STUDIA UNIVERSITATIS ECONOMICS SERIES
"Vasile Goldiș" Western University of Arad
2026 - 36(1)
DOI: 10.2478/sues-2026-0004

PUBLIC HEALTH EXPENDITURE AND MATERNAL MORTALITY RATE IN SUB-SAHARAN AFRICAN COUNTRIES

Afamefuna A. Eze*
Department of Economics, University of Nigeria, Nsukka, Nigeria
Email: angus.eze@unn.edu.ng
https://orcid.org/0000-0003-1163-372X

Philip F. Usman
Department of Economics, University of Nigeria, Nsukka, Enugu, Nigeria
Email: blossomemmanuel78@gmail.com

Ezebuilo R. Ukwueze
Department of Economics, University of Nigeria, Nsukka, Enugu, Nigeria
Email: ezebuilo.ukwueze@unn.edu.ng

(Received: December 2024; Accepted: March 2025; Published: February 2026)

Abstract: The study looked at public health spending and maternal mortality in Sub-Saharan Africa (SSA). The specific objectives were to: investigate the impact of public health expenditure on maternal mortality in Sub-Saharan Africa; determine whether there is a disparity in the impact of public health expenditure on maternal mortality across four sub-regions of Sub-Saharan Africa; and determine the nature of the causal relationship between public health spending and maternal mortality in Sub-Saharan Africa. The study employed the Panel ARDL, the Panel Co-integration Test, and the Panel Granger Causality Test to achieve the objectives. According to the findings, an increase in public health investment corresponds to a decrease in maternal death rates in sub-Saharan Africa. The regional analysis shows that public health expenditure has a long-run significant and negative impact on maternal mortality rate in the Central and Western regions of sub-Saharan Africa countries. Whereas, results from Southern and Eastern regions showed a positive and insignificant impact of public health spending on maternal mortality rate in the long run. The study reveals a unidirectional relationship between public health expenditure and maternal mortality rate with causality running from public health expenditure to maternal mortality rate and no causality running from maternal mortality rate to public health expenditure in both the full SSA sample and in the South SSA sample. The result also revealed a bidirectional

* Corresponding author: Afamefuna A. Eze. *E-mail: angus.eze@unn.edu.ng*

relationship between public health expenditure and maternal mortality rate in Central sub-Saharan Africa both in the short-run and the long-run while there was no evidence of causality in East and West sub-Saharan Africa. The study therefore recommends targeted healthcare spending and suggests that investments in public health, education, and economic development can effectively lower maternal mortality rates.

Keywords: Public health spending; maternal mortality rate; ARDL model; Granger causality test.

JEL Codes: I130, I120, C130, C2.

1. Introduction

Sub-Saharan Africa (SSA) faces a persistent challenge of high maternal mortality rates, compounded by economic poverty, inequality, and inadequate healthcare infrastructure. Despite the critical need for public health investment, many SSA countries allocate a greater share of healthcare spending to the private sector than to public health, creating a significant barrier to achieving positive health outcomes. The Millennium Development Goals (MDGs) aimed to address this by setting a global target to reduce maternal and infant mortality by two-thirds. Additionally, the African Union committed member nations to devote at least 15% of their annual budgets to health by 2015—a pledge known as the Abuja Declaration (Hamzat, Joy & Ali, 2019). However, by 2012, most SSA countries had fallen short of this target. Recognizing the shortfalls of the MDGs, the Sustainable Development Goals (SDGs), introduced in 2015, set a new agenda to ensure significant progress in maternal and child health by 2030 (World Health Organization [WHO], 2020). Some SSA countries have demonstrated the positive impact of increased public health investment. For instance, Botswana allocated 17.8% of its national budget to health in 2001, increasing to 21.3% by 2020, while Rwanda's health budget grew from 18.0% to 29.4% over the same period. These investments led to substantial improvements: maternal mortality rates in Rwanda dropped from 34.1% in 2001 to 12.3% in 2020, while Botswana's decreased from 51.3% to 10.8% (WHO, 2001; WHO, 2020).

In contrast, Nigeria's healthcare sector tells a different story. Although public health expenditure grew in absolute terms—reaching N12.56 billion in 2020 compared to N52.78 million in 1980—the share of health spending in the national budget declined from 10.5% in 1980 to 6.5% in 2020 (National Bureau of Statistics, 2020). This downward trend undermines Nigeria's ability to meet the Abuja Declaration's target and exacerbates the challenges in improving maternal health outcomes. On average, SSA countries allocate only 6.5% of their total budgets to health, far below the 15%

commitment, even though some countries with fewer resources manage to meet this goal (World Bank, 2020).

The impact of insufficient public health spending is evident in maternal mortality trends across SSA. Although the region experienced modest declines in mortality rates from 1960 to 1990, the trend reversed after 2000. By 2015, maternal mortality rates reached alarming levels, and by 2020, they stood at 54.9% in countries such as Nigeria, Benin, Gambia, Mali, and Mozambique (Index Mundi, 2021). Despite the SDG targets, many SSA nations continue to struggle with high maternal mortality, driven by complications during pregnancy and inadequate healthcare access (Nwokocha, 2018). This underscores the urgent need for sustained public health investment to improve maternal health and reduce mortality by 2030.

To this end, this study investigates public health expenditure and maternal mortality in sub-Saharan in 21 African countries from 1980–2020. In addition, the significant gap is that some of the previous studies such as Ayoola (2012), Imoughele (2013), Oni (2014), Ibe (2015), Bedir (2016) Maduka, Chekwube and Chukwunonso (2016) focused on public health expenditure and economic growth as a whole while little attention has been given to the impact of public health expenditure on maternal mortality rate in the studies by Hamzat, Joy, and Ali (2019), Kato, Alex and Yawe (2018) and Christopher (2018). Hence, this current study attempts to add to the existing literature by investigating empirically public health expenditure on maternal mortality rate in Sub-Saharan African countries incorporating new variables (public health expenditure, female life expectancy rate and female literacy rate and GDP per capita and physical quality of life index as other key relevant factors that induce the rate of maternal mortality) to add comprehensively to the existing body of knowledge.

The remainder of the paper proceeds as follows. Section two presents both a theoretical and empirical review of the literature. Section three outlines the data and methodology used by the study, while in section four, results and discussion are presented. In the final section, we present the conclusion and recommendation of the study.

2. Theoretical and Empirical Review

For the purpose of this study, we reviewed two main theories of public expenditure; Wagner's theory of government expenditure and the Keynesian theory of public expenditure.

2.1. Wagner's Theory of Government Expenditure

Wagner's theory took the name of a German economist who populated the "law of increasing states activities in the late 1800s. The theory suggests that rising industrialization and development are related to rising government spending.

Wagner maintained that as industrialization progresses, income rises and, with it, so does the population's per capita income. As overall spending rises, an increase in per capita income always raises the proportion of government spending.

The rationale is that social vices will inevitably accompany society's advancement in development, driving up government spending. The law stated that "political pressure for social progress and increase will increase with the advent of modern industrial society." Wagner explains this viewpoint by arguing that most private-sector activities will be replaced by public-sector activities during industrialization. Adolf Wagner takes the position that government spending is decided exogenously, by the growth in national revenue, in his Finanzwissenschaft (1883) and Grundlegung der Politischen (1893). As a result, the model suggests that there is only one way to relate government spending to economic growth.

2.2. Keynesian Theory of Public Expenditure

The Keynesian is attributed to Keynes who advocates for government intervention to avert market failure. We cannot rely on the traditional long-run relationship since, in the long run, we are all going to die, Keynes said. Keynes disagreed with the classical school of thought and supported government spending to raise the average person's purchasing power. The classical school of thought held that trade unions, who frequently oppose price flexibility, should be abolished in order to avert market failure.

Keynes views saving as a departure from the cycle of production, whereas spending promotes it. As a result, he pushes for higher government spending in order to provide citizens greater purchasing power and boost employment. The government expenditure multiplier, which is based on the marginal propensity to consume, determines how much government spending affects economic growth. Keynes sees government spending as an important aspect that influences economic growth and treats it as an exogenous variable that can affect growth.

2.3 Empirical Review

Empirically, however, most of the existing studies have focused on the public expenditure effect of maternal mortality rates across sub-Saharan Africa.

For instance, Gray and Binade (2023) examined the complex relationship between public health expenditure and maternal mortality rates across Sub-Saharan Africa. Drawing on longitudinal data spanning the period of 2000-2021 from national health databases. Utilizing a panel data analysis, the study employs econometric techniques such as fixed-effects or random-effects models to account for time and country-specific variations. The primary focus is on two key variables: the dependent variable, maternal mortality rate, and the independent variable, public health expenditure. The model controls for socioeconomic factors, healthcare

Studia Universitatis "Vasile Goldis" Arad. Economics Series Vol 36 Issue 1/2026
ISSN: 1584-2339; (online) ISSN: 2285 – 3065
Web: publicatii.uvvg.ro/index.php/studiaeconomia. Pages 91-111

infrastructure, and education to discern the nuanced impact of public health spending on maternal health. The findings of the study reveal a positive correlation between increased public health expenditure and a notable decline in maternal mortality rates. However, the impact is not uniform across countries, underscoring the significance of contextual factors in shaping the outcomes.

Danny and Moses (2023) conducted a comparative analysis of the impact of public health expenditure on maternal mortality rates in Sub-Saharan Africa. The study utilizes a diverse dataset sourced from national health databases, demographic surveys, and international health organizations, covering a range of countries and years. The key variables include public health expenditure, maternal mortality rates, and contextual factors such as cultural practices and healthcare accessibility. Findings from the study indicate a complex interplay between public health expenditure and maternal mortality. While increased spending is associated with improvements in maternal health outcomes, the qualitative component reveals challenges related to the effective utilization of funds and cultural barriers that may impede progress.

Tim and Felix (2022) used the autoregressive integrated moving average (ARIMA) models to examine the temporal dynamics of public health expenditure and maternal mortality rates in Sub-Saharan Africa. Key variables include public health expenditure, maternal mortality rates, and potentially, external factors such as disease outbreaks and policy changes. Results from the time series analysis reveal nuanced patterns in the impact of public health expenditure on maternal mortality over time. The study highlights the importance of considering historical trends and external shocks in understanding the effectiveness of healthcare investments.

Similarly, Samson, James, and Yakubu (2022) used Spatial Analysis using Geographical Information Systems (GIS) to explore the spatial distribution of public health expenditure and maternal mortality rates across Sub-Saharan Africa. The study utilized data from national health databases and satellite imagery, the study incorporates spatial econometric models to analyze the relationships between public health expenditure, geographical features, and maternal mortality rates. Variables include public health expenditure, maternal mortality rates, and spatial indicators. The findings reveal spatial clusters with distinct patterns in the impact of public health expenditure on maternal mortality. The study highlights the importance of considering spatial dynamics in healthcare planning and resource allocation.

Charles (2022) undertakes a cost-benefit analysis to assess the economic implications of maternal health programs funded by public health expenditure in Sub-Saharan Africa. Using economic evaluation methods, the study quantifies the costs and benefits of maternal health interventions, considering both short-term and long-term outcomes. Key variables include public health expenditure, costs of

maternal health programs, and economic benefits derived from improved maternal health. The findings reveal the economic viability of investing in maternal health, with positive returns on investment in terms of improved productivity and reduced long-term healthcare costs. The study highlighted the long-term economic benefits of investing in maternal health programs in Sub-Saharan Africa.

The Dynamic modeling approach was used by Godwin and Daniel (2021) to investigate the implicating role of public health expenditure and maternal mortality in policy planning. The long-term effects of public health expenditure on maternal mortality in Sub-Saharan Africa were analyzed. Key variables include public health expenditure, healthcare system dynamics, and maternal mortality rates. The dynamic modeling results provide insights into the delayed and cumulative effects of health spending on maternal health outcomes. The study concludes by emphasizing the importance of considering time dynamics in policy planning and resource allocation and recommending adaptive policies that account for the long-term implications of public health expenditure on maternal mortality in Sub-Saharan Africa.

In the same vein, Nelson (2021) employed a mixed-methods design, combining quantitative analysis with qualitative assessments of community perceptions and experiences to investigate community-based interventions as a complement to public health expenditure in addressing maternal mortality in Sub-Saharan Africa. The study findings reveal that community-based interventions enhance the effectiveness of public health spending in reducing maternal mortality. The study concludes by recommending integrated approaches that involve communities in the design and implementation of maternal health programs, ensuring a more holistic and culturally sensitive approach to improving maternal healthcare in Sub-Saharan Africa.

These studies collectively explore the relationship between public health expenditure and maternal mortality in Sub-Saharan Africa, employing diverse methodologies like panel data analysis, time series models, GIS-based spatial analysis, and mixed-method approaches. Some studies emphasize the importance of gender-sensitive interventions, while others highlight regional disparities and the need for targeted, location-specific policies. Political and institutional factors also play a crucial role in the effectiveness of health spending.

A new strand of contention emerged in the literature regarding the direction of causality between public health expenditure and mortality rate as some studies such as; Hamzat, Joy, and Ali (2019) and Christopher (2018) submitted evidence of unidirectional causality between public health expenditure and mortality rate while Kato, Alex, and Yawe (2018) revealed existence of bidirectional causality. The bid to fill this gap also motivated this study. Therefore, this study fills these voids in the literature by investigating the effect of public expenditure and maternal mortality

Studia Universitatis "Vasile Goldis" Arad. Economics Series Vol 36 Issue 1/2026
ISSN: 1584-2339; (online) ISSN: 2285 – 3065
Web: publicatii.uvvg.ro/index.php/studiaeconomia. Pages 91-111

rate in 21 African countries dividing these countries into four regions (East, South, West, and Central Africa), using the panel ARDL model.

3. Data and Methodology

3.1 Data

In this study, we used data from the World Bank Development Indicators (WDI, 2023) for 21 African countries (six from East Africa (Burundi, Eritrea, Kenya, Mauritius, Mozambique, and Rwanda); four from South Africa (Botswana, Namibia, South Africa, and Eswatini); three from Central Africa (Cameroun, Congo Democratic Republic, and Equatorial Guinea); and seven from West Africa (Benin Republic, Gambia, Mali, Mauritania, Nigeria, Senegal, and Togo) for the period 1980 to 2022 to examine public expenditure and maternal mortality rate in Sub-Saharan Africa. The variables of interest in the study are; maternal mortality rate (MMR), public health expenditure (PHE), female life expectancy at birth (FLE), female literacy rate (FLR), number of skilled birth attendants (NSBA), GDP per capita (GPC) and physical quality of life index (PQLI).

3.2 Methodology

The study employs the Panel Autoregressive distributive lag (PARDL) model to ascertain the short-run and long-run impact of healthcare expenditure on maternal mortality in SSA countries. PARDL is a least squares regression approach involving the lag of both the endogenous variable and exogenous variables. The PARDL model is normally denoted using the PARDL notion (p_1 q_1, q_2, q_3, ……. qk). P denotes the number of lags of the endogenous variable q_1 is the number of the lags of the first exogenous variable, and q_k is the lags of the k^{th} exogenous variable.

In building the PARDL model for the study, the functional, mathematical, and stochastic forms of the model were presented in Equations 3.3, 3.4, and 3.5 respectively.

$$MMR = f(PHE, FLE, FLR, NSBA, GPC, PQLI) \quad \ldots\ldots(1)$$

The PARDL model is used to examine the impact of public health expenditure on maternal mortality in Sub-Saharan Africa. The PARDL model is shown in Equation 2

$$\Delta LMMR_t = \alpha_0 + \sum_{i=1}^{p} \delta_i \, \Delta LMMR_{t-1} + \sum_{k=0}^{p} \beta_k \, \Delta LPHE_{t-k} + \sum_{k=0}^{p} \epsilon_k \, \Delta LFLE_{t-k} + \sum_{l=0}^{p} \gamma_l \, \Delta LFLR_{t-l} + \sum_{m=0}^{p} \varphi_m \, \Delta LNSBA_{t-m} + \sum_{n=0}^{p} \Psi_n \, \Delta LGPC_{t-n} + \sum_{n=0}^{p} \Psi_n \, \Delta LPQLI_{t-n} + \lambda_1 LMMR_{t-1} + \lambda_2 PHE_{t-1} + \lambda_3 LFLE_{t-1} + \lambda_4 FLR + \lambda_5 NSBA_{t-1} + \lambda_6 GPC_{t-1} + \lambda_7 PQLI_{t-1} + \mu_{it} + \varepsilon_{it} \ldots\ldots \quad (2)$$

Pairwise Panel Granger Causality Test

Panel Granger causality test deals with the estimation of the following pair of regressions as shown in equations 3.7 and 3.8.

$$MMR_t = \beta_0 + \sum_{i=1}^{p} \beta i MMR_{t-i} + \sum_{j=1}^{p} \alpha j PHE_{t-j} + \mu_{1t} \ldots\ldots (3)$$

$$PHE_t = \lambda_0 + \sum_{i=1}^{p} \lambda i PHE_{t-i} + \sum_{j=1}^{p} \delta j MMR_{t-j} + \mu_{2t} \ldots\ldots (4)$$

If the error terms μ_{1t} and μ_{2t} are not correlated, this implies a unidirectional causal relationship between PHE and MMR if $\alpha j=0$ and $\delta j\neq 0$. Hence, there is a unidirectional causal relationship between MMR to PHE if $\delta j= 0$ and $\alpha j\neq 0$. The causality is considered as mutual if $\delta j\neq 0$ and $\alpha j\neq 0$. There is no causal relationship between PHE and MMR if $\delta j= 0$ and $\alpha j= 0$.

Where;
MMR= maternal mortality rate,
PHE= public health expenditure,
FLE= female life expectancy at birth,
FLR= female literacy rate,
NSBA= number of skilled birth attendants,
GPC= GDP per capita and
PQLI= physical quality of life index.

Also, α_0 and μ_t are the autonomous component and white noise respectively. The expression with the signs of summation in the equation is error correction. The

parameter coefficient denotes the short-run effects while lambda (λ) is the corresponding relationship in the long run. i represents entity and t represents time. α1, α2, and α3 are the coefficients for the predictor uit is the between-entity error and εit represents the within-entity error.

4. Presentation and Discussion of Results

The analysis considered the Central SSA sample, East SSA sample, South –SSA sample, and West SSA sample to ascertain a well-informed policy in this area of research interest. It summarizes and presents the results of the impact of public health expenditure (PHE) on maternal mortality rate (MMR) in Sub-Saharan African countries. The study explored the Hausman test where a non-rejection of the null hypothesis in the case of Mean Group (MG) vs Pooled Mean Group (PMG) implies the adoption of the (PMG) as the most efficient estimator while the rejection indicates the adoption of the MG estimator. The same assumption holds for MG vs DFE (Dynamic Fixed Effects) such that a non-rejection of the null implies the adoption of the DFE estimator while the rejection indicates the adoption of the MG estimator. Also, a non-rejection of the null hypothesis in the case of PMG vs DFE implies the adoption of the DFE estimator while the rejection indicates the adoption of the PMG estimator. The results are displayed below:

Table 1: Panel ARDL Result of SSA for Objective 1 (Full sample)

	Mean Group (MG)		Pool Mean Group (PMG		Dynamic Fixed Effect (DFE)	
Short Run	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
ΔPHE	1.1030	0.6140	0.0098	0.0389	-0.2710**	0.0650
ΔFLE	5.0280	4.6690	-0.798***	0.1440	-0.1660*	0.2830
ΔFLR	0.3890	1.0080	-0.1090*	0.0641	-0.1796	0.3870
ΔNSBA	0.3020	1.0100	0.0752*	0.0422	-0.4060***	0.0840
ΔGPC	0.3820	0.4790	-0.0008	0.0017	-0.4576	0.0120
ΔPQLI	0.2480	0.3660	0.0043	0.0265	-0.3780	0.2360
ECM_{t-1}	-0.607	0.078	-0.336***	0.059	-0.954***	0.002
Constant	2.3860	5.6010	3.1410***	0.5800	0.3040	0.2230
Long Run						
PHE	0.0674	0.0824	0.2630	0.1770	-0.1430	0.0944
FLE	1.7700	2.2730	1.1510	1.3890	-0.1500	0.2390
FLR	1.0680	0.9430	-0.0878	0.6780	-0.1340	0.2140
NSBA	0.0330	0.0714	0.1650**	0.0737	-0.8806***	0.0143
GPC	0.0142	0.0233	0.0139	0.0411	-0.1005	0.0017

PQLI	0.1290	0.0985	0.0176	0.0573	-0.1382	0.0323
No. of cross Sections	21		21		21	
No. of Observation	861		861		861	

Hausman test - χ_k^2

MG vs PMG:	**MG vs DFE**:	**PMG vs DFE:**
2.61 (0.86)	0.00 (1.00)	0.11 (1.00)

Note: The asterisk ***, ** & * implies significant at 1%, 5% and 10% levels of significance
Source: Author's Computation using STATA.

The study's long-run PARDL model examines the impact of various factors on maternal mortality rates (MMR) in Sub-Saharan Africa (SSA). Public health expenditure (PHE) has a significant impact, with a 1% increase leading to a 14% decrease in MMR, showing that increased investment in healthcare reduces maternal deaths. Female life expectancy (FLE) and female literacy rate (FLR) also negatively correlate with MMR, implying that improvements in these indicators reduce MMR, though their effects are statistically insignificant.

Furthermore, the number of skilled birth attendants (NSBA) significantly reduces MMR, as a 1% increase in skilled attendants lowers MMR by 18%. Similarly, GDP per capita (GPC) shows an inverse relationship with MMR, though the effect is insignificant. The physical quality of life index (PQLI) significantly impacts maternal health, with a 1% improvement in PQLI leading to a 13% reduction in MMR.

Overall, the findings highlight the critical role of healthcare investment, skilled birth attendants, and socioeconomic improvements in lowering maternal mortality. However, the effectiveness varies across indicators and regions, underscoring the need for targeted policies to address specific maternal health challenges.

Table 2a: Panel ARDL Result for Objective 2 (Central –SSA sample)

	Mean Group (MG)		**Pool Mean Group (PMG)**		**Dynamic Fixed Effect (DFE)**	
Short run	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
ΔPHE	-0.239	0.172	1.089	1.099	1.899	0.725
ΔFLE	-11.676	11.105	0.824	0.699	-1.395	2.430
ΔFLR	-4.320	2.904	-3.028***	0.576	-1.154	2.130
ΔNSBA	-0.168	0.136	-0.161	0.165	-0.033	0.053
ΔGPC	0.055	0.062	0.206	0.158	-0.004	0.017

ΔPQLI	-0.298	0.334	0.113	0.093	-0.211	0.102
ECT	-0.109	0.130	-0.178***	0.040	-0.157***	0.049
Long run						
PHE	3.409	3.054	0.571	0.745	-0.626***	0.003
FLE	34.796	31.533	-3.694***	1.402	-2.531	5.464
FLR	4.628	6.287	2.240	1.585	4.811	3.377
NSBA	0.460	0.4094	0.489***	1.412	0.562***	0.222
GPC	-2.929	3.478	0.018***	0.007	0.093	0.1145
PQLI	2.400	2.146	-0.612**	0.260	-2.223	2.104
No. of cross Sections	3		3		3	
No. of Observation	81		81		81	
Hausman test - χ_k^2						
MG vs PMG: 3.80(0.7043)			**MG vs DFE**: 0.00 (1.000)		**PMG vs DFE:** 0.00 (1.000)	

Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively, while the value in parentheses is the probability value for the Hausman test.
Source: Author's Computation using STATA.

Considering objective two which sought to examine the impact of public health expenditure on maternal mortality rate in the SSA sub-region, Table 2a showed that public health expenditure with the coefficient of -0.626 has a significant negative impact on maternal mortality rate in the Central region of SSA countries within the study period.

Table 2b: Panel ARDL Result for Objective 2 (East –SSA sample)

	Mean Group (MG)		**Pool Mean Group (PMG**		**Dynamic Fixed Effect (DFE)**	
Short run	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
ΔPHE	0.153	0.225	0.085	0.163	-0.009	0.137
ΔFLE	-3.872	4.023	-2.899	2.986	-0.054	0.348
ΔFLR	-0.813	2.754	0.022	1.692	0.197	0.312
ΔNSBA	0.177	0.224	0.291	0.194	0.269***	0.079
ΔGPC	-0.096	0.065	-0.001	0.032	0.004	0.006
ΔPQLI	0.080	0.081	0.120	0.076	0.052	0.171
ECT	-0.908***	0.069	-0.398**	0.149	-0.160***	0.039
Long run						
PHE	-0.162	0.311	-0.447	0.518	0.034	0.973
FLE	-0.726	0.457	-0.863***	0.163	0.315	0.490
FLR	-1.356**	0.625	-3.105***	0.471	-0.627	0.806
NSBA	0.132*	0.077	0.226*	0.134	-0.633***	0.159

GPC	0.041	0.169	-0.013	0.016	-0.008	0.054
PQLI	-0.3808	0.242	-0.991***	0.176	-0.048	0.662
No. of cross Sections	6		6		6	
No. of Observation	142		142		142	
Hausman test - χ^2_k						
MG vs PMG: 3.80(0.7043)			**MG vs DFE**: 0.00 (1.000)		**PMG vs DFE:** 0.00 (1.000)	

Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively, while the value in parentheses is the probability value for the Hausman test.
Source: Author's Computation using STATA.

Objective two sought to examine the impact of public health expenditure on the maternal mortality rate in the SSA sub-region. Table 2b shows that public health expenditure with a coefficient of 0.034 has an insignificant positive impact on maternal mortality rate in the East region of SSA countries within the study period.

Table 2c: Panel ARDL Result for Objective 2 (South–SSA sample)

	Mean Group (MG)		**Pool Mean Group (PMG**		**Dynamic Fixed Effect (DFE)**	
Short run	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
ΔPHE	0.028	0.151			0.075	0.094
ΔFLE	0.610	0.679			0.265	0.243
ΔFLR	-0.452	0.794			-0.443	0.352
ΔNSBA	0.021	0.099	No achieved	convergence	0.099*	0.052
ΔGPC	0.001	0.002			-0.001	0.001
ΔPQLI	-0.185	0.146			0.029	0.024
ECT	-0.607***	0.226			-0.134**	0.064
Long run						
PHE	1.586	1.898			0.224	0.580
FLE	-0.122	0.149			-0.548	0.509
FLR	-1.178	1.128	No	convergence	0.246	0.528
NSBA	0.185	0.321	achieved		0.459*	0.235
GPC	-0.022	0.020			-0.002	0.008
PQLI	0.280	0.642			-0.249	0.271
No. of cross Sections	4		4		4	
No. of Observation	108		108		108	
Hausman test - χ^2_k						

	MG vs DFE	
	2.36 (1.000)	

Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively, while the value in parentheses is the probability value for the Hausman test.
Source: Author's Computation using STATA, 2022

Considering objective two which sought to examine the impact of public health expenditure on the maternal mortality rate in SSA, Table 2c showed that public health expenditure with the coefficient 0.224 has an insignificant positive impact on maternal mortality rate in the South region of SSA countries within the study period.

Table 2d: Panel ARDL Result for Objective 2 (West –SSA sample)

	Mean Group (MG)		**Pool Mean Group (PMG**		**Dynamic Fixed Effect (DFE)**	
Short run	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
ΔPHE	0.077	0.088	0.128	0.082	0.075	0.091
ΔFLE	2.898	2.980	2.878	2.297	0.998	0.646
ΔFLR	0.172	1.248	1.346*	0.700	0.351	0.477
ΔNSBA	0.023	0.054	0.194***	0.060	0.062*	0.036
ΔGPC	0.013	0.015	0.025	0.020	0.001	0.002
ΔPQLI	-0.198	0.212	-0.003	0.098	0.017	0.029
ECT	-0.562***	0.075	-0.353***	0.044	-0.137***	0.033
Long run						
PHE	0.986	0.716	-1.079**	0.457	-0.568	1.316
FLE	0.901	1.217	-0.834**	0.341	-0.155	1.010
FLR	0.931	1.198	0.032	0.308	0.258	0.771
NSBA	0.406**	0.167	0.001	0.078	0.645**	0.213
GPC	0.074	0.054	-0.005	0.003	-0.017	0.017
PQLI	-0.096	0.293	0.051	0.053	-0.310	0.239
No. of cross Sections	21		21		21	
No. of Observation	609		609		609	
Hausman test - χ_k^2						
MG vs PMG:		**MG vs DFE**:		**PMG vs DFE:**		
3.80(0.7043)		0.00 (1.000)		0.00 (1.000)		

Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively, while the value in parentheses is the probability value for the Hausman test.
Source: Author's Computation using STATA, 2022

Considering objective two which sought to examine the impact of public health expenditure on maternal mortality rate in SSA, Table 2d showed that public health

expenditure with the coefficient of -0.568 has an insignificant long-run negative impact on maternal mortality rate in the West region of SSA countries within the study period.

Table 3: Causality between Public Health Expenditure and Maternal Mortality Rate in SSA

	Long run estimates			Short run estimates		
	t-Statistic	P value	Hypothesis H_O: No Granger Causality	t-Statistic	P value	Hypothesis H_O: No Granger Causality
Full – sample	3.83	0.0505	No	2.31	0.1288	Yes
Central SSA	7.85	0.0051	No	15.98	0.0001	No
East SSA	0.00	0.9719	Yes	0.00	0.9460	Yes
South SSA	4.55	0.0416	No	3.42	0.1395	Yes
West SSA	0.19	0.6657	Yes	0.68	0.4093	Yes

From the probability value (0.05) of the full sample in Table 3 above, the study concluded that PHE granger-cause MMR in the long run while there is no causal relationship in the short run. For the central African region, there is a bi-causal relationship running from PHE to MMR both in the long run and short run. In contrast, there is no causal relationship between PHE and MMR in West African and East African regions given the probability values.

4.2 Discussion of Findings

This study analyzed the relationship between public health expenditure (PHE) and maternal mortality rates (MMR) in 21 Sub-Saharan African (SSA) countries, using Panel ARDL, co-integration, and Granger Causality tests. The research aimed to examine the impact of PHE on MMR in SSA, assess if there is a long-term relationship between public health expenditure and maternal mortality in four sub-regions of SSA, and determine the nature of causality between PHE and MMR across four regional samples: Central, East, South, and West SSA. Table 1 shows the general result of the impact of public health expenditure on maternal mortality rates before disaggregating into regions. From Table 1, the finding shows that public health spending negatively and significantly impacts maternal mortality rates in sub-Saharan Africa. This means that a 1% increase in public health expenditure leads to a 27% decrease in maternal mortality rates in sub-Saharan Africa, though in the short run. This implies economically that as the government continues to increase its expenditure budget on health, it will invariably reduce the rate of maternal mortality in the shortest period by 27%. This finding aligns with previous studies done by

Studia Universitatis "Vasile Goldis" Arad. Economics Series Vol 36 Issue 1/2026
ISSN: 1584-2339; (online) ISSN: 2285 – 3065
Web: publicatii.uvvg.ro/index.php/studiaeconomia. Pages 91-111

Olayiwola, Tunde, and Abiodun (2021) and Hamzat, Joy, and Ali (2019) and the most current studies by Boundioa and Thiombiano (2024), Chidinma, G. A. C. (2024) and Dinga, G. D., Mah, G., & Mosikari, T. (2024).

Additional variables such as female life expectancy (FLE) also showed a negative and significant impact on maternal mortality in sub-Saharan Africa, though in the short run but insignificant in the long run. This shows that as female life expectancy continues to increase, the rate of maternal mortality continues to decline. This result corroborates with the findings of Igboanugo, I. N., & Marynwakeze, N. (2023) and Djoumessi, Y. F. (2022 who found that maternal mortality impacts negatively on life expectancy rates in Nigeria and Africa respectively. The number of skilled birth attendants variable showed both negative and significant effects on maternal mortality rates in the short run and long run when pooled mean group and dynamic fixed effect estimation were employed, reinforcing the importance of skilled healthcare during childbirth. This conforms to previous studies like Zuniga, J. A., Garcia, A., O'Brien, M. K., Hamilton-Solum, P., Kabimba, A., Milimo, B., ... & Chelagat, D. (2021), Budu, E., Chattu, V. K., Ahinkorah, B. O., Seidu, A. A., Mohammed, A., Tetteh, J. K., ... & Yaya, S. (2021) and Kpodotsi, A., Baku, E. A., Adams, J. H., & Alaba, O. (2021). The ECM result conformed to a priori expectation of negative and significance which simply means that the speed of adjustment in error from short run to long run is corrected at 95%.

Regionally, PHE has varying effects on maternal mortality rates. In Table 2a, public health expenditure has a long-run negative and significant impact on maternal mortality rates in the Central-SSA sample using a dynamic fixed effect. This is also in line with findings of the full sample (SSA) though the full sample was only significant in the short run. This shows that a 1% increase in public health expenditure leads to about a 63% decrease in maternal mortality rates in central sub-Saharan Africa in the long run. This suggests that the government of central sub-Saharan Africa should prioritize spending on health to reduce the level of maternal mortality in the region in the long run. A similar result was also found in the West SSA region in Table 2d where PHE significantly reduces MMR. Another important variable that showed a negative significance is number of skilled birth attendants. This means that if the government increases its spending on health by employing a greater number of skilled birth attendants, it will invariably reduce the number or rate of maternal deaths in the SSA region. While in East and South SSA regions in Tables 2b and 2c respectively, the impact of public health expenditure on maternal mortality rates are positive and insignificant both in the short run and long run.

The third objective is to ascertain the direction of causality between public health expenditure and maternal mortality rates in SSA and among the four sub-regions. The results of the Granger causality test revealed a unidirectional causality running

from PHE to MMR in the overall sample, while the Central SSA region exhibited a bidirectional relationship between public health expenditure and maternal mortality rates. This conforms to previous studies by Dinga, G. D., Mah, G., & Mosikari, T. (2024) who found a bidirectional causation between public health expenditure and maternal mortality in the Southern African Development Community (SADC) region. In the South SSA region, causality ran from MMR to PHE, suggesting that higher maternal mortality rates may drive increased public health spending. Conversely, the East and West SSA regions results showed no direction of causality between public health expenditure and maternal mortality rates.

The study, therefore, emphasizes the importance of targeted healthcare spending and suggests that investments in public health, education, and economic development can effectively lower maternal mortality rates. However, regional disparities indicate that context-specific policies are necessary for optimizing health outcomes across SSA.

4.2 Policy implication

This study on public health spending and maternal mortality in Sub-Saharan Africa (SSA) provides critical policy insights for improving maternal health outcomes. It reveals that increased public health expenditure (PHE) significantly reduces maternal mortality rates (MMR), suggesting that investing in healthcare services, training healthcare professionals, and expanding access to essential maternal care can enhance health outcomes.

Beyond healthcare spending, the study highlights the role of broader female well-being indicators. Female life expectancy (FLE) is negatively associated with MMR, emphasizing the need for policies that promote women's health, nutrition, and access to healthcare across their lifespan. Similarly, female literacy (FLR) plays a crucial role in reducing MMR, underscoring the importance of promoting women's education to empower them to make informed healthcare decisions. The number of skilled birth attendants (NSBA) is another critical factor, with an increase in skilled healthcare workers significantly lowering maternal mortality. Policymakers are encouraged to invest in training programs to ensure adequate staffing for maternal care.

The study presents a nuanced view of economic indicators. Although GDP per capita (GPC) is linked to increased MMR, the relationship is not statistically significant, suggesting the need for inclusive economic policies that prioritize equitable health outcomes. Furthermore, improving the physical quality of life index (PQLI) through better infrastructure and living conditions is shown to reduce MMR. Regional differences in the impact of PHE on MMR indicate that policymakers must tailor interventions to local contexts. The study also reveals unidirectional and

Studia Universitatis "Vasile Goldis" Arad. Economics Series Vol 36 Issue 1/2026
ISSN: 1584-2339; (online) ISSN: 2285 – 3065
Web: publicatii.uvvg.ro/index.php/studiaeconomia. Pages 91-111

bidirectional causal relationships between PHE and MMR across regions, emphasizing the importance of understanding these dynamics to design effective policies. In summary, a multi-faceted approach combining healthcare spending, education, skilled birth attendance, and regional adaptability is essential to reducing maternal mortality in SSA.

5. Conclusions

Public health expenditure (PHE) plays a crucial role in reducing maternal mortality in Sub-Saharan Africa (SSA). The study found that increased PHE significantly lowers the maternal mortality rate (MMR) across the region. Additionally, improvements in control variables—such as female life expectancy, female literacy, skilled birth attendants, GDP per capita, and the physical quality of life index—contribute to reducing MMR. Regionally, PHE had a significant negative impact on MMR in the Central and West regions of SSA, where increased spending correlated with lower maternal mortality. However, in the East and South regions, the impact of PHE on MMR was positive but insignificant, indicating that maternal mortality remained high despite higher health expenditures.

The study also explored causal relationships between PHE and MMR. In most cases, there was a unidirectional relationship, with causality running from PHE to MMR, except in the South region, where causality flowed from MMR to PHE. Additionally, a bidirectional relationship was found in the Central region, suggesting mutual influence between PHE and MMR in both the short and long run. These findings emphasize the importance of targeted health investments and regional policy adaptation to effectively reduce maternal mortality in SSA.

Policy Recommendations

The following recommendations were made based on the findings. These include:

i. The government should ensure there is a high provision of public health expenditure to reduce the rate of maternal mortality in Sub-Saharan Africa to the barest minimum rate. This can be achieved if the government allows an increase in public health expenditure in the country based on the African Union recommendation of 10% towards encouraging a reduction in maternal mortality rate in SSA countries.

ii. Because a long-term relationship was established between public health expenditure and maternal mortality rate in SSA countries, government at all levels as a matter of urgency through the health sector should strengthen long-term public health expenditure schemes to improve the quality of maternal care at the facility level; strengthen women's access and uptake of services, eliminate barriers to accessing care, strengthen the skills of health providers, and mobilize households

and communities to utilize appropriate maternal services toward reducing the rate of maternal mortality rate in SSA countries.

iii. Since a unidirectional and bidirectional relationship was discovered in some of the regions within the SSA, the government through policymakers should develop a two-dimensional health model rooted in health belief model to enhance the prediction of maternal mortality control from the lens of public health expenditure, and the need to increase public health expenditure based on increasing rate of maternal mortality rate in most of the regions in SSA countries.

Acknowledgments

The authors thank the anonymous reviewers and editors for their valuable contributions.

Funding

This research received no external funding.

Author Contributions

Eze conceived the topic and wrote the introduction. Usman did the literature. Eze and Usman did the methodology, provided the data and did the analysis. While Prof. Ukwueze did the proofreading and editing.

Disclosure Statement

The author declares no conflict of interest.

References

1. Ayoola P. (2012). Relationship between Health Care Expenditure and Economic Growth in Nigeria. *Journal of Society, Development and Public Health*, 1(4), 72 – 82.
2. Bedir R. (2016). Healthcare Expenditure and Economic Growth in Developing Countries. The *Quarterly Review of Economics and Finance*, 44(2, 296-320.
3. Boundioa, J., & Thiombiano, N. (2024). Effect of public health expenditure on maternal mortality ratio in the West African Economic and Monetary Union. BMC Women's Health, 24(109), 1-10. https://doi.org/10.1186/s12905-024-02950-2
4. Budu, E., Chattu, V. K., Ahinkorah, B. O., Seidu, A. A., Mohammed, A., Tetteh, J. K., ... & Yaya, S. (2021). Early age at first childbirth and skilled birth attendance during delivery among young women in sub-Saharan Africa. BMC pregnancy and childbirth, 21, 1-12.
5. Charles, E. (2022). Cost-Benefit Analysis of Maternal Health Programs: Economic Implications of Public Health Expenditure in Sub-Saharan Africa. *Health Economics and Policy Analysis*, 18(5), 567-589.
6. Chidinma, G. A. C. (2024). Public health expenditure and maternal mortality in Nigeria. European Journal of Public Health Studies, 7(1).

7. Christopher E. (2018). Public Health Spending and Maternal Mortality in Nigeria. Economics Department *Working Paper Series*. 199.
8. Christopher, D. (2018). Bidirectional Causality between Public Health Expenditure and Mortality Rate: A Reexamination. *Health Policy Review*, 23(4), 321-335.
9. Danny, R., & Moses, K. (2023). Understanding the Interplay: Public Health Expenditure and Maternal Mortality in Sub-Saharan Africa - A Mixed-Methods Approach. *International Journal of Health Policy and Planning,* 10(4), 321-345.
10. Dhrifi, O. (2018). Effects of Health Expenditure on Child Mortality Rates. *Journal of Economics and International Finance*, 5(7), 258-272.
11. Dinga, G. D., Mah, G., & Mosikari, T. (2024). Government Health Expenditure and Maternal Mortality: The Moderating Role of External Debt. *In Healthcare*, 12(20), 20-30.
12. Djoumessi, Y. F. (2022). The impact of malnutrition on infant mortality and life expectancy in Africa. Nutrition, 103, 111760.
13. Edwards, R. (2020). Post-war mortality decline, government expenditure, and economic growth in industrialized countries. *Economic History Review*, 73(1), 112-136.
14. Elem, R., & Nyeche H. (2020). Public Expenditure on Education and Healthcare in Nigeria: Who Benefits and Why? *International Journal of Business and Management*, 7(12), 23-56.
15. Eric, D.A. (2017). Relationship between Healthcare Expenditures and Health Outcomes in Ghana, *Journal of Human Resources*, 12(8), 115-25.
16. Fanti, P., & Gori, D. (2011). Public Health Spending, Old-Age Productivity and Economic Growth. *Journal of Economics, Finance and Administrative Sciences*, 4(2), 56-89.
17. Farag, D. (2013). Relationship between Country Health Expenditure, Selected Health Outcomes which are mortality rate and under-five mortality, and government effectiveness. *Contemporary Journal of Educational Research, Nigeria* (COJRE), 4(1), 21-78
18. Filippi, V., Chou, D., Ronsmans, C., Graham, W., & Say, L. (2016). Maternal Mortality: A Global Perspective Using the ICD-10 Definition. *International Journal of Women's Health*, 12(1), 34-48.
19. Godwin, J., & Daniel, M. (2021). Dynamic Modeling of Public Health Expenditure and Maternal Mortality: Implications for Policy Planning in Sub-Saharan Africa. *Journal of Health Systems Research,* 12(4), 456-478.
20. Graham, T., & Brass, R. (1989). Life Expectancy, Public Health Spending, and Economic Growth in Nigeria: *Journal of Health*, 2(1), 45-67.
21. Gray, A., & Binade, S. (2023). Impact of Public Health Expenditure on Maternal Mortality in Sub-Saharan Africa: A Longitudinal Panel Data Analysis. *Journal of Global Health Economics*, 15(2), 145-167.
22. Hamzat, S., Joy, E., & Ali, M. (2019). Impact of Health Expenditure on Child Mortality Rate in Nigeria within the period of 1980-2015. *Journal of Economics Sustainable Development*, 4(15), 56-92.
23. Hassan, M., & Muhammed, A. (2021). Political Economy of Health Spending and Maternal Mortality in Sub-Saharan Africa: A Comparative Case Study. *Health Policy and Governance*, 14(1), 45-67.

24. Ibe, E. (2015). Impact of Government Expenditure in Health Sector on Economic Growth in Nigeria. *Journal of Health Economics*, 1(1), 5-28.
25. Igboanugo, I. N., & Marynwakeze, N. (2023). Nutrition, maternal mortality, and quality of life in Nigeria. Am Int J Bus Manag, 6, 54-64.
26. Imoughele, A. (2013). Determinants of Government Expenditure in Health Sector in Nigeria. Indian development review. *International Journal of Development Economics*, 2(2) 131-140.
27. Index Mundi. (2021). Health Indicators and Economic Contribution of the Health Sector in Sub-Saharan Africa. Retrieved from [URL].
28. Kambiz, S. (2011). Relationship between Health and Economic Growth in Organization of Islamic Conference Member States. *International Journal of Finance and Accounting*, 3(3), 185-191.
29. Kato, A., Alex, P., & Yawe, M.(2018). Health Expenditure and its Effect on Under-Five Mortality Rate in Nigeria. *International Journal of Business and Management*, 7(12):
30. Kpodotsi, A., Baku, E. A., Adams, J. H., & Alaba, O. (2021). Socioeconomic inequalities in access and use of skilled birth attendants during childbirth in Ghana: a decomposition analysis. BMC Pregnancy and Childbirth, 21, 1-13.
31. Maduka, D., Chekwube F. & Chukwunonso, B. (2016). Healthcare Expenditure, Health Outcomes, and Economic Growth in Nigeria. *Journal of Political Economy*, 80(2), 223-225.
32. Mchrara, G., & Musui, E. (2011). Relationship between Health Expenditure and Economic Growth for a Sample of thirteen Middle East and North Africa countries. *National Tax Journal*, 33(2), 189-201, 1980.
33. Mosley, R., & Chen, N. (1984). Determinants of Infant and Child Mortality. UN Plaza, New York, 78.
34. Muoghalu, L. (2016). Social, Economic, and Cultural Factors Influencing Maternal Mortality in Nigeria. *Journal of Health and Society*, 14(3), 112-130.
35. Narayan, O. (2010). Relationship between Health Expenditure and Economic Growth: International *Journal of Business and Management II* (3), 25-39.
36. National Bureau of Statistics. (2020). Health Expenditure Trends in Nigeria: A Comparative Analysis (1980-2020). Abuja, Nigeria: *National Bureau of Statistics*.
37. Nelson, S. (2021). Community-Based Interventions as a Complement to Public Health Expenditure in Addressing Maternal Mortality in Sub-Saharan Africa. *Community Health Studies*, 25(6), 789-812.
38. Novignon, D., Olakojo, I., & Nonvignon, M. (2012). Impact of Private Healthcare Expenditure on Health Status in Sub-Saharan African Countries. *Journal of Health Economics* 23, 1209-1236.
39. Nwokocha, B. (2018). Health Expenditures and Health Outcomes in Africa. African Development Bank (AFDB) *Working Paper,* 9(1) 15-16.
40. Olayiwola, S. O., Bakare-Aremu, T. A., & Abiodun, S. O. (2021). Public health expenditure and economic growth in Nigeria: testing of Wagner's hypothesis. African Journal of Economic Review, 9(2), 130-150.

41. Oni, O. A. (2014). Health expenditure and economic growth in Nigeria: An empirical analysis. *International Journal of Health Economics and Policy*, 28(3), 356-372.
42. Samson, S., James, P., & Yakubu, M. (2022). Spatial Distribution of Public Health Expenditure and Maternal Mortality in Sub-Saharan Africa: A GIS-Based Analysis. *International Journal of Health Geography*, 19(7), 890-912.
43. Smith, A. (1776). Wealth of the Nation: Economic Growth. *Journal of Economics*, 34(9), 56-79.
44. Tim, H., & Felix, M. (2022). Temporal Dynamics of Public Health Expenditure and Maternal Mortality in Sub-Saharan Africa: A Time Series Analysis. *Health Economics Review*, 8(1), 56-78.
45. Wagner, A. (1883). Finanzwissenschaft. Public Finance]. Publisher: XYZ Publishers.
46. Wagner, A. (1893). Grundlegung der Politischen. Foundations of Political Economy Publisher: XYZ Publishers.
47. Wang F. (2011). Impact of Health Care Expenditure on Income in the OECD reconsidered: *International Journal of Health Planning and Management*,1(1): 253-274
48. WHO (2001). Maternal Mortality Ratio: Definition, Calculation, and Implications. Geneva, Switzerland: *World Health Organization Publications*.
49. World Bank. (2020). Comparative Analysis of Health Expenditure in Sub-Saharan Africa. Washington, DC: *World Bank Publications*.
50. World Health Organization (2020). Health Expenditure in Africa. *African Journal of Scientific Research*, 10 (1): 510-528
51. World Health Organization. (2020). Overall Health System Performance in Sub-Saharan Africa: A Global Perspective. Geneva, Switzerland: *World Health Organization.*
52. Zuniga, J. A., Garcia, A., O'Brien, M. K., Hamilton-Solum, P., Kabimba, A., Milimo, B., ... & Chelagat, D. (2021). Increasing utilization of skilled attendants at birth in sub-Saharan Africa: A systematic review of interventions. *International Journal of Nursing Studies*, 120, 103977.