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Health Expenditure and Child Health Outcomes in Sub-Saharan Africa

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Abstract:

Purpose: *The Sub-Saharan African (SSA) countries have exerted efforts towards reducing mortality among children by raising the level of health expenditure in recent years. In spite of this, the health status of children in SSA only recorded marginal improvement. This questioned the efficiency of health care spending in improving child health outcomes. Therefore, this study was designed to examine the effect of health expenditure on child health outcomes in SSA.*
Design/methodology/approach: *The study is anchored on the Grossman (1972) human capital theory. Data were obtained from World Bank database. The data covered 44 countries across the SSA region. Two measures of child health outcomes; infant mortality rate and child mortality rate were used. A fixed effect model was estimated to investigate the effect of health expenditure on child health outcomes. Estimates were validated at $p \leq 0.05$.*
Findings: *Total health expenditure had a significant negative effect on infant ($t=-29.25$) and child mortality ($t=-30.13$), respectively. Total health spending decreased infant mortality by 22.37%, while it reduced child under-5 mortality by -43.39%.*
Practical implications: *Although the study did not examine the effect of disaggregated health expenditures on child health outcomes, total health expenditure is an important factor in reducing infant mortality rate and child mortality rate in SSA.*
Originality/value/contribution: *The examination of the relationship between aggregate of two measures of child health outcomes in Sub-Saharan Africa, is unique.*

Keywords: *Health expenditure, infant mortality rate, child mortality rate, Sub-Saharan Africa.*

JEL Classification: *H51, I15, J13.*

Paper type: *Research article.*

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1. Introduction

The impact of the healthcare system on human life (child health outcome) has over the years triggered public health concerns among policymakers. The issue of healthcare is so important that it is a major component of the Sustainable Development Goals (SDGs). The third objective of the SDG seeks to promote good health and well-being for all and at every stage (from conception to old age). This can be achieved by substantially increasing health expenditure and significantly reducing infant mortality and child mortality rates across Sub-Saharan Africa (SSA) and the world at large (Ahinkorah, 2021). A major factor in achieving the health target is the increase in both public and private spending on health.

The ability of government and households to sustain and enhance human health depends on health expenditures. However, the absence of adequate funding, insufficient health workers, and inadequate medical equipment implies that health promotion or disease prevention cannot be achieved (Chireshe and Ocran, 2021).

The amount spent on health shows how much healthcare is generally accessed by individuals and households. Not only would investing in the healthcare system result in healthy lives for adults, but it will also, increase child health outcomes, and social stability, generate job opportunities, and promote economic growth (Ahinkorah, 2021). As part of the effort to achieve good health and universal health coverage, there is a need for good healthcare systems to be in place (Owusu *et al.*, 2021).

The Sub-Saharan African region has the greatest risk of a child dying (51 deaths per 1000 live births) before the age of one in 2023, this is more than six times (8 deaths per 1000 live births) higher than what is obtainable in the European region. Also, Sub-Saharan Africa has the highest neonatal mortality rate in 2023 at 27 (25-32) deaths per 1000 live births, followed by central and southern Asia with 23 (21-25) deaths per 1000 live births. A child born in sub-Saharan Africa is 10 times more likely to die in the first month than a child born in a high-income country (World Health Organization, 2023).

The high infant mortality rate and Under-5 mortality rates in Sub-Saharan African countries are attributed, to a variety of socioeconomic factors such as poverty, poor sanitation, low female education attainment, low per capita income, dirty and unclean environment, and low-level health expenditures (Chireshe and Ocran, 2021). There have been notable improvements in the health system across SSA countries, and this includes progress in the use of modern healthcare techniques, improvement in the socioeconomic amenities and health infrastructures as well a decline in infant/child survival rates since 2015, when the Millennium Development Goals (MDGs) ended, and the sustainable development goals (SDGs) began.

Despite that, sub-Saharan African countries have the highest infant mortality rates (with 72 deaths per 1000 live births)when compared with other regions like Europe,

Asia, and North America, with only 3.43, 27.2, and 5.35 child fatalities per 1000 live births, respectively. Also, the 72 deaths per 1000 live births recorded in SSA far outweigh the target of 25 deaths per 1000 live births projected by SDGs.

Meanwhile, the budgetary allocation to health in SSA remains relatively minimal. The per capita health expenditure in 2015 was US$86, while it was US$74 in 2023. Similarly, countries with high per capita GDP rarely allocate a higher proportion to the health sector relative to, countries with low per capita GDP. For instance, high-income nations in Sub-Saharan Africa (SSA), such as Nigeria and South Africa, allocate 13.38% and 8.58% of their annual budget to the health sector in 2023. Meanwhile, several lower-income nations in SSA, like Ethiopia, Gambia, and Malawi, allocated 15% of their public expenditures to the health sector (World Bank, 2023).

In Sub-Saharan Africa, the major sources of health care financing are public health spending, mandatory health insurance, private health funding (out-of-pocket spending), Non-governmental Organizations (NGOs), and funds from multilateral organizations like the International Monetary Fund (IMF), World Bank, United Nations Children's Fund (UNICEF) and World Health Organizations (WHO).

World health expenditure has risen significantly in recent years, with aggregate spending increasing from $8.5 trillion in 2019 representing 9.8% of global gross domestic product (GDP) to US$9.8 trillion in 2021 amounting to 10.3% of global GDP (WHO, 2023). However, there exists wide variation among regions and countries of the world, for example, per capita health spending in SSA lags behind that of other regions.

The average per capita health expenditure in SSA was about US$73.79 in 2020 representing 4.92% of GDP, a decline of about 5% from 2019, while in Organization for Economic Cooperation and Development (OECD) countries the average per capita health expenditure is US$5,295.30 in 2020 representing 13.93% share of GDP. The variation among countries is more pronounced with public health expenditure than for other expenditure sources. On average, not more than 6.1% of overall health spending in SSA comes from public sources relative to about 9.5%, 6.94%, and 10.91% in OECD, Asia, and Europe respectively (National Institute of Health [NIH], 2023).

As a result of the poor public health spending, Sub-Saharan African (SSA) countries rely most often on private health spending which hinders a high proportion of the population from accessing health care services and ends up with poor health status and in a poverty trap (WHO, 2022). A large proportion of health expenditure in the Sub-Saharan Africa region comes from private sources and is primarily out-of-pocket (OOP) spending. The out-of-pocket expenditure per capita in SSA is US$58.74 billion in 2020 accounting for 30.35% of total health expenditure. This is on the high side when compared to the OOP health spending in Europe and Central

Asia which is 15.84% of total health expenditure. Similarly, only 12.34% of the total health expenditure was accounted for by OOP in the OECD.

According to WHO (2020), about 10% of the population in the Sub-Saharan Africa region experiences catastrophic health spending (out-of-pocket spending above the share of aggregate spending among households) each year as a result of high out-of-pocket spending. this tends to perpetuate a vicious cycle of poverty and leads to more sickness, disability, and deaths when households cannot afford OOP spending. This is worrisome given the multi-dimensional poverty in SSA and more worrisome given that about 40% of the population in SSA is projected to fall below the poverty line (International Monetary Fund [IMF], 2023).

Another source of financing healthcare in SSA is external spending. External sources include foreign transfers distributed by the government; it covers all financial inflows to the health system from multilateral organizations. The external health expenditure per capita in SSA is US$25.42, this was estimated to be 13.18% of current health spending in 2020. This tends to exert a significant influence on public and private health spending in SSA. However, the flow of external funds can be distorted by exogenous forces.

To reduce the risks associated with a child's health status, policymakers have formulated several policies aimed at improving population health status generally and enhancing economic growth. One of the economic reforms that were executed in most SSA countries is the adoption and implementation of the structural adjustment program (SAP) advanced by the World Bank and International Monetary Fund (IMF).

Some of the fundamentals of the reforms are prudent use of public resources, control of public wages, elimination of subsidy, and liberalization of the economy as well as currency devaluation to attain sustained economic growth (World Bank, 2022). The outcomes of these reforms on child health were not significantly different among the countries in SSA (World Bank, 2022).

Another program aimed at promoting health care is universal health coverage (UHC). The main objective of UHC is to guarantee access to health care by households without experiencing financial difficulties. It ensures SSA countries develop their human capital and economic growth, because without good health, there will be high absenteeism from school among children, and adults will often abstain from work (World Bank, 2020).

Also, efforts at reducing infant mortality rate and under-5 mortality rates include the Abuja Declaration of 2001, where members agreed to commit 15% to healthcare, and years after, many African countries like Malawi, the Gambia, and Ethiopia have increased their share of overall public expenditure to healthcare. Despite this effort to increase health spending, Sub-Saharan African countries have the lowest

healthcare expenditure when compared to other regions of the world. This may be due to limited resources with many competing sectors, hence, the tendency to place less priority on the health sector given that health is a demerit good.

Furthermore, policymakers target the provision of affordable, quality health care to women, children, adolescents, and the community at large, thereby ensuring a long-term investment in human capital. Despite these efforts, maternal and child mortality are on the high side in the SSA countries. About 25% of girls and women in SSA lack access to family planning, giving rise to unplanned pregnancies as well as maternal, infant, and child mortalities (World Bank, 2022). It is attributed to factors such as poverty, inadequate sex education, and social exclusion.

To improve maternal, child, and adolescent access to health care among SSA countries, the World Bank set up the global financing facility (GFF). It tends to deliver the benefits of rapid population growth in SSA with a high proportion of the young population through investment in the health and well-being of the children to boost human capital and facilitate demographic dividend (World Bank, 2023).

Finally, the policymakers in SSA also target increasing funding for the healthcare system to achieve universal health coverage and attain sustainable development goals. The policymakers also developed an integrated framework to strengthen investments in health systems and promote results monitoring among countries. Despite these efforts, the SSA countries are faced with a lot of health challenges that require significant investments in the health sector.

This study examines the impact of health expenditure on child health outcomes in SSA. Specifically, the study provides an answer to the following questions: what is the effect of total health expenditure on infant mortality rate? And what is the effect of total health expenditure on the child mortality rate in Sub-Saharan Africa? The study focuses on Sub-Saharan Africa and is restricted to the periods between 2000 to 2020.

The choice of the study period is to understand the development in the health sector in SSA as it relates to the effect of health expenditure on child health outcomes in the region. The choice of the period is informed by the increase in global health spending that accompanies the development of SDGs and the accessibility and availability of reliable data on all the variables used for this study in the context of Sub-Saharan Africa.

Following the introductory part of the study is the review of the literature review. Section three dwells on the methodology employed in the study, and data type and source. In section four, estimated results are presented. The results are discussed in chapter five. The summary, conclusion, recommendation, and limitation of the study are presented in the last section.

2. Literature Review

The study of health expenditure and health outcomes relies on Grossman (1972) model and the Health Production Function. Investment is necessary for improving health outcomes. The amount of health spending has been identified as an important measure of the level of health investment in an economy. In any economy, public health spending is an important policy tool for policymakers- the government provides and administers healthcare services Arthur and Oaikhenan (2017).

Therefore, public health spending is an important tool, in an attempt to foster healthcare. This relationship is best explained using the Grossman (1972) health capital model, or the health production function. The Grossman (1972) health model dwells on the individual, hence a micro model analysis. The individuals are utility maximizers who invest in health to derive maximum utility from good health given income and time constraints, as well as depreciation in health.

Meanwhile, the health production function, assumes that the health system is a production unit aimed at generating health care. Both the Grossman (1972) health model and the health production function treat health expenditure as an input required in the production of healthcare evidenced by health outcomes. The major point of diversion between the two theoretical approaches is the fact that the Grossman model is a micro-model analysis. However, it is applicable in a macro-model analysis by aggregating the variables and utilizing them as per capita.

An increasing number of empirical studies examine the extent to which public health expenditure influences health outcomes in developed and developing countries. In the European Union countries, Onofrei *et al.* (2021) found that rising public health spending lowers newborn mortality and increases life expectancy at birth. Owusu *et al.* (2021), in a study of some selected low- and middle-income countries found a negative relationship between health spending and infant mortality. In some selected West African countries, Kilanko (2019) found that for every percentage point rise in health expenditure, there is a 2.4 percent decrease in infant mortality, a 3.9 percent decrease in under-five mortality, and a 4.9 percent decrease in maternal death.

In a study on Sub-Saharan Africa, Chireshe and Ocran (2021) found that higher healthcare spending is associated with lower under-five death rates. Another Sub-Saharan Africa study found that in general, health expenditure has a negative relationship with health outcomes. Evidence suggested that public health spending and not private health spending had a greater impact on newborn, under-5, and neonatal mortality rates (Novignon and Lawanson, 2017). Kiross *et al.* (2020) revealed that public and external health expenditures significantly influence infant and neonatal mortality rates.

However, private health expenditure has no effect on infant and neonatal mortalities in SSA. In a study of Oil-Producing Countries in Africa, Opeloyeru *et al.* (2021)

discovered that out-of-pocket health expenditure has a negative influence on health outcomes, while health expenditures from public and external sources improve health outcomes. Arthur and Oaikhenan (2017) reported that health expenditure has an inelastic effect on health outcomes in SSA. They found that private health expenditure improves life expectancy at birth, while public health expenditure reduces mortality rates.

In the South Asian Association for Regional Cooperation (SAARC) and Association of South East Asian Nations (ASEAN), Rahman *et al.* (2018) found that total health expenditure is significant in reducing infant mortality rate. They found a greater influence of private health spending than public health spending on infant mortality rate. In the Middle East and North Africa (MENA), increased government spending and private health expenditure reduced infants, under-five, and the number of women that died as a result of pregnancy complications (Akinci, 2014).

While substantial literature on health expenditure and health outcomes in Sub-Saharan Africa abound, it did not account for differentials in health outcomes based on age group. Moreover, most of the analysis considers a single number of health outcomes.

3. Research Methodology

Based on the Grossman (1972) health model and the health production function, the relationship between child health outcomes and health expenditures is described by the production function expressed below:

$$Y_{it} = f(HE_{it}) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

The Grossman (1972) demand for health theory emphasized that investment in health is fundamental to individual well-being in society and that of the country in general. Therefore, any individual society that desires to see an improvement in child health outcomes should invest in healthcare services. For an individual, it goes beyond financial investment, to time and changes in lifestyle changes (Chireshe and Ocran, 2021).

The study carried out by Kiross *et al.* (2020) suggests that health input serves as an investment to produce health for the child and society. The resources committed as an investment to produce this health must be seen to influence child health outcomes. Therefore, increased health spending is expected to have a positive effect on child health outcomes, thereby significantly reducing infant mortality and under-5 mortality.

The health production function is expressed in econometrics form as:

$$Y_{it} = \alpha + \beta HE_{it} + \mu_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

$i = 1,2, \dots n \;\; t = 1,2, \dots T$

Where; Y_{it} is the vector of child health outcomes (infant and under-5 mortalities) across countries over time t and HE_{it} is health expenditure influencing child health outcomes across countries over time t, while β is the coefficient of the independent variables. μ_{it} is the error term which is assumed to be normally distributed with zero mean and constant variance.

The integration order (stationarity) of the variables in the data set is tested using panel unit root tests. Three-panel unit root tests (Levin *et al.*, 2002; Im *et al.*, 2003; and ADF Fisher) are performed to determine the order of integration of the variables involved in the study.

The Pooled Regression (Pooled least squares) model, random effect model, and fixed effect models were estimated.

The Pooled Regression model ignores the panel structure of the data by pooling together data on the units. The model disregards potential differences that may give rise to different coefficients for each country. The yearly (T) observations on each of the countries (N) are arranged one on top of the other to produce (NT) observations for each of the variables. The coefficients are assumed to be the same for all units in all periods and do not account for possible individual heterogeneity. The least squares estimator is applied to this model, hence, the name pooled least squares, estimator. The pooled regression model in matrix form is given as:

$$Y_{it} = X_{it}\beta + \varepsilon_{it} \quad \dots\dots 3$$

The error term has zero mean, and constant variance and is uncorrelated over time and units.

The random effects model assumes that all units in the sample are randomly chosen, thus, the unit differences are treated as random as against fixed. The random effect model is expressed in equation 10 below:

$$Y_{it} = X_{it}\beta + \alpha + \mu_i + \delta_{it} \quad \dots\dots 4$$

The random effect model for this study can be specified as

$$IMR_{it} = \alpha + \beta_1 PuHE_{it} + \mu_i + \delta_{it} \quad \dots\dots 5$$

$$CMR_{it} = \alpha + \beta_1 PuHE_{it} + \mu_i + \delta_{it} \quad \dots\dots 6$$

Where: α is the common intercept and the disturbance is $\varepsilon_{it} = \mu_i + \delta_{it}$; μ_i is the unobservable country-specific effect. The key assumption that distinguishes the model from the fixed effects model is the time-invariant unit-specific effect μ_i, which is uncorrelated with Equation 3:

IMF_{it}, CMR_{it}, and HE_{it} are as defined above.

The fixed effect model accounts for the panel structure of the data. The model assumes all behavioral differences between units (individual heterogeneity) are captured by the intercept. Although the intercept may vary across units, each individual's intercept does not differ over time. The model is time-invariant. Thus, the unit effect μ_i in equation 8, is treated as a parameter.

The model is specified as:

$$Y_{it} = X_{it}\beta + \varepsilon_{it} \quad \text{……………………………………….} \quad 7$$

Specifying the error structure for the disturbance term:

$$\varepsilon_{it} = \mu_i + \gamma_t + \delta_{it} \quad \text{… ……………………… 8}$$

Where μ_i is the unobservable cross-section-specific effect, γ_t is the unobservable time-specific effect, and δ_{it} is the common cross-section time series effect?

Combining equations 7 and 8 gives the cross-section and time-specific effects model. Hence, the study adopts a two-way fixed effects model:

$$Y_{it} = X_{it}\beta + \mu_i + \gamma_t + \delta_{it} \text{ ……………………………………………… 9}$$

δ_{it} is the disturbance term with the following assumptions:

$$\epsilon(\delta_{it}) = 0$$
$$V(\delta_{it}) = \sigma^2$$
$$CoV(\delta_{it}, \delta_{js}) = 0 \; for \; i \neq j \; or \; t \neq s$$

The specific effect is allowed to be correlated with the explanatory variables. That is, $\text{cov}(\mu_{i,} X_{it}) \neq 0$. The fixed effect model for this study is specified as:

$$IMR_{it} = \alpha + \beta_1 HE_{it} + \mu_i + \Upsilon_t + \delta_{it} \quad \text{… … …..10}$$

$$CMR_{it} = \alpha + \beta_1 HE_{it} + \mu_i + \Upsilon_t + \delta_{it} \quad \ldots\ldots\ldots 11$$

Since the fixed effects model does not assume that the regression function is constant over time and space, in a one-way fixed effects model, each cross-sectional unit (country) has its intercept. The intercept (fixed effect) is allowed to vary over units by including an intercept dummy variable for each unit. To avoid falling into the dummy-variable trap, this study specified a constant and dummy variables in the regression functions below:

$$IMR_{it} = \alpha_1 D_{1i} + \alpha_2 D_{2i} + \ldots + \alpha_{43} D_{43i} + \beta_1 HE_{it} + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots 12$$

$$CMR_{it} = \alpha_1 D_{1i} + \alpha_2 D_{2i} + \ldots + \alpha_{43} D_{43i} + \beta_1 HE_{it} + \varepsilon_{it} \quad \ldots \ldots \ldots \ldots 13$$

In equations 12 and 13, each dummy variable, D, coefficient $(\alpha_1 - \alpha_{43})$ is equal to the difference between the intercept for its individual (country) and the intercept for the base individual (Angola) for which no dummy variable was specified.

In panel analysis, the Hausman test can be used to distinguish between fixed effects and random effects models and helps to choose between the two (2) models. Hausman suggests the following test:

$$H = \left(\beta_{RE} - \beta_{FE} \right) \left(\varepsilon_{FE} - \varepsilon_{RE} \right)^{-1} \left(\beta_{RE} - \beta_{FE} \right)$$

$$H_0 : Cov\,(Xit, ait) = Cov\,(Xit, \mu it) = 0$$

$$H_1 : Cov\,(Xit, ait) = Cov\,(Xit, \mu it) \neq 0$$

H checks how close the difference, is to zero. If the computed H_1 value exceeds the critical value of the Chi square distribution, then reject H_0 that the difference between the estimators is zero (0).

Based on the plethora of empirical analyses and the Grossman theoretical stipulations, private health expenditure, public health expenditure, and external health expenditure would have a non-increasing impact on child health outcomes (infant mortality rate and child mortality rate). An increase in health spending should bring about a declining child health outcome. Intuitively, an increase in health expenditures is supposed to have a significant influence on child health outcomes in Sub-Saharan Africa (SSA).

This research employs panel data. The data for health expenditures proxied by health expenditure and child health outcomes (Infant mortality rate and Under-5 mortality rate) were obtained from the World Bank database covering the period 2000 to 2020.

4. Research Results and Discussion

4.1 Descriptive Statistics

Table 1 presents the descriptive statistics of the variables in terms of measures of dispersion and central tendency in the form of mean, standard deviation, minimum, and maximum values. The study analyzed data on 44 countries in Sub-Saharan Africa (SSA) for the period 2000 to 2020.

Table 1. *Descriptive Statistics of the Variables*

	GDP	THE	IMR	CMR
Mean	1963.374	83.1363	59.6378	91.8370
Median	780.0170	31.9915	58.0000	86.8000
Maximum	19849.72	788.5220	138.6000	228.5000
Minimum	110.4609	3.7778	11.9000	13.9000
Std. Dev.	2983.371	134.2274	23.6954	41.4792
Skewness	2.9359	2.7272	0.2955	0.4261
Kurtosis	12.4404	10.2080	2.9325	2.9560
Observations	924	924	924	924

Source: *Authors' computation.*

Panel Unit Root Test Result:
The stationarity of the data was examined using the Levin *et al.* (2002), Im, Pesaran, and Shin (2003), and Augmented Dickey-Fuller (ADF) Fisher panel unit root test. The results are presented in Tables 2, 3, and 4, respectively.

Table 2. *Levin, Lin, and Chu Unit Root Result.*

Variables	Statistics (Adj)	Statistics (Unadj)	P-Value
Levin and Chu Unit root At Level			
CMR	-16.7172	-18.4082	0.0000
IMR	-15.4453	-16.6843	0.0000
THE	-1.6912	-6.3963	0.0454
Levin and Chu Unit root At First Difference			
CMR	-8.7401	-11.3559	0.0000
IMR	-4.2280	-8.0008	0.0000
THE	-9.4724	-21.1812	0.0000

Source: *Authors' computation.*

The results from the Levin *et al.* (2002) unit root test in Table 2 above indicate that child mortality rate, infant mortality rate, and total health expenditure, as well as Gross Domestic Product, are all stationary at level. Thus, integrated of order zero I(0).

The result for Im, Pesaran, and Shin unit root is presented in Table 3.

Table 3. *Result of Im, Pesaran and Shin Unit Root.*

Variables	Level	First difference	Conclusions
THE	-1.6557	-4.7492	Difference stationary
IMR	-7.8814	-1.4508	Stationary at level
CMR	-10.2685	-1.2075	Stationary at level

Source: *Authors' computation.*

From Table 3 above, Im, Pesaran, and Shin (2003) unit root test indicates that child mortality rate, and infant mortality rate, are stationary at level. Meanwhile, total health expenditure is stationary at first difference. These suggest that some of the variables are integrated of order one I(I) while others are stationary at the level I(0).

Finally, the ADF Fisher unit root result is presented in Table 4 below.

Table 4. *Result of ADF Fisher Unit Root.*

Variables	Variable at levels	First difference	Conclusions
THE	139.2413	109.8200	Stationary at level
IMR	135.0686	119.6070	Stationary at level
CMR	183.2572	165.4130	Stationary at levels

Source: *Authors' computation.*

The result from the ADF Fisher unit root test in Table 4 above, indicates that CMR, IMR, THE, and GDP are stationary at level, while PuHE and PrHE are not stationary until after the first difference. ADF Fisher unit root test shows that some of the variables were integrated of order one I(I) while others are stationary at the level I(0). Given that all the series are stationary at a level using Levin et al. (2002), this study concludes that the series is I(0).

4.2 Panel Cointegration Test Result

Based on the unit root test result, the result of the Pedroni panel (PP) cointegration test is presented in Table 5 below.

Table 5. *Result of Pedroni Panel Cointegration Test*

Alternative hypothesis: common AR coefs. (within-dimension)

		Statistic	Prob.	Weighted Statistic	Prob.
Panel	v-Statistic	-1.929694 32	0.97	-4.268556 00	1.00
Panel	rho-Statistic	4.838945 00	1.00	4.272598 00	1.00
Panel	PP-	-4.472884	0.00	-11.19018	0.00

Statistic		00		00	
Panel ADF-Statistic		1.026192	76 0.84	-4.841909	00 0.00

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	7.026980	00 1.00
Group PP-Statistic	-15.00256	00 0.00
Group ADF-Statistic	-3.545304	02 0.00

Source: Authors' computation

Table 5 presents the Pedroni panel cointegration test between health expenditure and child health outcomes (infant and child (under-5) mortality rate). The test explores all the tests for several groups (i.e., between and within groups) to establish the cointegration state of the variables.

On one hand, the within dimension consists of all the computed values of parameters on estimators that combined all the autoregressive coefficients for different countries for the stationarity test on the likely residuals. On the other hand, between dimensions encompass the parameters computed from the mean estimators of separately estimated coefficients of each country.

Based on the above empirical outcome, four of the seven statistics of the model were significant at 1%, especially the PP and ADF panel and group statistics of both the within and between dimensions.

Therefore, the existence of a long-run relationship between health expenditures (total health expenditure) and child health outcomes (infant and child mortality rates) in SSA countries was established. The existence of a long-run association in SSA is meaningful economically, which suggests that these variables tend to influence child health outcomes in the SSA region in the long run.

Effect of Total Health Expenditure on Child Health Outcomes*:*
The results for the effect of total health expenditure on child health outcomes in SSA is presented in Tables 6 and 7.

Effect of total health expenditure on infant mortality rate:
The result of the effect of total health expenditure on infant mortality rate is presented in Table 6.

Table 6. *Total Health Expenditure and Infant Mortality Rate (IMR).*

VARIABLES	OLS	Fixed Effects	LSDV	Random Effects
LTHE	-10.54***	-22.37***	-22.37***	-21.26***
	(0.591)	(0.765)	(0.765)	(0.742)
Benin			-37.71***	
			(3.000)	
Botswana			-8.948***	
			(3.046)	
Burkina Faso			-40.27***	
			(3.030)	
Burundi			-58.31***	
			(3.173)	
Cameroun			-22.62***	
			(2.869)	
Central Africa Rep.			-32.44***	
			(3.109)	
Chad			-10.00***	
			(2.945)	
Comoros			-28.58***	
			(2.849)	
Congo Republic			-42.24***	
			(3.265)	
Cote D'Ivoire			-7.573***	
			(2.849)	
Djibouti			-27.85***	
			(2.870)	
Equatorial Guinea			21.67***	
			(2.936)	
Eritrea			-74.99***	
			(3.094)	
Ethiopia			-67.67***	
			(3.230)	
Gabon			-15.11***	
			(2.957)	
The Gambia			-71.41***	
			(3.131)	
Ghana			-42.33***	
			(2.867)	
Guinea			-27.19***	
			(2.985)	
Guinea Bissau			-24.55***	
			(2.925)	
Kenya			-52.58***	
			(2.884)	
Lesotho			-19.55***	
			(2.854)	
Liberia			-22.03***	

			(2.945)	
Madagascar			-63.42***	
			(3.084)	
Malawi			-67.47***	
			(3.198)	
Mali			-28.42***	
			(3.006)	
Mauritania			-48.84***	
			(2.881)	
Mauritius			-33.32***	
			(3.065)	
Mozambique			-47.92***	
			(3.191)	
Namibia			-7.338**	
			(3.096)	
Niger			-39.26***	
			(3.033)	
Nigeria			1.581	
			(2.854)	
Rwanda			-57.77***	
			(3.040)	
Sao Tome			-57.58***	
			(2.858)	
Senegal			-46.39***	
			(2.873)	
Seychelles			-22.15***	
			(3.247)	
Sierra Leone			12.64***	
			(2.899)	
South Africa			-1.522	
			(3.158)	
Sudan			-35.61***	
			(2.858)	
Tanzania			-58.08***	
			(3.012)	
Togo			-43.95***	
			(2.951)	
Uganda			-54.06***	
			(2.999)	
Zambia			-40.42***	
			(2.907)	
Zimbabwe			-35.81***	
			(2.850)	
Constant	98.12***	141.3***	175.1***	137.2***
	(2.260)	(2.808)	(3.821)	(3.865)
Observations	924	924	924	924
R-squared	0.257	0.493	0.856	
Number of countries		44		44

firm effect	YES		YES
year effect	NO	NO	NO
F-test	855.6	118.5	
Prob > F	0	0	
Wald-chi2			820.4
Prob > chi2			0
country effect		YES	

Note: *Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1*
Source: *Authors' computation*

The result from the fixed effect model suggests that total health expenditure has a significant effect on the infant mortality rate (IMR). It indicates a negative and significant coefficient (-22.37) for infant mortality rates in Sub-Saharan African (SSA) countries. Specifically, the result implies that a 1% increase in total health expenditure leads to a reduction in infant mortality rates by 22.4%. Thus, total health expenditure affects child health outcomes. Improvement in infant mortality rates in SSA can result from higher levels of health expenditure in the region.

Effect of total health expenditure on child (under-5) mortality rate:
The result for the effect of total health expenditure on child under-5 mortality rate is presented in Table 7

Table 7. *Total Health Expenditure and Child Mortality Rate.*

VARIABLES	OLS	Fixed Effects	LSDV	Random Effects
LTHE	-19.36***	-43.39***	-43.39***	-40.52***
	(1.017)	(1.440)	(1.440)	(1.389)
Benin			-72.31***	
			(5.650)	
Botswana			-8.438	
			(5.737)	
Burkina Faso			-60.36***	
			(5.707)	
Burundi			-110.9***	
			(5.975)	
Cameroun			-40.39***	
			(5.404)	
Central Africa			-51.27***	
			(5.855)	
Chad			-38.71***	
			(5.546)	
Comoros			-61.73***	
			(5.365)	
Congo Republic			-102.0***	
			(6.149)	
Cote D'Ivoire			-26.41***	

	(5.365)
Djibouti	-71.97***
	(5.405)
Equatorial Guinea	26.12***
	(5.528)
Eritrea	-139.5***
	(5.826)
Ethiopia	-128.2***
	(6.083)
Gabon	-20.78***
	(5.568)
The Gambia	-125.6***
	(5.896)
Ghana	-77.47***
	(5.398)
Guinea	-53.25***
	(5.621)
Guinea Bissau	-47.27***
	(5.508)
Kenya	-92.88***
	(5.430)
Lesotho	-44.22***
	(5.375)
Liberia	-58.35***
	(5.545)
Madagascar	-119.0***
	(5.807)
Malawi	-121.7***
	(6.022)
Mali	-45.49***
	(5.661)
Mauritania	-91.49***
	(5.425)
Mauritius	-48.60***
	(5.771)
Mozambique	-100.1***
	(6.009)
Namibia	-3.070
	(5.830)
Niger	-38.13***
	(5.711)
Nigeria	1.637
	(5.374)
Rwanda	-106.7***
	(5.724)
Sao Tome	-101.6***
	(5.381)
Senegal	-77.06***

				(5.411)	
Seychelles				-25.67***	
				(6.115)	
Sierra Leone				5.023	
				(5.459)	
South Africa				4.492	
				(5.947)	
Sudan				-65.22***	
				(5.382)	
Tanzania				-106.2***	
				(5.671)	
Togo				-82.55***	
				(5.557)	
Uganda				-98.41***	
				(5.648)	
Zambia				-71.00***	
				(5.473)	
Zimbabwe				-58.01***	
				(5.367)	
Constant	162.5***	***	250.2	312.8***	239.7***
	(3.887)	)	(5.287	(7.196)	(6.826)
Observations	924		924	924	924
R-squared	0.282		0.508	0.833	
country effect	NO			YES	
year effect	NO		NO	NO	NO
F-test	362.7		907.8	99.64	
Prob > F	0		0	0	
Number of countries			44		44
firm effect			YES		YES
Wald-chi2					850.3
Prob > chi2					0

Note: *Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*
Source: *Author's Computation using STATA 15, and data from World Bank.*

The result from the fixed effect model suggests that total health expenditure has a significant effect on the child mortality rate (Under-5) in SSA. It indicates a negative and significant coefficient (-43.39) for child mortality rates in Sub-Saharan African (SSA) countries. Therefore, the results imply that a 1% increase in total health expenditure leads to a reduction in child mortality rates (Under-5) by 43.4%. Thus, total health expenditure affects child health outcomes in Sub-Saharan Africa. Hence, the significant improvement in child under-5 mortality rate in SSA can result from an increased level of health expenditure in the region.

5. Discussion

This study examines the effect of health expenditure on child health outcomes and determines the income elasticity of health spending in SSA countries. The findings from this study showed that total health expenditure is significantly associated with the infant mortality rate. A 1% increase in total health expenditure significantly reduced the infant mortality rate by approximately 22.4% in the fixed effect model. Also, the findings from the study showed that total health expenditure is significantly associated with child (under-5) mortality rates.

A 1% increase in total health expenditure, significantly reduced child mortality (under 5) by approximately 43.4%. These findings support the Grossman (1972) model, which postulates that investment in health improves child health outcomes, thus leaving the individual better off. Empirically, these findings are in agreement with other studies that have reported a significant effect of total health expenditure on child health outcomes. These include studies by Kiross *et al.* (2020), Cherish and Ocran, (2021).

In the period 2000 to 2020, the rate of infant and child (under-5) mortality rates in SSA decreased but is still high compared to other regions like Europe. Health expenditure reflects the overall level of consumption of health goods and services by the population across countries. Investing in the health care system will not only lead to healthier lives, it will also enhance economic growth and productivity.

6. Conclusions, Proposals, Recommendations

6.1 Research Contribution

This study examined the effect of health expenditure on child health outcomes in sub-Saharan African (SSA) countries for the period 2000 to 2020. The study measures health expenditures using public, private, and external expenditures, while infant and child (under 5) mortality rates are measures of child health outcomes.

The study examined the effect of health expenditure on child health outcomes using the Grossman (1972) demand for health model and estimates a fixed effect model.

The result shows that total health expenditure has a negative significant effect on infant and child (under-5) mortality rates in SSA, this implies that an increase in health spending can bring about a reduction of infant and child (under-5) mortality rates by 22.37% and 43.39% respectively. The examination of the relationship between aggregate of two measures of child health outcomes in Sub-Saharan Africa, is unique.

6.2 Research Implications

The results reveal that health expenditure exert a significant influence on infant mortality and child mortality in Sub-Saharan African. The result confirmed that total health expenditure is an important factor in reducing infant mortality rate in SSA, and also, affirmed that total health expenditure had a significant effect on child mortality rate, hence, an effective tool in reducing negative child health outcomes.

The findings suggest that policymakers should emphasize increasing overall health expenditure aimed at improving child health outcomes, should be intensified by policymakers.

6.3 Research Limitation and Future Works

There are possibilities for future research based on the empirical findings of this study. There is need to examine the disaggregated impact of health expenditure on child health outcomes in Sub-Saharan African. This will provide comprehensive information on the effects of health expenditures on health status.

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