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Government Health Expenditure and Health Outcomes: An Empirical Analysis of OPEC Member Countries with Emphasis on African

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Abstract
This study investigates the impact of government health expenditure on health outcomes in African OPEC member countries (Nigeria, Algeria, Angola, Gabon, and the Republic of Congo) using panel data from 2000 to 2024. Employing econometric models, including unit root tests, co-integration analysis and the Pooled Mean Group (PMG) estimator. Results revealed that long-term, both out-of-pocket and government health expenditures positively influence life expectancy, while short-term effects are insignificant. For maternal mortality, short-term analysis shows significant reductions with increased government spending and out-of-pocket payments, though long-term effects are insignificant. The findings underscore that effective health expenditure, coupled with responsible management of external debt and systemic reforms, is vital for improving health outcomes. The study concludes that policymakers should focus on increasing healthcare funding, reducing out-of-pocket costs, enhancing health system efficiency. Recommendations include increasing healthcare funding, reducing out-of-pocket costs, responsible management of external debt(EXD) and strengthening healthcare infrastructure. Emphasizing sustainable economic growth and targeted maternal health interventions are essential. Future research at the regional level within Nigeria could provide deeper insights for tailored health strategies to enhance outcomes across different areas.

Keywords: Government health expenditure, health outcomes, PMG and OPEC Member Countries.

1. Introduction

Healthcare plays vital role in fostering economic growth and development. The United Nations (UN) recognizes health as both a key enabler and crucial outcome of sustainable development, emphasizing the importance of well-being for all ages. The UNDP also considers healthcare critical indicator of human development. Economically, healthier population boosts productivity and income (Bleakley, 2010). Poor countries tend to be unhealthy and unhealthy countries tend to be poor, a cycle that stresses the importance of healthcare investments (Piabuo

& Tieguhong, 2017). Investing in healthcare requires resources and many studies affirm that increased healthcare expenditure leads to better health outcomes (Aboubacar & Xu, 2017; Rahman et al., 2018; Nketiah-Amponsah, 2019).

In oil-producing countries, government healthcare funding is often linked to oil revenues; higher oil prices typically mean more resources for health. However, the impact of oil wealth on health varies. For example, Saudi Arabia, which allocates a significant portion of its budget to health, has seen substantial improvements in health outcomes and human development (Haque & Khan, 2019), whereas Nigeria, despite being an oil-exporting country, lags behind with poor health indicators and low healthcare investment (World Bank, 2020; UNDP, 2022). In some African countries like Nigeria, health challenges are severe, with high maternal and child mortality rates, a significant burden of infectious diseases like malaria and high out-of-pocket expenditure over 70% of health costs are paid directly by households (WHO, 2019; World Bank, 2023). This

financial burden often plunges families into poverty, highlighting the urgent need for increased government health spending. Despite pledges in 2001 to allocate 15% of its budget to health, actual spending remains below this target, with only 5.1% allocated in 2022, compared to other oil-producing countries that have achieved better health outcomes through higher investments.

This study aims to examine how government health expenditure influences health outcomes in OPEC member countries, with a particular focus on African nations like Nigeria. It also seeks to provide policy recommendations to bridge the financing gap and improve health outcomes, leveraging lessons from countries such as Saudi Arabia.

Statement of the Research Problem

Despite the significance of government expenditure in the healthcare sector and economic growth, its impact on health outcome and pledging alongside other African leaders, Nigeria's health expenditure has not reached the agreed benchmark. While the total federal government budget has seen a remarkable increase of nearly 2,000 percent, rising from N894 billion in 2001 to N17.13 trillion in 2022, it is concerning that the allocation to the health sector has not kept pace. In 2022, the appropriation bill allotted only 5.1 percent of the national budget to the health sector, which is notably less than the 15 percent pledge in Abuja and slightly higher than the 3.75 percent allocated in 2001.

Nigeria has not leverage on the presence of crude oil to improve health outcomes like other oil producing countries. Health outcomes in Nigeria are among the poorest globally, with the country bearing a significant burden of preventable or treatable infectious diseases. The top 10 diseases contributing to mortality in Nigeria include Malaria, HIV/AIDS, neonatal disorders, lower respiratory infection, diarrheal, ischemic heart disease, congenital defects, tuberculosis, stroke, and meningitis (Institute for Health Metrics and Evaluation (IHME), 2019). The majority of these diseases are treatable or preventable. According to IHME (2019), 29.7 percent of malaria deaths, 19 percent of meningitis deaths, 11.8 percent of diarrheal disease death, 10.4 neonatal disorders deaths, 9.5 percent of HIV/AIDS deaths and 9.5 percent of congenital defects deaths in the World in 2019 occurred in Nigeria. To address these health issues, significant investment is needed in the health sector. Thus, Nigeria must make a concerted effort to achieve its objective of allocating 15 percent of its annual total budget to the healthcare sector, as improvements in health outcomes can yield a multiplier effect in enhancing the country's economic situation.

Theoretical Framework

This study is anchored in the Health Capital Model developed by Michael Grossman (1972), which views health as a form of human capital that can be enhanced through investments such as government health expenditure, health promotion, and access to healthcare services. The model emphasizes that health outcomes, including life expectancy and mortality rates, depend not just on the level of health spending but also on the efficiency of resource allocation and systemic effectiveness. In resource-constrained environments like many African OPEC member countries, the model underscores the importance of targeted investments and efficient management to translate expenditures into tangible health improvements.

Empirical research further supports this framework by indicating that government health expenditure positively influences health outcomes when effectively allocated and managed (Narayan & Popp, 2017; Akinboade & Kinyondo, 2020). These studies highlight that systemic factors, including governance, infrastructure, and resource utilization, determine the extent to which health investments translate into better population health. Overall, the theoretical and empirical literature underscores the need for efficient, targeted health spending to improve health outcomes in African OPEC nations, providing a solid basis for analyzing the relationship between government health expenditure and health indicators within this context.

2. Empirical Literature Review

Recent research, such as Onofrei et al. (2021), has explored the relationship between government health expenditure and health outcomes in EU developing countries, using OLS regression and factor analysis. Their findings indicate that higher government spending improves life expectancy and lowers infant mortality, highlighting the importance of supportive policies and resources. However, the study's cross-sectional design limits causal interpretation over time, and factor analysis, although comprehensive, may mask the specific influence of individual variables on health outcomes.

Anwar et al. (2023) analysed data from 38 OECD countries between 1996 and 2000, employing the Generalized Method of Moments (GMM) to address potential indigeneity issues. Their findings indicated that increased government health spending positively impacted health outcomes such as life expectancy, although the effects varied across countries and indicators. The study highlights that in developed economies, optimizing resource allocation can enhance health benefits, but its applicability to developing or resource-constrained countries remains limited. Moreover, it underscores the importance of healthcare efficiency, an aspect not explicitly examined in the study.

Similarly, Kiross et al. (2023) examine countries in African, data spanning from 2000 to 2015 using panel data methods. Interestingly, they found that higher healthcare expenditure was associated with increased infant mortality, suggesting that resource misallocation, systemic inefficiencies, or broader socio-economic challenges hinder the translation of spending into improved health outcomes. Their findings stress that simply increasing health budgets is insufficient; instead, efforts should prioritize enhancing healthcare efficiency, equitable resource distribution, and addressing social determinants of health.

Furthermore, Alimi & Odugbemi (2023) investigated the short- and long-term impacts of public health expenditure on life expectancy and infant mortality in Nigeria from 1984 to 2020. Using the Autoregressive Distributed Lag (ARDL) approach, their results revealed a negative short-term effect of increased spending on life expectancy but a positive long-term effect in reducing infant mortality. This suggests that sustained investments are necessary to realize long-term health benefits. However, the contradictory short- and long-term effects point toward systemic inefficiencies or misallocation issues, emphasizing the need for effective resource utilization.

Opeloyeru etal., (2021) investigated health expenditure effects in African oil-producing countries via panel regression analysis. Findings show that health expenditure and external healthcare financing significantly improve health outcomes, while out-of-pocket payments negatively affect them. The impact varies with each country's level of economic development, highlighting heterogeneity. However, reliance on aggregate data overlooks intra-country disparities and specific health system factors, which are crucial for targeted policy interventions.

On the same vein, Chireshe & Ocran (2020) examined 45 sub-Saharan African countries from 1995 to 2018 using fixed effects and generalized methods of moments (GMM). They found that increased health expenditure per capita and public health spending reduced under-5 mortality and increased life expectancy. Despite these positive associations, issues such as potential endogeneity and the use of aggregate expenditure measures may mask underlying structural challenges, such as health system inefficiencies and unequal resource distribution, limiting the applicability of findings at sub-national levels.

Azuh et al., (2020) examined the relationship between health expenditure and under-five mortality in Nigeria over a comparable period. Surprisingly, their analysis showed a positive association between government spending and under-five mortality, implying that increased expenditure did not translate into better child health outcomes. This counterintuitive result indicates that mere increases in funding are insufficient unless accompanied by improvements

in health system efficiency, targeted interventions, and quality of service delivery. Data quality and the effectiveness of expenditure allocation may significantly influence these outcomes.

In Zimbabwe, Manyika et al. (2019) focused on maternal mortality, finding a significant inverse relationship between government health expenditure and maternal mortality rates. Their results support the idea that increased healthcare investment can effectively reduce maternal deaths when funds are appropriately allocated and targeted, reinforcing the importance of sustained health financing and specific maternal health programs.

Hlafa et al., (2019) examined the impact of public health expenditure on health outcomes in provinces of South Africa from 2002 to 2016 using panel data analysis (SUR and LSDV). Results varied across provinces, indicating that governance and responsiveness influence the strength of the relationship. The study underscores regional disparities but does not fully address how specific governance mechanisms or health system factors contribute to these differences, highlighting a gap in understanding localized drivers of health outcomes.

While these studies emphasize the value of healthcare spending for improving health outcomes, their broader implications are limited by reliance on aggregate data, potentially concealing inefficiencies and misallocations. Although methods such as GMM and ARDL address some methodological concerns, they do not fully resolve causality or unobserved heterogeneity issues. Future research should use more detailed data, assess healthcare efficiency, and apply robust causal inference techniques to better capture expenditure impacts across diverse contexts.

3. Materials and Methods

Research Design

This study adopts an ex-post facto research design, utilising secondary data sourced from the 2024 World Bank Development Indicators database. A quantitative approach was employed, applying Mean Group (MG) and Pooled Mean Group (PMG) estimators across two econometric models with Life Expectancy and Maternal Mortality as dependent variables, and out-of-pocket health expenditure, government health expenditure, GDP, and external debt as independent variables. For robustness, both Fixed Effect and Random Effect models were estimated to examine the impact of government health spending on health outcomes, with the Hausman test guiding model selection; a p-value above 5% favours the Random Effect model, while a lower p-value supports the Fixed Effect model. The analysis covers African OPEC member countries, Algeria, Nigeria, Congo Republic, Angola, and Gabon—over the period 2000 to 2024, ensuring a comprehensive assessment of the relationship between economic factors and health indicators in these nations.

Table 1: Variable Codes Measurement and Source

Variable Code	Variable Name	Description and Measurement of Variable	Source
LE	Life Expectancy	Measured in years, it reflects the average number of years a new born is expected to live under current mortality rates, serving as a key indicator of entire population health influenced by healthcare quality and living conditions.	WDI (2024)
MM	Maternal Mortality	Expressed as the number of maternal deaths per 100,000 live births, this indicator measures the quality of	WDI (2024)

		maternal healthcare services and reproductive health within a country.	
OPHE	Out of Pocket Health Expenditure	Represented as a percentage of total health expenditure, it indicates the financial burden borne directly by households for healthcare, affecting access to and affordability of health services.	WDI (2024)
GHE	Government Health Expenditure	This is the proportion of current health expenditure financed by the government, reflecting the level of public investment in healthcare and its potential impact on health outcomes.	WDI (2024)
GDP	Gross Domestic Product	Measured in current US dollars or local currency, it represents the average economic output per person and indicates a country's capacity to allocate resources toward health and social services.	WDI (2024)
EXD	External EXD	Expressed as a percentage of GNI, it denotes the total foreign EXD owed by a country, which can influence the government's ability to fund health expenditures and improve health outcomes.	WDI (2024)

Source: Author's compilation 2026

Method of Data Analysis

In panel data analysis, estimators can become inefficient if the variables are nonstationary unless they are cointegrated. Therefore, testing for stationarity is a crucial step before applying methods like the Pooled Mean Group. In this study, we use the Pesaran and Shin (2003) test, known as the IPS test, to check for unit roots. The IPS test allows for variation in the autoregressive parameters across different cross-sectional units, meaning it recognizes that each unit may behave differently over time. It combines the individual test results from each of the N cross-sectional units to assess whether the variables are stationary. The test assumes that the time dimension (T) is the same for all units.

Considering the t-test for each cross-section unit based on T observations. Let $t_{i,T}(i = 1,2, \dots, N)$ denote the t-statistics for testing unit roots and let $E(t_{i,T}) = \mu$ and $V(t_{i,T}) = \sigma^2$. Then

$\sqrt{N}\frac{(\bar{t}_{N,T}-\mu)}{\sigma} \Longrightarrow N(0,1)$…….

where $\bar{t}_{N,T} = \frac{1}{N}\sum_{i=1}^{N} t_{i,T}$, $E(t_{i,T})$ and $V(t_{i,T})$ will vary as the lag length included in the ADF regression varies. It should be noted that $E(t_{i,T})$ and $V(t_{i,T})$ are the same for all i. Thus, the IPS

test considers only balanced panel data. The IPS test is easy to use because there are tables available for $E(t_{i,T})$ and $V(t_{i,T})$. However, these are valid only for the ADF test (Maddala and Wu, 1999).

Cointegration Test

The study utilizes the Pedroni (1999) panel cointegration test, which includes two different tests to ensure robustness. The null hypothesis of the Pedroni test is that there is no cointegration; this null is rejected if the p-value is less than 5%, indicating a statistically significant cointegration relationship.

Estimation procedure

This study employs panel data regression to analyze the effect of government health expenditure on health outcomes in selected oil-producing countries where it utilizes the PMG estimator. The PMG estimator, proposed by Pesaran et al. (1999), allows for heterogeneity in short-term dynamics while assuming homogeneous long-term relationships across groups. The model is specified for the panel data with groups (i = 1, 2, ..., N) over time periods (t = 1, 2, ..., T \). The unrestricted ARDL specification for each group can be expressed as:

$$y_{i,t} = \sum_{j=1}^{p} \lambda_{i,j}\, y_{i,t-j} + \sum_{j=0}^{q} \gamma'_{i,j}\, x_{i,t-j} + \mu_i + \epsilon_{i,t} \quad (3.1)$$

where $y_{i,t}$ is the dependent variable, $x_{i,t}$ is the K× 1 vector of regressors for group i, μ_i denotes the fixed effects, $\lambda_{i,j}$ is the coefficient of the lagged dependent variable, and $\gamma'_{i,j}$ is a representation of the coefficients of the regressors.

The re-parameterized form of equation (3.1) is such that:

$$\Delta y_{i,t} = \vartheta_i y_{i,t-1} + \delta'_i x_{i,t-1} + \sum_{j=1}^{p-1} \lambda_{i,j}\, \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \gamma'_{i,j}\, \Delta x_{i,t-j} + \mu_i + \epsilon_{i,t} \quad (3.2)$$

Equation (3.2) can be written such that:

$$\Delta y_{i,t} = \vartheta_i \eta_{i,t-1} + \sum_{j=1}^{p-1} \lambda_{i,j}\, \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \gamma'_{i,j}\, \Delta x_{i,t-j} + \mu_i + \epsilon_{i,t} \quad (3.3)$$

In equation (3.3), $\eta_{i,t-1}$ is the error correction term and ϑ_i is coefficient of the error coefficient term which must be negative and statistically significant. The error correction term represents the speed at which variables adjust back to the long-run equilibrium. To verify the robustness of the long-term estimates obtained from the Pooled Mean Group approach, the study also employed the Panel Fully Modified Ordinary Least Squares (FM-OLS) method. The FM-OLS estimator is particularly efficient in addressing issues of endogeneity and serial correlation, ensuring reliable and consistent long-run parameter estimates.

Model (1) of the study where life expectancy is the dependent variable can be specified as:

$$le_{i,t} = \alpha_o + \alpha_1 ophe_{i,t} + \alpha_2 ghe_{i,t} + \alpha_3 gdp_{i,t} + \alpha_4 debt_{i,t} + u_{i,t} \quad (3.4)$$

where, le is life expectancy, $ophe$ is out of pocket health expenditure, ghe is government health expenditure, gdp is gross domestic product, a proxy for economic growth and $debt$ is external EXD, u represents the error term which is expected to tend towards zero.

The PMG long run equation for model (1) can be specified as:

$$\Delta le_{i,t} = \varphi_o + \sum^{n}_{i=1} \varphi_1 \Delta le_{i,t-j} + \sum^{n}_{i=1} \varphi_2 \Delta ophe_{1i,t-j} + \sum^{n}_{i=1} \varphi_3 \Delta ghe_{2i,t-j} + \sum^{n}_{i} \varphi_4 \Delta debt_{3i,t-j} + \beta_0 le_{i,t-1} + \beta_1 ophe_{1i,t-1} + \beta_2 ghe_{2i,t-1} + \beta_3 ghe_{3i,t-1} + \beta_4 debt_{4i,t-1} + \epsilon_{i,t} \quad (3.5)$$

In equation (3.5), Δ is the first difference operator and $\varphi$is a drift component. Equation (3.5) is a representation of an unrestricted error correction model where the summation sign, Σ, expresses the error correction dynamics and the expressions β_0 to β_4 denotes the long run relationship.

The PMG short run equation for model (1) can be specified as

$$\Delta le_{i,t} = \varphi_o + \sum^{n}_{i=1} \varphi_1 \Delta le_{i,t-j} + \sum^{n}_{i=1} \varphi_2 \Delta ophe_{1i,t-j} + \sum^{n}_{i=1} \varphi_3 \Delta ghe_{2i,t-j} + \sum^{n}_{i} \varphi_4 \Delta debt_{3i,t-j} + \varphi_8 ect_{t-1} + \epsilon_t \quad (3.6)$$

where, ect is the error correction term which validates the existence of a long run relationship among the variables in the model when its coefficient is negative, less than one and significant statistically.

Model (2) of the study where maternal mortality is the dependent variables can be specified as:

$$mm_{i,t} = \alpha_o + \alpha_1 ophe_{i,t} + \alpha_2 ghe_{i,t} + \alpha_3 gdp_{i,t} + \alpha_4 debt_{i,t} + u_{i,t} \quad (3.7)$$

where, $mm$is maternal mortality, $ophe$ is out of pocket health expenditure, ghe is government health expenditure, gdp is gross domestic product, a proxy for economic growth and $debt$ is external EXD, u represents the error term which is expected to tend towards zero.

The PMG long run equation for model (2) can be specified as:

$$\Delta mm_{i,t} = \varphi_o + \sum^{n}_{i=1} \varphi_1 \Delta mm_{i,t-j} + \sum^{n}_{i=1} \varphi_2 \Delta ophe_{1i,t-j} + \sum^{n}_{i=1} \varphi_3 \Delta ghe_{2i,t-j} + \sum^{n}_{i} \varphi_4 \Delta debt_{3i,t-j} + \beta_0 le_{i,t-1} + \beta_1 ophe_{1i,t-1} + \beta_2 ghe_{2i,t-1} + \beta_3 ghe_{3i,t-1} + \beta_4 debt_{4i,t-1} + \epsilon_{i,t} \quad (3.8)$$

The PMG short run equation for model (2) is represented as:

$$\Delta mm_{i,t} = \varphi_o + \sum_{i=1}^{n} \varphi_1 \Delta mm_{i,t-j} + \sum_{i=1}^{n} \varphi_2 \Delta ophe_{1i,t-j} + \sum_{i=1}^{n} \varphi_3 \Delta ghe_{2i,t-j} + \sum_{i}^{n} \varphi_4 \Delta debt_{3i,t-j} + \varphi_8 ect_{t-1} + \epsilon_t$$

Granger Causality Test

To assess whether government health expenditure can serve as a predictor for future levels of life expectancy at birth, the study employs the Dumitrescu and Hurlin (2012) Granger causality test. This test involves averaging the individual Wald statistics of Granger non-causality across cross-sectional units. Under the null hypothesis, the Wald statistic converges to a standard normal distribution as the sample size increases. The distribution of the test statistic is characterized for a fixed time dimension (T), with a semi-asymptotic distribution derived for this context. The modeling uses a standardized statistic based on moment approximations of the Wald statistics. Monte Carlo simulations indicate that these standardized panel statistics exhibit excellent small-sample properties, making them suitable for the sample size of the study

The Dumitrescu and Hurlin test is such that:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_{ik} y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} x_{i,t-k} + \varepsilon_{i,t} \quad (3.9)$$

with $i = 1, \dots, N$ and $t = 1, \dots, T$,

where $x_{i,t}$ and $y_{i,t}$ are the observations of two stationary variables for individual i in period t. Coefficients are allowed to differ across individuals but are assumed to be time invariant. The lag order K is assumed to be identical for all individuals, and the panel must be balanced (Lopez and Weber, 2017).

A Priori Expectation

It is anticipated that an increase in government health expenditure will positively impact health outcomes by improving life expectancy and reducing maternal mortality at birth during the observed period.

4. Results and Discussion

Descriptive Statistics

Prior to engaging our data to examine the impact of government health expenditure on health outcomes in selected African OPEC member countries, a summary statistic describing the variables in the model is presented in Table 1.

Table 2: Result of the Summary Statistics of the Variables

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis
LE	105	60.8230	8.4447	46.054	76.274	0.0008	0.0069
MM	105	461.181	362.9515	77	1248	0.0004	0.0629
GHE	105	45.556	19.2204	13.0609	7.6942	0.5225	0.0000
OOPE	105	45.1613	30.14623	3.5396	13.4573	0.0000	0.0000
GDP	105	3558.394	1840.044	1462.566	7612.835	0.0001	0.5735
EXD	105	46.1733	950.4806	2.5413	243.7754	0.0001	0.1085

Source: Author's computation. Using EViews 11, 2026

The summary statistics offer a detailed overview of the variables within the 105 observations, highlighting both central tendencies and dispersion. Life expectancy demonstrates a mean of 60.82 years and moderate variability (SD = 8.44), with a nearly symmetric distribution. Maternal mortality averages 461.18 per 100,000 live births but shows considerable variability (SD = 362.95) and wide disparities, though the distribution remains largely symmetric. Government health expenditure has a mean of 45.56 units (SD = 19.22), with some skewness towards higher values, yet overall low skewness and kurtosis. Out-of-pocket expenditure and EXD levels display substantial variability and mostly symmetric distributions, while GDP shows slight positive skewness. Overall, the data reflect diverse health and economic profiles.

Correlation Analysis

In Table 3, the correlation matrix is utilized to examine the correlation among the variables in the model (1).

Table 3: Result of the Correlation Matrix for Model (1)

	LE	GHE	OOPE	GDP	EXD
LE	1.0000				
GHE	-0.8382	1.0000			
EXD	0.0072	-0.1710	1.0000		
GDP	-0.6060	0.4220	-0.2477	1.0000	
OOPE	-0.2409	0.0573	-0.5635	0.6272	1.0000

Source: Author's computation. Using EViews 11, 2026

The correlation matrix for Model (1) reveals significant relationships among the variables. Life expectancy (LE) is strongly negatively correlated with government health expenditure (GHE) (-0.8382), indicating that higher government spending is associated with lower life expectancy, which may seem counterintuitive. GHE has a weak negative correlation with EXD (0.0072) and

a moderate positive correlation with GDP (0.4220), suggesting that increased government health spending is linked to higher economic output. Out-of-pocket expenses (OOPE) show weak correlations with LE and GHE but have a moderate positive relationship with GDP (0.6272) and a moderate negative relationship with life expectancy (-0.2409). Overall, the results indicate complex and somewhat counterintuitive associations, particularly between government health expenditure and life expectancy, highlighting the need for further analysis to understand these dynamics.In Table 4, the correlation matrix is utilized to examine the correlation among the variables in the model (2).

Table 4: Result of the Correlation Matrix for Model (2)

	MM	GHE	OOPE	GDP	EXD
MM	1.0000				
GHE	0.7642	1.0000			
OOPE	0.3968	0.0573	1.0000		
GDP	0.5312	0.42720	0.6972	1.0000	
EXD	-0.2865	-0.1710	-0.5285	-0.2877	1.0000

Source: Author's computation. Using EViews 11, 2026

The correlation matrix for Model (2) indicates strong positive relationships among most variables, with government health expenditure (GHE) showing a high correlation with market measures (MM) (0.7642) and moderate correlations with GDP (0.4272) and out-of-pocket expenses (OOPE) (0.3968). GDP is strongly correlated with OOPE (0.6972), suggesting that higher economic output is associated with increased health spending by individuals. Conversely, EXD (EXD) exhibits negative correlations with GHE (-0.1710), OOPE (-0.5285), and GDP (-0.2877), indicating that higher EXD levels tend to be linked with lower government health spending, individual health expenditures, and economic performance. Overall, the matrix reflects interconnected relationships where increased government and personal health expenditures align with economic growth, while higher EXD is associated with declines in these areas.

Unit Root Test

The initial stage of the statistical analysis involves testing the stationarity of the variables to assess their suitability for further modeling. Table 5 presents the results of the Im, Pesaran, and Shin panel unit root test for each variable.

Table 5: Result of the IPS Panel Unit Root Test

Variables	Levels		First Difference		Order of Integration
	Statistics	Probability Value	Statistics	Probability Value	
Life Expectancy	-2.7875	0.0164	-4.7659	0.0000	I (1)
Maternal Mortality	-1.6965	0.3395	-4.0243	0.0000	I (1)
Out of Pocket	-2.9785	0.0083***	-	-	I (0)
Government Health Expenditure	-1.5272	0.4786	-5.5715	0.0000	I (1)
GDP	-2.2898	0.0784	-3.5327	0.0000	I (1)
EXD	-2.3381	0.0383	-4.3897	0.0000	I (1)

Source: Author's computation. Using EViews 11, 2026Note: Statistics is t-bar statistic. No lags included. Note: ***, ** and * represent statistical significance at 1%, 5% and 10%, respectively.

The Im, Pesaran, and Shin (IPS) panel unit root test results reveal that life expectancy, maternal mortality, government health expenditure, GDP, and external debt are nonstationary at levels, as their p-values exceed 0.05 (except EXD at 0.0383), but achieve stationarity after first differencing, indicating they are integrated of order one, I(1). In contrast, out-of-pocket expenditure is stationary at levels (p = 0.0083), thus classified as I(0). These findings underscore the importance of employing econometric techniques suitable for variables with mixed integration orders, ensuring robust analysis and preventing spurious regression when modelling the relationship between health outcomes and expenditure among the studied variables.

Cointegration Test

Before the estimation of the PMG, the study employs the Pedroni (1999) panel cointegration test. While the test for cointegration is not entirely necessity, it provides some robustness to confirm the existence of long run relationship among the variables in the model. Table 6 present the result of Pedroni test for model (1).

Table 6: Result of the Pedroni Panel Cointegration for Model (1)

Test	Statistic	p-value
Modified Phillips-Perron	2.4743***	0.0065
Phillips-Perron	1.8636**	0.0298
Augmented Dickey-Fuller	2.4754***	0.0070

Source: Author's computation. Using EViews 11, 2026. Note: ***, ** and * represent statistical significance at 1%, 5% and 10%, respectively.

The findings indicated the existence of long-term equilibrium relationship among the variables in the model. Three of the sub-tests within the Pedroni cointegration test show probability values below 5%, providing strong evidence to confirm the presence of long-run association among these variables. This suggests that these factors are interconnected over time and any changes in one are likely to be reflected in the others in the long run. The Pedroni cointegration test results for model (2) demonstrated significant long-term relationship among the variables.

Table 7: Result of the Pedroni Panel Cointegration for Model (2)

Test	Statistic	p-value
Modified Phillips-Perron	2.0401**	0.0212
Phillips-Perron	1.1262	0.1322
Augmented Dickey-Fuller	1.554*	0.0648

Source: Author's computation. Using EViews 11, 2026

Note: ***, ** and * represent statistical significance at 1%, 5% and 10%, respectively.

The evidence indicates cointegration at both the 5% and 10% significance levels, confirming that these variables are interconnected over the long run. Additionally, the results from the modified Phillips-Perron, Phillips-Perron, and augmented Dickey-Fuller tests further support the presence of a long-term equilibrium relationship among these variables, reinforcing the robustness of the findings.

Pooled Mean Group and Mean Group Results

Two separate tests were conducted for both model 1 and 2 where results are presentenced as follows: **PMG and MG result for Model 1**

In table 9, the PMG result for model (1) is presented along with the mean group (MG). The result of the PMG estimate reveals that both government health expenditure and out of pocket health expenditure have a positive and significant relationship with life expectancy in the long run. Table 4.9 further shows that in the long run, GDP and EXD have a positive but insignificant relationship with life expectancy.

Table 8: Result of the Pooled Mean Group Estimation for Model (1)

Variables	Pooled Mean Group	Mean Group
	Long Run	
GHE	0.0013*	-0.0005
	(0.056)	(0.817)
OOPE	0.1107***	0.0358
	(0.000)	(0.387)
GDP	0.0495	-0.3314
	(0.125)	(0.533)
EXD	0.00004	0.0015
	(0.731)	(0.412)
	Short Run	
ECT (-1)	-0.1151*	-0.3560
	(0.092)	(0.119)
D(GHE)	0.00005	0.0003
	(0.610)	(0.155)
D(OOPE)	-0.0109	-0.0161
	(0.610)	(0.219)
D(GDP)	0.0107	-0.0868***
	(0.857)	(0.001)
D(EXD)	-0.00008**	6.50e-06
	(0.038)	(0.944)
Constant	0.3866*	0.7592
	(0.090)	(0.183)
Hausman (MG/PMG)	0.7273	
Observations	100	100

Source: Author's computation. Using EViews 11, 2026

Note: ***, ** and * represent statistical significance at 1%, 5% and 10%, respectively. Probability values are in parenthesis.

The long-run results from the Mean Group (MG) estimator indicate no significant relationship between government or out-of-pocket health expenditure and life expectancy. However, the Hausman test confirms the Pooled Mean Group (PMG) as the more appropriate model, given its p-value exceeds 5 per cent. PMG results reveal that, in the long run, both government health expenditure and out-of-pocket expenditure are positively associated with life expectancy, with the latter being highly significant at the 1 per cent level. GDP and external debt show no significant long-term effects. In the short run, only external debt significantly influences life expectancy, while the Error Correction Term confirms adjustment towards equilibrium, emphasising the importance of health spending and external debt over varying time horizons.

PMG and MG result for Model 2

Table 9 presents the PMG and MG results for the second model and the probability of the Hausman test. The PMG and MG estimations results reveal distinct long-term and short-term relationships among the variables. In the long run, external debt (EXD) exhibits a significant positive impact at the 5% level, indicating that higher external debt levels are associated with improvements in the dependent variable over time. Other variables, including government health expenditure (GHE), out-of-pocket expenditure (OOPE), and GDP, do not show significant long-term effects. In the short term, the error correction term (ECT) is significantly negative in both models, confirming the system's tendency to revert to equilibrium after deviations.

Figure 9: Result of thePooled Mean Group Estimation for Model (2)

Variables	Pooled Mean Group	Mean Group
	Long Run	
GHE	0.0151	0.00225
	(0.345)	(0.893)
OOPE	0.4705	-0.7683
	(0.245)	(0.353)
GDP	0.9980	3.5208
	(0.269)	(0.297)
EXD	0.01177**	0.01764
	(0.034)	(0.311)
	Short Run	
ECT (-1)	-0.2152***	-0.3205**
	(0.005)	(0.002)
D(GHE)	-0.0079***	-0.00307
	(0.000)	(0.554)
D(OOPE)	-0.2088***	0.0527
	(0.000)	(0.790)
D(GDP)	1.0887*	1.5165***
	(0.081)	(0.003)
D(EXD)	0.00069	0.0006*
	(0.560)	(0.0645)
Constant	-1.1591*	0.9061
	(0.101)	(0.806)
Hausman (MG/PMG)	0.5756	
Observations	100	100

Source: Author's computation. Using EViews 11, 2026

Note: ***, ** and * represent statistical significance at 1%, 5% and 10%, respectively. Probability values are in parenthesis.

Short-term, GHE and OOPE have significant negative coefficients, suggesting that increases in these expenditures may initially reduce the dependent variable's value, while GDP shows a significant positive effect, indicating immediate benefits from economic growth. External debt (EXD) is only significant at the 10% level in the short run. The Hausman test suggests the PMG estimator is appropriate, with the model based on 100 observations. Overall, these results highlight the nuanced short- and long-term influences of fiscal and economic variables on the outcome studied.

Granger Causality Test for Model

Table 10 presents the results of the Dumitrescu and Hurlin (2012) Granger non-causality test for model 1.

Table 10: Result of Granger Causality Test for Model (1)

	W-bar	Z-bar	P-value
GHE→LE	0.4566	-0.8592	0.302
OOPE→LE	3.4113***	3.8901	0.0001
GDP→LE	2.2377**	2.0034	0.0480
EXD→LE	2.5528**	2.4635	0.0460

Source: Author's computation. Using EViews 11, 2026

Note: *** and ** indicates statistical significance at 1% and 5%, respectively.

The findings indicate that out-of-pocket health expenditure, GDP, and external debt Granger cause life expectancy in the selected African countries. This suggests that these variables can be used as predictive factors to accurately forecast future changes in life expectancy within the observed countries. Similarly, Table 11 presents the results of the Dumitrescu and Hurlin (2012) Granger causality test for model 2.

Table 11: Result of Granger Causality Test for Model (2)

	W-bar	Z-bar	P-value
GHE→MM	1.3343	0.5961	0.526
OOPE→MM	1.495	0.7886	0.4540
GDP→MM	2.3192**	2.0600	0.0375
EXD→MM	1.848	1.3226	0.1873

Source: Author's computation. Using EViews 11, 2026

Note: *** and ** indicates statistical significance at 1% and 5%, respectively.

The results indicated that government expenditure, out-of-pocket health expenditure, and external debt do not Granger cause maternal mortality in the selected African countries. This implies that these variables are not useful for predicting future maternal mortality rates in the observed countries. Conversely, GDP does Granger cause maternal mortality, suggesting it can be employed as a predictor for future maternal mortality outcomes in these nations.

Diagnostic Test

Post estimation tests in panel data studies is crucial for verifying the appropriateness of the model, diagnosing any residual problems assessing the explanatory powers of the model and ensuring the robustness of the results. Without these tests, there is the risk of relying on biased, inconsistent or inefficient estimates, which will lead to misleading conclusions in in empirical studies. Therefore, these tests are vital to validate the quality of findings.

Fixed and Random Effects

The diagnostic results in Table 12, particularly the Hausman test statistic of 68.40 with a p-value of 0.0000, strongly favor the Fixed Effects model over the Random Effects model, indicating that individual-specific effects are correlated with the repressors'.

Table 12: Result of the Fixed and Random Effect Analysis for Model (1)

Variables	Fixed Effects	Random Effects
GHE	0.0021***	0.0063***
	(0.004)	(0.000)
OOPE	0.0525***	0.1224***
	(0.001)	(0.000)
GDP	0.0996**	-0.0623**
	(0.025)	(0.040)
EXD	-0.00002	0.0006***
	(0.907)	(0.001)
Constant	3.0096***	3.8426***
	(0.000)	(0.000)
Hausman	68.40***	
	(0.0000)	
Observations	105	105

Source: Author's computation. Using EViews 11, 2026

Note: ***, ** represents statistical significance at 1% and 5%, respectively. Probability values are in parenthesis.

The findings indicate that the Fixed Effects estimator yields more consistent and reliable results for this panel data analysis, as evidenced by the significance of government health expenditure, out-of-pocket expenditure, and GDP in explaining maternal mortality. While external debt is insignificant in the Fixed Effects model, it emerges as significant in the Random Effects model. This disparity suggests that the Mean Group estimator, which assumes effect independence and heterogeneity, is unsuitable here. Instead, the Pooled Mean Group estimator is preferred, as it accounts for country-specific heterogeneity and delivers consistent estimates. The Hausman test for Model (2), with a statistic of 29.30 and p-value of 0.0000, further substantiates the superiority of the Fixed Effects model.

Table 13: Result of the Fixed and Random Effect Analysis for Model (2)

Variables	Fixed Effects	Random Effects
GHE	-0.1056**	-0.0099**
	(0.003)	(0.015)
OOPE	-0.2319***	0.2640**
	(0.010)	(0.010)
GDP	0.3520	0.3069
	(0.449)	(0.546)
EXD	-0.0029**	0.0026*
	(0.021)	(0.064)
Constant	-0.1043***	-0.1031***
	(0.000)	(0.000)
Hausman	29.30***	
	(0.0000)	
Observations	105	105

Source: Author's computation. Using EViews 11, 2026

Note: ***, ** represents statistical significance at 1% and 5%, respectively. Probability values are in parenthesis.

This suggests that the Fixed Effects estimator provides more consistent estimates for this model. Notably, variables such as GHE, OOPE, and EXD are statistically significant in the Fixed Effects framework, while GDP is not. The contrasting signs and significance levels between the Fixed and Random Effects models, along with the Hausman test outcome, imply that heterogeneity across countries is better captured by the Fixed Effects approach. These diagnostic results support the use of the PMG (Pooled Mean Group) estimator, which accommodates heterogeneity in short- and long-run dynamics, over the MG (Mean Group) estimator, which assumes complete homogeneity. Overall, the tests advocate for the PMG approach as the most appropriate for analyzing the data, ensuring reliable estimation of both short-term and long-term relationships.

Discussion

The empirical results from the PMG and MG estimations for Models 1 and 2 provide deepw perceptions into the long and short-term relationships between health expenditures, economic variables and health outcomes, aligning with and extending the findings from the reviewed literature.

Model 1:

The PMG results indicate that, in the long run, both government health expenditure and out-of-pocket expenditure significantly and positively influence health outcomes, such as life expectancy, supporting the findings of Onofrei et al. (2021) and Manyika et al. (2019) on the benefits of targeted health spending. In contrast, GDP and external debt exhibit no significant long-term effects, consistent with Kiross et al. (2023), who highlight that economic growth alone does not ensure better health outcomes. Short-term analysis reveals that external debt

exerts an immediate effect on health, aligning with Opeloyeru et al. (2021), while negative short-term coefficients for health expenditures suggest transitional adjustment processes, as noted by Alimi and Odugbemi (2023). The Hausman test validates the choice of the PMG estimator, underscoring the need to address inefficiencies to fully realise the benefits of health spending.

Model 2

The PMG and MG estimation results for Model 2 reveal that external debt significantly enhances health outcomes in the long term, supporting literature that underscores the benefits of effective external financing. This indicates that, when efficiently managed, external funding can substantially improve health indicators. Conversely, government health expenditure, out-of-pocket expenditure, and GDP do not demonstrate significant long-term effects, challenging the assumption that increased spending or economic growth alone assures improved health outcomes and highlighting inefficiency concerns raised by Kiross et al. (2023). In the short term, negative coefficients for health expenditures reflect initial inefficiencies, while GDP's significant positive effect affirms the immediate health benefits of economic growth. The Hausman test validates the PMG estimator for cross-country analysis, underscoring the necessity for improved efficiency and structural reforms in health financing.

Conclusion and Recommendations

This study examines the impact of government health expenditure and health outcomes on selected OPEC Member countries, emphasis on Africa. It underlines the complex and degree of relationship between health expenditures, economic variables and health outcomes across these countries. The study concluded that while long-term improvements in health outcomes are significantly associated with increased government health spending and out-of-pocket payments, the effects are often contingent upon systemic efficiency and proper resource allocation. External debt can also play supportive role in enhancing health metrics when managed effectively. However, the presence of short-term negative effects suggests transitional costs and inefficiencies that need to be addressed. These insights highlight the importance of not only increasing health financing but also improving health system efficiency, governance and targeted interventions to translate expenditures into tangible health benefits.

The following recommendations are derived from the findings of the study:

1. Policymakers should focus on enhancing health system efficiency by implementing targeted reforms that improve resource management, reduce wastage, and strengthen healthcare delivery infrastructure. This entails establishing robust monitoring and evaluation frameworks to ensure that increased health expenditures directly translate into better health outcomes, signaling a need for strategic allocation of resources aligned with system priorities.
2. External financing, including debt, must be carefully managed with clear policy signals promoting transparency, accountability, and effective utilization. Governments should prioritize borrowing for sustainable health projects that have long-term impacts, ensuring that external funds are channeled into infrastructure and programs with measurable health benefits, thus reinforcing fiscal discipline and strategic resource planning.
3. Given the short-term negative effects observed, policies should include transitional support measures such as capacity building and phased implementation strategies to mitigate initial inefficiencies. Clear policy signals encouraging gradual reforms and stakeholder engagement can facilitate smoother transitions, ensuring that short-term costs lead to long-term health improvements.
4. Future research and policy should emphasize the importance of incorporating efficiency assessments and granular data analysis to inform targeted interventions. Governments should signal a commitment to evidence-based policymaking by investing in data collection,

health system diagnostics, and continuous improvement processes, fostering a culture of accountability and adaptive learning.

5. Integrating economic growth strategies with health sector reforms is crucial. Policy signals should promote multi-sectoral coordination, emphasizing that sustained economic development coupled with targeted health financing reforms will generate lasting health improvements, thereby aligning fiscal policies with long-term health objectives.

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