resources (Rajkumar & Swaroop, 2008). Thus, while increasing health expenditure is essential, ensuring its efficient and equitable utilization is critical for achieving optimal health outcomes.

2.2 Concept of Income Inequality

Income inequality refers to the uneven distribution of income across individuals or groups within a society. It highlights the gap between the rich and the poor, often measured using indicators like the Gini coefficient (World Bank, 2023). High income inequality can limit access to essential services such as education and healthcare, thereby reinforcing cycles of poverty (Stiglitz, 2012). Economic globalization and technological change have been identified as key drivers of widening income gaps, as they tend to benefit skilled workers more than unskilled ones (Piketty, 2014). Additionally, weak government policies, such as inadequate taxation and social welfare systems, can exacerbate inequality. Income inequality also has social and political consequences, including reduced social mobility and increased social tensions (OECD, 2015). Addressing it requires inclusive policies, progressive taxation, and investment in human capital development.

2.3 Concept of Under Five Mortality

Under-five mortality rate (U5MR) refers to the probability that a child born in a given year will die before reaching the age of five, usually expressed per 1,000 live births. It is a key indicator of child health and overall socio-economic development (World Bank, 2023). U5MR reflects the combined effects of nutrition, healthcare access, maternal education, environmental conditions, and public health interventions (UNICEF, 2022). High rates are often associated with poverty, weak health systems, and inequality in access to essential services. Conversely, declining under-five mortality suggests improvements in

immunization, sanitation, and maternal and child healthcare. In developing regions, preventable causes such as pneumonia, diarrhea, and malaria remain major contributors to child deaths (WHO, 2021). The indicator is widely used to monitor progress toward global goals such as the Sustainable Development Goals (SDGs). Importantly, disparities in U5MR across and within countries highlight inequities in health outcomes. Therefore, reducing under-five mortality requires integrated policies addressing both health sector investment and broader social determinants. Overall, U5MR serves as a critical measure of a nation's development and the effectiveness of its health policies.

2.4 Empirical literature review

Odusanya et al (2021) examine the effect of income inequality on health outcomes for 31 Sub-Saharan African countries from 1995 to 2015 using life expectancy at birth, infant mortality rate, and under-five mortality rate as indicators of population health, as well as the Gini index as a measurement of income inequality. The study employed the Generalized Method of Moments (GMM). The study shows that income inequality contributes significantly to poor population health in Sub-Saharan Africa, thereby affirming the validity of the Income Inequality-Health Hypothesis for the region

In another study, a sub-Saharan African study, Malderen (2019) investigated the socio-economic determinants of under-five mortality in Sub-Saharan Africa, aiming to evaluate the relative contributions of four key socio-economic factors to variations in child mortality rates across the region. The study utilized birth history data from Demographic and Health Surveys conducted in 32 Sub-Saharan African countries between 2010 and 2016. Using a regression-based decomposition of a Gini-type index, the study assessed the influence of a child's sex, place of residence, maternal education, and household wealth on under-five mortality. The findings highlighted significant inequalities in child mortality rates across the region, with no single explanatory pattern applicable to all countries.

In another study, Ray et al. (2020) examined the relationship between health expenditure and health outcomes using a global panel dataset of 195 countries covering the period 1995–2014. The study employed dynamic panel data estimation techniques, which are designed to handle persistence in health indicators such as life expectancy and infant mortality. The result shows that Public health expenditure has a stronger and more consistent positive impact on health outcomes compared to private health expenditure, where private health expenditure was found to be negative but insignificant, meaning a weaker and less consistent impact on health outcomes compared to public health expenditure.

Jamshaid et al. (2023) estimate the impact of income inequality on the health sector performance of Pakistan. Health performances are measured with the two leading indicators, life expectancy and infant mortality rate (IMR). The study employs the Autoregressive Distributed Lag (ARDL) model for co-integration analysis from 1980-2020. Furthermore, this study investigates the causality analysis with the help of the Toda Yamamoto Modified Wald test. The empirical result shows that income inequality has an adverse and significant impact on Pakistan's health performance measures. Moreover, the

unidirectional relationship is confirmed between income inequality and life expectancy. The findings of the current work suggest that reducing income inequality would be an essential policy option for improving infant mortality conditions, life expectancy, and other poor health outcomes.

While Adebowale and Onisanwa (2024) examined the effect of health expenditures on health outcomes in Sub-Saharan African (SSA) countries. The study was based on the Grossman Human Capital Model on the demand for health, and a fixed effect model was estimated to investigate the effect of health expenditure on health outcomes. The findings revealed that public, private and external health expenditures have negative and statistically significant effects on infant mortality, but have positive and statistically significant effects on life expectancy. The fixed effects showed that public, private and external health expenditures are important in reducing infant mortality. While fixed effects showed that public, private and external health expenditures improve life expectancy.

Similarly, Arthur and Oaikhenan (2017) examined the influence of public and private health expenditures on health outcomes across 40 SSA countries using a fixed effects estimation technique. Their findings aligned with prior studies, concluding that public health expenditure significantly reduces under-five mortality rates, while private health expenditure does not have a significant impact on under-five mortality.

Antonio et al. (2024). This study assesses the relationship of income inequality as a determinant of neonatal mortality in the Americas and relates it to the achievement of the Sustainable Development Goals. Yearly data from 35 countries in the Americas during 2000–2019 was collected. The Study employs a linear regression model that relates the neonatal mortality rate (dependent variable) to the Gini index (independent variable), while controlling for other factors that influence neonatal mortality. Coefficient estimates and their robust standard errors were obtained using panel data techniques. A positive relationship between income inequality and neonatal mortality is found in countries in the Americas during the period studied. In particular, the analysis suggests that a unit increase in a country's Gini index during 2000–2019 is associated with a 0.27 (95% CI [− 0.04, 0.57], P =.09) increase in the neonatal mortality rate.

Oluwaseun and Onisanwa (2024) examine the effect of income distribution disparity on life expectancy and determine the causal relationship between health outcomes and income inequality in Nigeria. The Autoregressive Distributed Lag model was estimated to examine the impact of income inequality on life expectancy. Toda Yamamoto causality was used to determine the causal relationship between life expectancy and income inequality. Income inequality had a negative impact on life expectancy, both in the long-run and short run, but statistically significant in the long run. There is a unidirectional causality running from life expectancy to the Gini coefficient.

In another development, Onisanwa and Audi (2024) investigated the impact of health expenditure on child health outcomes in Sub-Saharan Africa (SSA) using data obtained from the World Bank database, covering 44 countries in the region. The study utilized two key indicators of child health outcomes: infant mortality rate and child

mortality rate. A fixed effects model was estimated to analyze the relationship between health expenditure and child health outcomes. The findings indicated that total health expenditure had a significant negative effect on both infant and child mortality rates, demonstrating that increased health spending led to a reduction in under-five and infant mortality rates.

Agbatogun et al. (2025) study examines the effects of income inequality and out of pocket (OOP) health expenditure on health outcomes proxy by the under-five mortality rate in selected economies in Africa. The study employed a constructed ARDL-PMG Model. The outcome shows that none of the independent variables have significant effect on under-five mortality rate in the short-run. However, in the long-run both Gini index and OOP demonstrate positive significant effect on under-five mortality. While health expenditure and GDP per capita show a significant negative effect.

In another study, Amy & Daniel (2020) examine the relationship between income inequality the risk for infant/neonatal mortality at the state and country level and tested possible mediators of this relationship. The study used multilevel model to test whether income inequality was associated with infant/neonatal mortality. Country-level factors were tested as potential mediators. Adjusted analysis indicated that income inequality associated with infant/neonatal mortality at the country level, but not at the state level where was associated with increased odds of infant/neonatal deaths. Our mediators explain all these variations. Bivariate analysis reveals an association between 3 country-level measures: patient-to-physician ratio, the violent crime rate and infant and neonatal mortality rate. Proportion of college-educated adults was associate with decrease odds for neonatal mortality.

The studies reviewed provide strong evidence that income inequality worsens health outcomes, but they leave several important gaps: First, lack of interaction analysis is the most critical gap. Most studies such as Odusanya et al. (2021) Jamshaid et al. (2023) and Antonio et al. (2024), examine the direct effect of income inequality on health outcomes, but they do not explore how income inequality and health expenditure jointly influence under-five mortality. Only Agbatogun et al. (2025) comes close, yet even that study focuses more on long-run effects without deeply modeling interaction terms or conditional relationships.

Second, there is a limited focus on under-five mortality specifically. Several studies such as Jamshaid et al. (2023) Oluwaseun & Onisanwa (2024) Amy & Daniel (2020), use broader indicators like life expectancy and infant mortality which may mask the unique determinants of under-five mortality. This creates a gap in understanding child-specific vulnerabilities, particularly in Sub-Saharan Africa where under-five mortality remains high.

3.0 Data and Methodology

This section of the study outlines the nature and sources of the data employed, as well as the model specification and the analytical techniques applied.

3.1 Source/ Method of Data Collection

This study utilizes secondary data drawn from credible international databases. Data on under-five mortality rate, domestic public health expenditure, and domestic private health expenditure are obtained from the World Bank (2024). While data on income inequality are drawn from the Standardized World Income Inequality Database (Solt, 2024). The dataset consists of annual observations covering a 23-year period from 2000 to 2023, selected based on data availability and the relevance of trends in child mortality. The study focuses on a panel of 46 countries in Sub-Saharan Africa.

3.2 Model specification

To evaluate the interactive impact of income inequality and Health Expenditure on under-five mortality in Sub-Saharan Africa, this study will employ health production theory by Grossman in 1972 as a theoretical framework of the study.

This study adapts the empirical model of Sibanda et al. (2024**)**, who examine the relationship among Health Expenditure, Institutional Quality, and Under-Five Mortality in Sub-Saharan Africa. Their study explicitly specifies a panel interaction model of the form:

$U5MR_{it} = \beta_1 HE_{it} + \beta_2 (HE_{it} \times INST_{it}) + \beta_3 X_{it} + \varepsilon_{it}$

Where:

U5MR = under-five mortality rate

HE = health expenditure (public, private, out-of-pocket, external)

INST = institutional quality index

HE × INST = interaction term capturing moderation effect

In line with Sibanda et al. (2024), the functional GMM estimation framework employed in this study can be expressed as follows:

$$U5MR_{it} = \alpha + \beta_1 Dphe_{it} + \beta_2 Dprh_{it} + \beta_3 Ineq_{it} + \beta_4 (Dphe_{it} \times Ineq_{it}) + \beta_5 (Dphe_{it} \times Ineq_{it}) + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where

$U5MR_{it}$ = Under five Mortality rate

$Dphe_{it}$ = *Domestic public health expenditure*

$Dprh_{it}$ = *Domestic private health expenditure*

$Ineq_{it}$ = Income Inequality

$Dphe_{it} \times Ineq_{it}$ = interaction term of Domestic public health expenditure and Income inequality on mortality

$Dprh_{it} \times Ineq_{it}$ = interaction term of Domestic private health expenditure and Income inequality on mortality

α = Intercept

$\varepsilon_{it} = error\ term$

i: Country, t: Time

β_1 ($Dphe_{it}$): Effect of Domestic health expenditure on under-five mortality when governance = 0

β_2 ($Dprh_{it}$): Effect of Domestic private health expenditure on under-five when Income inequality = 0

β_3 (Income inequality**):** Direct effect of Income inequality on under-five mortality

β_4 ($Dphe_{it} \times Ineq_{it}$**):** interaction terms capture how Income inequality modifies the effect of Domestic public health spending on under-five mortality.

B_5 **(**$Dprh_{it} \times Ineq_{it}$**):** interaction terms capture how Income inequality modifies the effect of Domestic private health expenditure.

Aprior expectation:

If the coefficients of β_4 and B_5 are negative and significant means Income inequality strengthens the mortality-reducing effect of health expenditure, if the coefficients are positive, it implies that Income inequality weakens the mortality-reducing effect of health expenditure, which is theoretically uncommon.

4.0 Analysis and Results

This section presents the analysis of the interaction effects between health expenditure and governance on under-five mortality in Sub-Saharan Africa over the period 2000 to 2023. The empirical analysis begins with the presentation of the panel unit root test results, followed by the correlation analysis. It then proceeds to the estimations from the pooled OLS, fixed effects, and difference GMM models, before presenting the system GMM results. Finally, the section concludes with the system GMM diagnostic test results.

4.1 Panel Unit Root Test Result

To ensure the validity of the empirical analysis over the study period, this study conducts a stationarity test of all variables, which is a critical prerequisite in panel data analysis, particularly in datasets with a long-time dimension spanning the period of study**.** This is necessary because the use of non-stationary data may lead to spurious regression results and unreliable parameter estimates.

To determine the order of integration of the variables over the study period, panel unit root tests were employed using both first-generation and second-generation methodologies. The first-generation panel unit root tests include the Harris–Tzavalis (ρ) and Levin–Lin–Chu (LLC) tests, both of which operate under the null hypothesis that the variable contains a unit root. These tests assume cross-sectional independence among the panel units.

To further strengthen the robustness of the findings and account for potential cross-sectional dependence among countries over the study period, a second-generation

panel unit root test, the Cross-sectionally Augmented Im, Pesaran and Shin (CIPS) test was also employed. This test provides additional confirmation of the stationarity properties of the variables by allowing for cross-sectional correlation. The results of these tests are presented in Tables 1 and 2.

Table 1: Panel Unit Root Test Results (Harris-Tsavalis and Levin-Lin-Chu)

Harris-Tzavalis	**At level 1(0)**	**Prob**	**1st Difference 1(1)**	**Prob**
U5MR	0.6984	0.0000**	-0.5796	0.0000
Dphe	0.7343	0.0000**	-0.2731	0.0000
Dprh	0.7660	0.0000**	-0.1888	0.0000
Ineq	-0.0287	0.0000**	-0.6361	0.0000
Levin-Lin-Chu				
U5MR	-14.9527	0.0000**	-12.2772	0.0000
Dphe	-3.8283	0.0001**	-15.5242	0.0000
Dprh	-5.9156	0.0000**	-13.6881	0.0000
Ineq	-3.4922	0.0002**	-17.4475	0.0000

Note: The asterisk (**) denotes rejection of the null hypothesis that the series has a unit root at 5%
Source: Authors' Computation from STATA 17

The Harris-Tsavalis unit root test in Table 1 results show that under-five mortality rate (U5MR), domestic public health expenditure (Dphe), domestic private health expenditure (Dprh) and income inequality (Ineq) are stationary at level or integrated of order zero [1(0)]. The result of the Levin-Lin-Chu unit-root further confirms the result of the Harris-Tsavalis unit root test and shows that under-five mortality rate (U5MR), domestic public health expenditure (Dphe), domestic private health expenditure (Dprh) and income inequality (Ineq) are also stationary at level or integrated of order zero [1(0)] as justifies by significant probability values at 5% level. Thus, the first-generation unit root tests **(**Harris-Tsavalis unit root test and Levin-Lin-Chu unit-root**)** affirmed that none of the series is stationary at the second difference.

The stationarity properties of the series were further examined using a second-generation panel unit root test, under the null hypothesis that all cross-sectional units contain a unit root. This approach was employed to more robustly determine the order of integration of the variables, while accounting for potential cross-sectional dependence among the panel units. The result of the Cross-sectionally Augmented Im, Pesaran and Shin (CIPS) unit root test is shown in Table 2.

Table 2: Cross-Sectionally Augmented IPS (CIPS) Panel Unit Root Test Results

Pesaran's CADF	**Level (I(0))**	**5% CV**	**1st Difference**	**5% CV**	**Order**
U5MR	-2.329	-2.11**	-1.535	-2.11	I(0)
Dphe	-2.003	-2.11	-5.108	-2.11**	I(1)
Dprh	-2.493	-2.11**	-4.972	-2.11	I(0)
Gov	-2.071	-2.11	-4.926	-2.11**	I(1)

Ineq	-3.531	-2.11**	-5.432	-2.11	I(0)

Note: The asterisk (**) denotes rejection of the null hypothesis that the series has a unit root at 5%
Source: Authors' Computation from STATA 17.

The CIPS test shows that under-five mortality rate (U5MR), domestic private health expenditure (Dprh), and income inequality are stationary at level (integrated of order zero, I(0))**.** In contrast, domestic public health expenditure and governance are stationary at first difference (integrated of order one, I(1)**)**. Thus, the results in Table 2 indicate that the variables in the study have mixed orders of integration [I(0) and I(1)]**,** but none of the variables is integrated of order two [I(2)]**.**

4.2 Correlation Analysis

The correlation test assesses multicollinearity among under-five mortality, domestic public and private health expenditure and income inequality. Correlation coefficients (r), ranging from -1 to 1, indicate the strength and direction of relationships between variables. Following Noora (2020), multicollinearity is present when |r| = 0.8; otherwise, it is not a concern.

Table 3: Correlation Result

Variables	U5MR	Dphe	Dprh	Ineq
U5MR	1.0000			
Dphe	-0.4508	1.0000		
Dprh	0.3944	-0.5575	1.0000	
Ineq	0.0311	0.0740	-0.0539	**1.0000**

Source: Authors' Computation from STATA 17

The results of the correlation test show weak association among under-five mortality rate, domestic public health expenditure, domestic private health expenditure and income inequality. This indicates lack of multicollinearity, meaning the variables are relatively independent and do not convey overlapping information given that the correlation values are not equal to 0.8 (Noora, 2020). Such independence can enhance the reliability of the model's coefficients and predictions, as multicollinearity can lead to unstable estimates and reduced interpretability. Therefore, the low correlations suggest that the model is free from the multicollinearity problem.

4.3 Choosing between Difference Generalized Method of Moments (GMM) and System GMM

The selection of GMM in this study follows the rule of thumb proposed by Bond (2001). According to Bond (2001), an autoregressive model should first be estimated using pooled OLS and fixed effects methods. The pooled OLS estimate of the lagged dependent variable (under-five mortality rate) is regarded as the upper-bound estimate, while the corresponding fixed effects estimate serves as the lower-bound estimate. If the Difference GMM estimate is close to or falls below the fixed effects estimate, it indicates that Difference GMM is downward biased due to weak instruments; hence, System GMM

becomes more appropriate. Following Bond's (2001) procedure, the pooled OLS, fixed effects, and Difference GMM estimates are reported in Table 3.

Table 4: Pool OLS, Fixed Effect and Difference GMM Results (LEX as response varaible)

Pool OLS	Pool OLS		Fixed Effect		Difference GMM
Variables		Variables		Variables	
L.U5MR	0.8002537	L.U5MR	0.307369	L. U5MR	0.2692326
	(0.000)***				

Robust standard errors in parentheses, ** p<0.05
Source: Authors' Computation from STATA 17

The pooled OLS results in Table 4 indicate that the coefficient of the lagged under-five mortality rate is 0.800. In the fixed effects estimation, this coefficient declines to 0.307, while under the difference GMM specification it further falls to 0.269. According to Bond (2001), the fact that the difference GMM estimate is lower than the fixed effects estimate implies that system GMM is the more appropriate estimator. Consequently, the study employs system GMM, with a preference for the two-step estimator, since it is asymptotically more efficient than the one-step estimator as it applies optimal weighting of the moment conditions based on the variance-covariance structure of the error terms.

4.4 Interactive impact of health expenditure and income inequality on under-five mortality in Sub-Saharan Africa

Table 5: Generalized Method of Moments (GMM) test result of the interactive impact of health expenditure and income inequality on under-five mortality in Sub-Saharan Africa

Variables	Coefficient	Standard Errors	Prob
L.U5MR	.1287522	.1624336	0.432
Dphe	-.2255252	.4190123	0.593
Dprh	-1.061090	.175661	0.000
Ineq	.917938	.312660	0.007
Dphe_Ineq	-.051267	.017454	0.008
Dprh_Ineq	.344317	.1718341	0.043
Yr3	-4.509028	2.359365	0.063
Yr4	-9.158121	3.160399	0.006
Yr5	-13.15545	4.016314	0.002
Yr6	-15.6971	4.598538	0.001
Yr7	-21.81807	5.016361	0.000
Yr8	-25.12918	5.887864	0.000
Yr9	-28.06493	6.728067	0.000
Yr10	-27.08642	4.797771	0.000
yr11	-34.32438	7.40114	0.000
yr12	-37.03446	8.399502	0.000
yr13	-38.45685	8.127511	0.000
yr14	-38.45685	8.127511	0.000
yr15	-41.71311	8.96749	0.000

yr16	-45.75957	9.925167	0.000
yr17	-46.38768	9.739923	0.000
yr18	-47.36808	9.404515	0.000
yr19	-49.73429	10.11836	0.000
Yr20	-49.41529	9.46185	0.000
yr21	-52.16428	10.18984	0.000
yr22	-52.50077	9.983748	0.000
yr23	-51.93544	8.694359	0.000
yr24	-58.24762	11.30913	0.000
Cons	72.12169	28.31919	0.015

Source: Authors' Computation from STATA 17

4.11 Generalized Method of Moments (GMM) diagnostic test

The system GMM validity and reliability of Results are shown in Table 5 below:

Table 5: Autocorrelation and Instrument Validity Test Results

Test		
Arellano-Bond test for AR(2) in first differences	z = -0.81	Pr > z = 0.147
Hansen test of overid. Restrictions	chi2(44) = 6.528	Prob > chi2 = 0.314

Source: Authors' Computation from STATA 17

The test for autocorrelation is checked using the Arellano-Bond test for AR(2) in first differences, with the null hypothesis that the error term is not serially correlated. The probability value of 0.147 for the Arellano-Bond test for AR(2) shows no second-order series correlation (that is the value of AR (2) > 0.05). This implies that the original error term is serially uncorrelated and the moment conditions are correctly specified. The Hansen test for overall validity of the instrument is used and it has a p-value of 0.314, which supports the choice of instruments since the p-value is not below 0.50 but between 0.05 and 0.80; thus, the instruments are valid.

5.0 Conclusion and Recommendation

The findings of this study provide strong evidence that health financing plays a decisive role in shaping child survival outcomes in Sub-Saharan Africa. Specifically, domestic public health expenditure emerges as a critical protective factor, though not significantly reducing under-five mortality directly. But indirectly, through its interaction with income inequality reveals that increased public spending not only improves health outcomes but also mitigates the adverse effects of unequal income distribution. In contrast, the interaction between private health expenditure and income inequality is associated with higher under-five mortality, indicating that reliance on private, market-driven healthcare systems in highly unequal societies may deepen disparities in access to essential health services and ultimately worsen child health outcomes.

The study concludes that the effectiveness of health financing in reducing under-five mortality in Sub-Saharan Africa depends not only on the level of health

expenditure but also on the distributional context within which such spending occurs. These findings underscore the importance of strengthening publicly financed health systems and implementing policies that reduce income inequality as complementary strategies for improving child health and accelerating progress toward the reduction of preventable under-five deaths in Sub-Saharan Africa.

Based on these findings, it is recommended that governments in Sub-Saharan Africa prioritize increased and sustained investment in public health systems as a central strategy for reducing child mortality. Policymakers should focus not only on expanding the volume of public health expenditure but also on ensuring its equitable allocation toward primary healthcare services, particularly in underserved and low-income communities. In addition, efforts to reduce income inequality, such as through progressive taxation, social protection programs, and inclusive economic policies, should be pursued alongside health sector reforms to enhance the overall effectiveness of health spending. Furthermore, while private sector participation in healthcare can complement public provision, it should be carefully regulated to prevent inequities in access and affordability. Strengthening health system governance, improving efficiency in resource utilization, and promoting universal health coverage will also be essential in ensuring that increased health spending translates into meaningful and sustained improvements in child survival across the region.

Policy Implications/Recommendations: Based on these findings, it is recommended that governments in Sub-Saharan Africa prioritize increased and sustained investment in public health systems as a central strategy for reducing child mortality. Policymakers should focus not only on expanding the volume of public health expenditure but also on ensuring its equitable allocation toward primary healthcare services, particularly in underserved and low-income communities. In addition, efforts to reduce income inequality, such as through progressive taxation, social protection programs, and inclusive economic policies, should be pursued alongside health sector reforms to enhance the overall effectiveness of health spending. Furthermore, while private sector participation in healthcare can complement public provision, it should be carefully regulated to prevent inequities in access and affordability. Strengthening health system governance, improving efficiency in resource utilization, and promoting universal health coverage will also be essential in ensuring that increased health spending translates into meaningful and sustained improvements in child survival across the region.

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