ECONOMIC EVALUATION OF COST AND OUTCOMES OF HEALTHCARE SERVICES: A GUIDE FOR OPTIMAL HEALTHCARE DECISION-MAKING

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Abstract

This study evaluated the cost and outcomes of healthcare services in some African countries with a particular focus on the sub-Saharan African (SSA) regions. It carried out analyses of fixed, random, and dynamic effect of lagged cost of healthcare on health outcomes. To achieve the study's objective, cross-sectional data from eight (8) African countries were obtained from secondary sources. Panel regression econometric techniques and panel generalised moment/dynamic (PGMM/D) methods were used to determine the lagged effects among the study variables. This study identified the pooled, fixed, and random effects of healthcare costs on health outcomes. It was statistically significant at a 5 percent level. This study documented a positive relationship between health outcomes needs and healthcare costs. The behaviour exhibited by the variables was symmetrical, as revealed by the mean and the standard deviation of the descriptive analysis estimates. The findings of the regression analysis confirmed the peculiarity of the health outcomes and healthcare cost positions among the selected countries. The health outcomes estimate constituted strong drivers of healthcare costs. Therefore, in line with the findings of Healthcare Value Hub (2018), optimal interventions to address technological inadequacy and inefficient system performance to achieve quality health outcomes are recommended.

Keywords: Generalised Method Moment, Healthcare Cost, Health Outcomes, Panel Regression

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1. INTRODUCTION

The place of an individual's health in promoting productivity, overall well-being, and economy leaves much to be desired. The provision of an adequate health system that enhances the outcomes of healthcare and healthcare services entails costs or financing which may emanate from different sources like individuals, government, and non-governmental organizations (NGOs). Government financing of health has become one of the significant components of public expenditures in most countries. The provision of quality healthcare is fundamental to the growth and improvement of the quality of life of the people and the increasing life expectancy rate at birth. Quality healthcare services has also the potential to reduce the maternal mortality rate among women giving birth, neonatal (< 28) days, under five, and infant mortality as among the desired health outcomes.

Besides the government expenditures in financing healthcare, individual health costs described as payments incurred by patients for healthcare delivery overwhelmingly impact the individuals' out-of-pocket spending. To supplement personal spending on health, non-governmental organizations have deemed it necessary the need to promote accessibility and the provision of universal health coverage through various interventions in the health system. In the health market system, healthcare providers including clinicians, physicians, and other healthcare management organizations undertake substantial costs to deliver healthcare services. The cost of healthcare globally, especially in African countries, remains a challenge to healthcare providers and consumers, thereby subjecting the health system to excessive challenges and disproportionate health outcomes.

Most countries especially in sub-Saharan Africa (SSA) are faced with a high poverty rate which makes the populace rely significantly on the government and other public for healthcare financing. This is to alleviate the burden associated with inadequate and poor access to healthcare services that typically lead to a high mortality rate. The flawed health system in African countries, especially Nigeria, has been documented to have drawn in 59,000 maternal mortality annually among women giving birth (Nwokocha, 2008). Maternal morbidity resulting from pregnancy and after delivery is also documented to be prevalent and frightening in most African countries, especially Nigeria (Akokuwebe & Okafor, 2015). The World Health Organisation (WHO) (2010) puts the global maternal mortality rate after 48 days of birth at 287,000 between 1999 and 2012, from which African countries shared about 147,741. A report by WHO (2010) which African countries, such as Zambia, Ghana, Uganda, and Nigeria, lack efficient and effective healthcare systems due to poor or inadequate healthcare financing, making their healthcare sectors perform below the optimal level. This led the world health proposes 13 percent of countries' budgetary allocation to their healthcare sectors.

Despite this, information on the cost of delivering healthcare services and the resulting health outcomes remains sketchy in some African countries. It not only constitutes hindrances to optimal allocations of resources to the health sector but imprecise knowledge of the mortality and morbidity among women and infants of all kinds. The planning and management system of healthcare suffered a great deal of neglect or inadequate funding. This can be gleaned from poor healthcare facilities found in most health centres (HCs) and the community-based health planning and service (CHPS). The poor health outcomes which are characterized by high mortality among women giving birth, neonatal death, and infant mortality warranted this study to investigate the degree of convergence and divergence of healthcare costs and health outcomes from countries in SSA.

This study is structured into six sections including an introduction, literature review, research methodology, results, discussion, and conclusion. Section 1 deals with the introduction which gives the background and highlighted the problem of the study. Section 2 reviews the relevant literature which comprised both theoretical and empirical issues. The methodology used in conducting this study was analyzed in Section 3. Results obtained from the estimated variables' coefficients were presented in Section 4. In Section 5, discussions of the results were carried out and a conclusion was made in Section 6.

2. LITERATURE REVIEW

2.1. Theoretical review

Various scholars have utilised theories to investigate healthcare services' costs and outcomes. Among the thoughts are transactional cost economic theory, expectancy theory, contingency theory, cost-benefit analysis theory, social support theory, care cost-effectiveness analysis, the human-capital approach, and so on.

Parrish (2010) investigated health outcomes in America and identified three approaches to measuring population health outcomes which include: aggregating health outcomes measurements made on people into summary statistics like population averages or medians; assessing the distribution of individual health outcome measures in a population and among specific subgroups of the population; and measuring the function and well-being of the population or society itself.

2.1.1. Transactional cost economic theory

Transactional cost economics (TCE) theory is a conceptual framework for analysing healthcare transactions and quantifying their impact on healthcare structures. TCE explains how characteristics of transactions determine the governance structures that bring about effectiveness while optimising the cost. Williamson (1979) perceived transaction cost as the cost associated with the search, negotiation, and enforcement of contracts to facilitate a transaction. According to Wallis and North (1986), it costs, patients incurred to access health care transferred to appropriate healthcare providers. The transactional cost economics theory was also applied in the healthcare field by Zinn et al. (2003) to study the factors that determine the decision to engage skilled nursing with consideration to costs and their particular roles in health facilities to maximise their benefits. Abimbola et al. (2015) applied transactional cost economics to examine the implications of the care-seeking pathways of tuberculosis patients for health system governance in Nigeria. Their study provided insight into a weak health system resulting in high patient transaction costs.

2.1.2. Expectancy theory

According to Vroom (1964), expectancy theory posits that individuals are motivated to perform if they know that their extra performance is recognised and rewarded. Vroom opined that motivational forces are a function of valence, instrumentality, and expectancy. Vroom expectancy theory assumes that behaviour results from conscious choices among alternatives aimed to maximise pleasure and minimise pain. He maintained that employee performance is a function of personality, knowledge, skills, experience, and, abilities es. Abilities here can be a function of the quality of health of an individual. Therefore, people's or patients' willingness to pay the cost of health services to have good health outcomes depends on their level of expected results.

On the other hand, the willingness to provide or produce healthcare products and services is influenced by the returns or payments the physician and other ancillary health providers are expected. This model has been drawn into the field of medicine that dwelt on healthcare utilisation by Fishbein (1963) as cited in Walker and Thomas (1982) to describe the behavioural intent. In their study, Walker and Thomas did an integrative motivational model from a healthcare perspective by looking beyond expectancy theory.

2.1.3. Cost-benefit analysis theory

Cost-benefits were developed to evaluate the economic gain related to the expenditure for a specific treatment or health method. However, applying this approach comes with enormous difficulties, such as quantification of the health status of individuals, some morbidity conditions, and cure and mortality avoidance. Methodological problem is another difficulty associated with using the cost-benefit approach.

2.1.4. Social support theory

Social support theory is centered on the proposition that instrumental, informational, and emotional supports reduce the likelihood of delinquency and crime. It is concerned with various types of assistance, or support individuals or society could get from governments, donors, and other institutions like health providers to reduce the burden of out-of-pocket spending, thereby increasing the health outcomes of the populace. Social support has been significantly correlated to individuals' psychological well-being (Lakey & Cohen, 2000). By extension, health services funding to the individual as social support improves the health outcomes of the individuals.

2.1.5. Care cost-effectiveness analysis

Cost-effectiveness analysis is closely related to cost-benefit analysis, which mutually scrutinises the costs and health outcomes of one or more interventions. The cost and gain of intervention are estimated and compared to another intervention cost to determine the degree of health outcomes like death, heart attack, diseases, and quality of life year gained. This is fundamental to health expenditures' planning as it informs a decision to increase or decrease the intervention as well as ascertaining the net cost of interventions. When the net worth of interventions is positive, the investment in health will be increased verse versa. Neumann (2005) documented that cost-effectiveness analysis improves health as it enables optimal health intervention decision-making.

2.2. Empirical review: Cost and outcomes of healthcare

Outcome measurement is the ultimate measure of quality and essential information for improving the performance of healthcare services in every nation. The outcome provides information that informs a better policy measure that enhances the provision of quality health care services to the patient. Therefore, reporting results in the health sector is an essential measure that provides a complete cycle of care and necessary adjustments for underlying diseases confronting patients. To measure better health outcomes at lower costs, Zhao et al. (2014) investigated the benefits of primary care utilisation for chronic disease management in remote indigenous communities in Australia's Northern territory. Their study did a comparative analysis of health outcomes and costs at different levels of primary health care utilisation to establish if there is an efficient use of resources among indigenous patients with common chronic diseases. Their study of incremental cost-effective ratio and acceptability curves revealed that primary care in remote indigenous communities is associated with cost-savings to public hospitals and health benefits to individual patients.

To measure how the cost of healthcare helps bring about good healthcare decision-making, Grover (2019) documented that cost-effectiveness analysis is one of the types of economic evaluation that can be useful in choosing alternatives for healthcare delivery. She pointed out that the most common use of cost-effectiveness analysis is the quality-adjusted life years (QALY), a metric used to measure morbidity and mortality reduction gains.

Robinson and Chalkley (1997) explored the theory and evidence on cost sharing in health care, leaning on an economic perspective relating to cost sharing and pharmaceuticals in the United Kingdom. Their study established that the economist's focus is the impact of health charges on health service utilisation. Documented in their research, Towse et al. (2018) critique the estimated costs of production and potential prices for the WHO essential medicines list and document greater transparency in drug pricing, and propose generating estimates of the cost of manufacturing essential medicines to inform negotiations on drug pricing.

A recent cross-sectional study by Odebode and Okesina (2017) focused on the expectations of patients towards healthcare in Nigeria and Canada, utilising descriptive research design complemented with analysis of variance (ANOVA) and factor analysis and concluded that there is a significant difference between the expectation of Nigeria and Canada patients towards healthcare based on age and gender.

A study on cost-effectiveness by Rocks et al. (2020) employed a systematic literature review and meta-analysis to examine the cost-effectiveness of integrated care studies. The random effects meta-analysis of their mean cost and mean outcomes of integrated care revealed mixed results such as substantial heterogeneity in both costs and outcomes across groups. Their study concludes that integrated care is likely to reduce costs and improve health outcomes despite the evidence of cost and outcomes variation among groups. In another related study, high-cost patients' characteristics and healthcare utilization were investigated using systematic review data up to 2017. A similar study utilized a systematic review to investigate high-cost patient characteristics and healthcare utilization, it was discovered that the high cost of healthcare utilization was determined by the level of prevalence of chronic disease, mental health, the rising age of the population, and disease predisposition which varied among payers and countries. Their study, therefore, suggested appropriately tailored interventions to mitigate the high cost of patients' healthcare utilization (Wammers et al., 2018).

In comparing public healthcare and private healthcare system in terms of both quality and cost, Al Kaabi et al. (2022) did a systematic review of the healthcare system in some selected developed countries including Sweden, the United Kingdom, New Zealand, Japan, Spain, Italy, Portugal, France, Ireland, Germany, Australia, Canada, South Korea, and Qatar. Their study established that the public healthcare system in the countries reviewed offered high-quality medical care to their citizens regardless of the payers' ability to pay as against the private healthcare system which viewed healthcare as economic goods which must be paid for by the citizens rather than social goods. Their study concluded that health insurance should be administered by non-profit healthcare providers to assure universal healthcare and promote healthcare accessibility owing to the drawback associated with the private healthcare system. Petra (2022) investigated the countries' approaches to improving value-based healthcare and employed a five-step systematic review protocol and preferred reporting items for systematic reviews and meta-analysis (PRISMA) methods to descriptively analysed the Triple Aim (TA) framework for optimizing health system performance which focuses on population health, patient experience, and cost of care. The study demonstrates the divergence of impacts of the policy on the goals of an improved health system thereby concluding that standard measures are needed for the assessment of health system performance.

The delivery of quality health services is imperative to promoting health outcomes globally, on this basis the WHO et al. (2018) described the essential role of quality in the delivery of healthcare services. Their findings show that the quality of care in most countries is sub-optimal, especially in low-income and middle-income countries. To them, optimal healthcare can only be achieved with a tailored emphasis on quality of healthcare delivery that is consistent with current professional knowledge besides the provision of necessary infrastructure, medical supplies, and healthcare providers.

To explore how to improve the prognosis of healthcare in the United States, the study by Galvani et al. (2020) discovered that a shift to single-payer healthcare would be able to provide great relief to lower-income households. According to them, a single-payer system would not only ensure access to healthcare for all Americans but also would be capable of saving 1,73 million lives yearly. Their study, therefore supported the implementation of the proposed health policy: the Medicare for All Act (MAA) since it is likely to transform the healthcare system of America.

In exploring the main problem faced by Americans, Dugan (2017) undertook a survey of households in America and discovered that the cost of healthcare is the biggest financial concern to Americans. The American Hospital Association (AHA, 2021) highlights that the major drivers of healthcare costs in America are the increase in the aging population, hospital growth prices coupled with the COVID-19 pandemic care, supply chain, and labour shortage. To understand what drives healthcare costs and the way to target those drivers effectively which remain a serious concern to the American health system, Healthcare Value Hub (2018) analyse the impact of different healthcare costs drivers such as healthcare provider incentives, price inflation, technological growth, inefficient system performance, and insurance benefits design and discovered that the unit prices and technology are the most important drivers of growth in healthcare cost in America.

2.3. Gap in literature

Various studies have investigated the cost of healthcare and outcomes. Still, their emphasis is on producing and manufacturing health products and services with country-specific but few on cross-country analysis, especially on maternal and infant mortality. A comparison of mortality rates (maternal, neonatal, and infant) among selected countries have been documented from our knowledge of the literature review. Therefore, to fill the gap in the field of reproductive health study within public health, this study adopts an econometrics technique to evaluate the costs and outcomes of health care services in selected African countries.

2.4. Hypothesis development

Thus, the following hypotheses are formulated:

$H1_0$: There is no significant pooled effect of health outcomes on healthcare costs among the selected SSA countries.

$H2_0$: There is no significant fixed effect of health outcomes on the level of health cost among SSA countries.

$H3_0$: There is no significant random effect of health outcomes on healthcare costs among SSA countries.

$H4_0$: There is no significant dynamic effect of lagged cost of healthcare on the current healthcare costs among selected African countries.

$H5_0$: There is no significant convergence between country-specific to the pooled effect of health outcomes on healthcare costs in some selected countries.

3. RESEARCH METHODOLOGY

3.1. Theoretical framework

This study relied on the care cost-effectiveness analysis to evaluate the relationship between the cost and outcome of healthcare services in line with the reasoning (Neumann, 2005; Zhao et al., 2014; Grover, 2019). The authors noted the need to address the problem associated with a lack of quality health like high maternal, infant, morbidity, and neonatal mortality rates always informed the need for optimal decisions to spend on health. According to Neumann (2005), the investment in health will be increased verse versa if the expected outcome is favourable. This connotes a causal relationship between health expenditures including public and private in financing health services and health outcomes. In view of this, a cost function in economic theory can be specified to express the relationship between the cost of healthcare and the health outcomes such as reduction in mortality of all kinds and the cost of training health physicians. This can be captured with the cost function $C(x) = F + V_x$ which is a mathematical expression that provides a business firm to determine how changes in the production of commodities can impact the total cost of production.

Here, taking health as a commodity that must be paid for by either the public; or private, *C(x)* is the total cost of producing health commodities (*xi*), taking total health outcomes as total commodities; *F* is the fixed cost of producing health commodities; *V* is a variable cost of producing a unit of health commodity (*xi*) which varies according to population, the prevalence of disease, the number of physicians, and other health needs; *x* is the total health commodities.

The objective of this is to minimize the cost of healthcare and maximize the health outcome in terms of reducing the mortality rates rate and the need for more physicians.

3.2. Specification of the model

Therefore, maintaining the assumption of health as a commodity or service in this study that yields utility to individuals, the objective is either the minimisation or maximisation of costs with respect to the maximization of health outcomes.

To achieve this, and based on the theoretical framework of the study, a dynamic panel model to evaluate the extent to which health outcomes influenced the cost of healthcare provision is specified. A panel regression technique is employed in this study, owing to the cross-section of countries' healthcare costs and outcomes data over a period of time investigated. The panel regression technique will enable the fixed, and random effects of cross-sectional differences among the countries to be examined. While accommodating the heterogeneity or differences that are associated with specific countries in terms of costs and outcomes of healthcare in the fixed effect regression; this model also enables the study to account for independent variations and time-dependent variations among countries in the random effect model. The model estimates biases resulting from variables that cannot be observed and change over time. The alternative model that could be suitable for this study is panel vector autoregression (PVAR) which is capable of permitting all the variables in the study to function as either dependent on one hand or independent on the other in the model of study. however, this study could not do that owing to the limited number of observations.

In relation to health economics studies, the panel regression model is specified generally as thus:

$$Y_{it} = \alpha + \sum \beta_k X_i + \mu_{it}, \qquad k = 1, \dots, j \qquad (1)$$

where,

– Y is the dependent variable representing the cost of healthcare;

– X_i is the explanatory variable;

– the subscript i and t refer to the cross-sectional dimension of the entity (countries) and time series size, respectively;

– μ_{it} is the composite error term decomposed into specific effects and remainder disturbance.

The static panel data model can be estimated with ordinary least square (OLS), fixed effect (FE), and random effect (RE).

Therefore, the pooled regression model specified for this study is thus:

$$CHE_{it} = \alpha + \beta_1 MMR_{it} + \beta_2 IMR_{it} + \beta_3 NMR_{it} + \beta_4 DNM_{it} + \mu_{it} \qquad (2)$$

where,

– *CHE* = current health expenditure;

– *MMR* = maternal mortality rate;

– *IMR* = infant mortality rate;

– *NMR* = neonatal mortality rate;

– *DNM* = density of nurses and midwifery to population/thousand.

Specification of the model to capture fixed effect is thus:

$$Y_{it} = \sum \beta_k (X_{kit} - X_{ki}) + \varepsilon_{it} - \varepsilon_i;\ k = 1, \dots, j \qquad (3)$$

$$Y_{it} - Y_{it} - 1 = \sum \beta_k (X_{kit} - X_{it} - 1) + \varepsilon_{it} - \varepsilon_{it} - 1 \qquad (4)$$

$$CHE_{it} = \alpha + \beta_1 MMR_{it} + \beta_2 IMR_{it} + \beta_3 NMR_{it} + \beta_4 DNM_{it} + \mu_{it} + \varepsilon_{it} \qquad (5)$$

Equation (5) is the random effect model with μ_{it} (between-entity error) and ε_{it} (within-entity error).

It is assumed in the random effect model that the entity error is not correlated with the predictors which may allow for time-invariant variables to play a role as explanatory variables in the model. Though, this may lead to variable omission bias which this study overlooked.

4. RESEARCH RESULTS

Table 1 illustrates the descriptive statistics of variables *CHE*, *MMR*, *IMR*, *NMR*, and *DNM* used in this study.

Table 1. Summary of descriptive statistics

Descriptive statistics	*CHE*	*MMR*	*IMR*	*NMR*	*DNM*
Mean	5.714409	52.27500	28.95536	0.894643	2949.123
Median	5.588931	47.35000	27.15000	0.900000	1654.000
Maximum	7.402452	92.50000	42.30000	2.700000	19036.00
Minimum	4.956531	31.90000	20.00000	0.200000	9.486000
Std. dev.	0.537289	16.15591	5.710033	0.496989	4424.020
Skewness	1.136509	0.805654	0.483261	0.875102	2.490031
Kurtosis	3.680312	2.508901	2.007780	3.934042	7.932805
Jarque-Bera (J-B)	26.27070	13.24164	8.953771	18.36635	229.2901
Probability	0.000002	0.001332	0.011369	0.000103	0.000000
Sum	640.0138	5854.800	3243.000	100.2000	330301.7
Sum sq. dev.	32.04347	28972.49	3619.097	27.41679	2.17E+09
Obs.	112	112	112	112	112

Source: Authors' results using EViews 9.0.

Table 2 shows the panel stationarity (unit roots) test results using both Levin-Lin-Chu (LLC) test and the Philip-Perron (PP) test. The stationarity test results of the variables are tested at a 5% (0.05) level of significance at both levels and differences for order one.

Table 2. Presentation of penal stationary (unit root) test results

Variables	*LLC*				*PP*			
	At level	*1st difference*	*Status*	*Prob.*	*At level*	*1st difference*	*Status*	*Prob.*
CHE	-5.47521*	-214.809	I(0)	0.000	87.0201*	30.1981	I(0)	0.017
MMR	-13.8317*	-3.30879	I(0)	0.005	98.6114*	29.5881	I(0)	0.0203
IMR	-1.41356**	-8.96928	I(1)	0.0787	27.9157*	57.0328	I(0)	0.0324
NMR	-1.18865**	-8.87628	I(1)	0.1173	26.6599*	91.2552	I(0)	0.0454
DNM	-1.15845**	-8.08075	I(1)	0.1233	24.1732**	71.3831	I(1)	0.0858

*Note: * stationary at level, ** stationary at first difference.*
Source: Authors' estimations.

Table 3 illustrated the cointegration test among the variables and the results revealed that there is no cointegration among the variables as depicted by the trace statistics. Besides, the trace statistics estimated were found to be less than the critical value at 5% (0.05) level of significance at most 3 denoting rejection of the null hypothesis except at most 4 where the trace statistics is greater than the critical value of 0.05.

Table 3. Presentation of unrestricted cointegration rank test (trace) results

Hypothesized No. of CE(s)	*Eigenvalue*	*Trace statistic*	*0.05 critical value*	*Prob.***
None	0.208944	66.72425	69.81889	0.0861
At most 1	0.161019	41.64491	47.85613	0.1689
At most 2	0.088807	22.85926	29.79707	0.2531
At most 3	0.067893	12.90820	15.49471	0.1182
At most 4*	0.049084	5.385248	3.841466	0.0203

*Note: CE = Cointegrating equation, * rejection of the hypothesis at the 0.05 level, and ** the MacKinnon p-value.*
Source: Authors' estimations.

Table 4 illustrates the pooled regression result derived from the panel least squares method. Cross-sections of eight (8) countries were included with a total of the panel (balanced) 112 observations.

Table 4. Presentation of pooled panel regression results

Variable	*Coefficient*	*Std. error*	*t-statistic*	*Prob.*
Dependent variable: CHE				
C	4.400345	0.157150	28.00097	0.0000
MMR	0.020806	0.002704	7.693057	0.0000
IMR	-0.009372	0.007701	-1.216943	0.2263
NMR	0.443897	0.054052	8.212375	0.0000
DNM	3.41E-05	6.58E-06	5.187061	0.0000

Note: C = Constant, R-squared = 0.8015, Adjusted R-squared = 0.7941, F-statistics = 108.027, Prob (F-statistics) = 0.000.
Source: Authors' results using EViews 9.0.

Table 5 presented fixed effects regressions of the panel data. It captures specific effects in panel data based on the assumption that the results are fixed parameters that can be estimated. It is deployed to overcome problems of simultaneity biases and correlation of the regressors (the health outcomes) with shocks that affect the dependent variable *CHE*.

Table 5. Presentation of fixed effect regression results

Variable	*Coefficient*	*Std. error*	*t-statistic*	*Prob.*
C	4.677699	0.136936	34.15963	0.0000
MMR	0.014828	0.002373	6.249297	0.0000
IMR	-0.011840	0.006417	-1.845002	0.0682
NMR	0.506360	0.046402	10.91253	0.0000
DNM	5.13E-05	6.01E-06	8.540197	0.0000

Note: R-squared = 0.879, Adjusted R-squared = 0.858, F-statistics = 40.53, Prob (F-statistics) = 0.000.
Source: Authors' estimations.

Table 6 presents the random effect regression results. The panel estimated generalized least square (EGLS) techniques was employed to determine the period random effects of the model. The results were found to be consistent with the fixed panel results.

Table 6. Random effect regression results

Variable	*Coefficient*	*Std. error*	*t-statistic*	*Prob.*
C	4.400345	0.130392	33.74703	0.0000
MMR	0.020806	0.002244	9.271744	0.0000
IMR	-0.009372	0.006390	-1.466672	0.1454
NMR	0.443897	0.044849	9.897631	0.0000
DNM	3.41E-05	5.46E-06	6.251494	0.0000
Swamy-Arora estimator of component variances				

Note: R-squared = 0.8015, Period random Std. dev. = 0.0000, Rho = 0.0000, Idiosyncratic random Std. dev. = 0.2022, Rho = 1.0000.
Source: Authors' estimations.

Table 7 presented the results of the Hausman test of correlation between the fixed and random effect results of the panel regression estimators. The Hausman test compared the fixed effect regression to the random effect regression in order to show if there are divergence or convergence effects of the health outcomes of the study and the cost of healthcare among the countries of discourse.

Table 7. Hausman test result

Test summary		*Chi-sq. statistic*	*Chi-sq. d. f.*	*Prob.*
Period random		56.673952	4	0.0000
Variable	*Fixed*	*Random*	*Var (Diff.)*	*Prob.*
MMR	0.013625	0.018840	0.000000	0.0000
IMR	-0.012616	-0.010196	0.000000	0.0000
NMR	0.465809	0.410229	0.000129	0.0000
DNM	0.000056	0.000042	0.000000	0.0000

Source: Authors' estimations.

The PGMM/D was employed to determine the lag effect of the cost of healthcare on health outcomes in the selected SSA countries. The dependent variable *CHE* was transformed by taking the first differencing and included as one of the explanatory variables. The results revealed that the first lagged period of *CHE*, *CHE* (-1), has a statistically significant effect on the current level of healthcare costs in SSA countries like Nigeria, Kenya, Zambia, etc.

Table 8. Presentation of PGMM/D model (dependent variable is *CHE*)

Variable	*Coefficient*	*Std. error*	*t-statistic*	*Prob.*
CHE (-1)	0.851191	0.191670	4.440921	0.0000
MMR	0.000919	0.001787	0.514196	0.6084
IMR	0.009058	0.012868	0.703881	0.4833
NMR	0.018372	0.020895	0.879267	0.3816
DNM	9.60E-06	1.34E-06	7.147070	0.0000

Source: Authors' results using EViews 9.0.

5. DISCUSSION OF THE RESULTS

This study evaluated the cost and outcomes of healthcare services in some selected countries in the SSA regions. An attempt was made to examine the influence of health outcomes indicators such as *MMR*, *IMR*, *NMR*, and *DNM* as the explanatory variables on the cost of healthcare represented by *CHE*. The variables' cross-section data from eight countries were gathered and estimated using panel regression econometric techniques. The study examined the pooled effects (PE), FE, and RE between the variables of the study among the countries. To determine the dynamic impact of the model, the PGMM/D regression techniques were equally employed. Time series analysis was done on Nigeria and Uganda to investigate the symmetrical behaviour of the variables among countries and country-specific.

5.1. Discussion of descriptive results

The descriptive statistics results were presented in Table 1. It was observed from the table that about 112 observations of a cross-section of eight selected SSA countries were used in this study. The results revealed that the mean of *CHE* of the panel data estimated is 5.71, the *MMR* — 52.27, *IMR* — 28.96, *NMR* — 0.89, and *DNM* — 2949.12. It indicates that the density of nursing and midwifery to population per thousand constituted the highest mean among the study variables. It implies the existence of inadequate qualified nursing and midwifery personnel in SSA countries. The *NMR* occupies the least mean of the study variables among the nations, indicating a low incidence of neonatal mortality rate in the region. The mean current health expenditure of 5.71 in the area was relatively quiet. At the same time, the average *MMR* (52.27 in the region) was higher than the average infant mortality rate of 28.96. It implies the death among women giving birth in SSA countries is still very high.

The *CHE* and *NMR* exhibited a low spread with 0.53 and 0.50 standard deviations, respectively, among the countries of study in SSA; this indicates that the data points are close to their respective mean in the distribution. A high spread or standard deviation of 4424.02 was recorded with a density of nursery and midwifery to the population, implying data points over a wide range of the population are spread out. A maternal mortality rate spread of 16.16 was recorded, indicating relatively moderate variability of maternal mortality rate to the mean distribution among the study countries. On the other hand, a relatively low variability of the infant mortality rate of 5.71 was recorded among the countries in the region.

The data of the variables showed normal distribution and spread as documented by the J-B statistics of the study variables. The J-B statistics of the *CHE* among the selected SSA countries was 26.27 with a p-value of 0.01. The *MMR* was 13.24 with a p-value of 0.01, the *IMR* was 8.95 with a p-value of 0.01, the *NMR* was 18.37 with a p-value 0.01 and *DNM* to population recorded 229.29 with p-value (0.01). This implies the same trend or pattern of health costs and outcomes in SSA countries. The descriptive statistics show that the variables depict good behavioural patterns.

5.2. Discussion of unit root (stationarity) test results

Table 2 in section four presented the stationarity test. The LLC determines the standard unit roots among the cross-sectional variables of the selected countries from the SSA region. It is based on the assumption of common traits or homogenous characteristics in political, social, and economic behaviours. However, to determine the variables' unit roots behaviours in the country-specific cross-section observation, the PP stationarity test was employed. Therefore, the LLC test showed that variables *CHE* and *MMR* were stationary at the level while the *IMR*, *NMR*, and *DNM* per thousand were stationary at the first difference. On the individual scale, PP was used, and the diagnostic test results indicate that apart from the density of nurses and midwifery in the population that attained stationarity after the first difference, all other variables, *CHE*, *MMR*, *IMR*, and *NMR* were stationary at level. Based on this, the study carries out a co-integration test to investigate the existence of the long-run relationship between the study's variables. The results of the cointegration test using trace statistics indicate that there is no evidence of a long-run relationship among the variables. Since the trace statistics is less than the critical value at most at a 3 lag difference provides sufficient evidence to reject the null hypothesis, and lend support to the alternative that there is no cointegration among the variables of the study.

5.3. Discussion of the pooled regression results

Table 4 illustrates the pooled regression result derived from the panel least squares method. Cross-sections of eight (8) countries were included with a total of the panel (balanced) 112 observations. The results revealed based on the probability values that *MMR*, *NMR*, and *DNM* are statistically significant at a 5% level while *IMR* is not. Therefore, this indicates that a 1% increase in *MMR* attracts a substantial increase in the *CHE* by 0.020806 (2.08%) to address the rise in maternal mortality in the selected SSA countries. This relationship between the *CHE* and *MMR* was found to be statistically significant. Therefore, provided adequate evidence to reject the null hypothesis and accept the alternative hypothesis given its associated probability value of 0.001, which is less than the 5% level of significance. The result indicates that the cost to tackle the problem of maternal mortality will rise with the increase in maternal mortality rate in the selected SSA countries (Nigeria, Ghana, Kenya, Ethiopia, Senegal, Liberia, Zambia, and Uganda). It was revealed from the results that a 1% increase in *NMR* brought about a 0.443897 (44.39%) increase in *CHE* in the selected SSA countries. The result showed a positive relationship between *NMR* and *CHE*. It was revealed that a 1% increase in the *NMR* attracted about 0.4438 (44.3%) increase in the cost of healthcare in the region. It was found to be statistically significant at a 5% level given its t-statistics (8.212) with a p-value of 0.001.

The findings documented that a 1% increase in the *DNM* brought about a 0.00034 (0.0341%) rise in the *CHE*. It was discovered to be statistically significant at a 5% level given its t-statistics (5.187) with a p-value (0.001). This implies that, as there is an increase in spending to boost the numbers of nurses and midwifery, the *CHE* rises in SSA countries. This result provides enough information to reject the null hypothesis and accept the alternative hypothesis that there is a significant relationship between healthcare cost and health outcomes. Conversely, an 1% decrease in *IMR* leads to a healthcare cost reduction of -0.009372 (0.94%) in the selected SSA countries. Though, this relationship is non-statistically significant at the 5% level as the associated probability value of 0.2263 is greater than the decision rule of 5%. The model displayed an excellent fit as demonstrated by the R-squared of 0.801524, indicating that about 80.15% of variation in the *CHE* provision is accounted for by the variation in the health outcomes variables combined. The behaviour of the model was also confirmed by the F-statistic (108.0267) with a probability value of 0.001.

By implication, the estimated model demonstrated that the level of health outcomes desired by the cross-section of countries is responsible for the level of the *CHE* to be incurred. This is consistent with the recent findings of (Wammers et al., 2018) that discovered population aging, the prevalence of diseases, and the level of healthcare utilization as the important drivers of healthcare costs. It is now left to critical decision-making by both producers and consumers of healthcare to undertake an optimal policy measure that will provide quality healthcare at minimal costs that will produce good health outcomes, especially for SSA.

5.4. Discussion of fixed effect regression results

Table 5 showed the results of the fixed effects of the estimated variables which capture the drivers of the *CHE* variable. The rationale behind fixed effect regression is that; it captures causes of specific effects of health outcomes variations on health costs of the country of study. It is based on the assumption that the results are fixed parameters that can be estimated. It is deployed to overcome problems of simultaneity biases and correlation of the regressors (the health outcomes) with shocks that affect the dependent variable (*CHE*). Therefore, in this study, the least square dummy variable (LSDV) was deployed to eliminate the unobserved effect of time-invariant features like race, gender, religion, politics, and culture of the countries of study. The model is well fitted as revealed from the estimates of the F-statistic of 40.53344 with a probability value of 0.0001, suggesting that all the coefficients in the model are significantly different from zero. All the variables in the model have a significant influence on the regress at a 5% level except the *IMR* variable. This was confirmed by the R-squared estimates of 0.879 which implies that about 87.9% of variations in the *CHE* were accounted for by the regressors included in the model while leaving about 12.1% unexplained which can be attributed to the error terms.

In discussing the individual variables in the model as demonstrated in Table 5, it was discovered that a 1% change in the *MMR* leads to an increase in the *CHE* by 0.0148 (1.48%). This denotes a positive relationship between healthcare spending and maternal mortality rate. It is statistically significant at the 5% level given its t-value test (6.249) with a p-value of 0.001 which is less than 0.05. This connotes that the more the incidence of *MMR*, the more expenditure is needed to intervene in the health system to ameliorate the problem; thereby pushing the *CHE* among countries. A negative relationship was found between the *IMR* and *CHE* as a 1% reduction in *IMR* brought about a 0.0118 (1.18%) decline in the *CHE*. It was significant at 10% (0.10) giving the t-value test (-1.845) with a p-value (0.06) which is greater than 0.05 (5%) level of significance. This implies that as the incidence of *IMR* is reduced the *CHE* decreases. This means that with the absence of diseases, the *CHE* will be significantly reduced. The results showed that a positive relationship exists between *NMR* and *CHE*. While holding other variables constant, it was discovered a 1% change in neonatal death spikes a significant increase in the *CHE* within countries by 0.506 (50.6%). It was statistically significant given its t-value test (10.912) with a p-value (0.001) which is less than the 5% level. The variable *DNM* was documented in this study to positively and significantly influenced the *CHE*. This means while holding other variables constant, a 1% increase in the *DNM* leads to about 0.000513 (0.05%) increase in the *CHE*. It was statistically significant given its t-value test (8.54) with a p-value (0.001) which is less than 0.05 (5%) level. This finding is consistent with the specific health cost drivers discovered in America by the AHA (2021) that hospital growth prices and technology remained among the major drivers of health costs in America.

5.5. Discussion of random effect regression results

The results presented in Table 6 show that in SSA *MMR*, *NMR*, and *DNM* positively and significantly impacted the *CHE* given their p-values (0.001) which are less than 0.05. However, the *IMR* negatively influenced the *CHE* but was not statistically significant at the 5% level.

It was revealed that a 1% increase in the *MMR* would raise the *CHE* by 0.020 (2.0%) while a 1% increase in *NMR* would raise the *CHE* by 0.443 (44.3%). The weighted statistics of the random effect measured by the R-squared (0.801) indicate that about 80.1% of total variations in the *CHE* were accounted for by the predictors in the model while 19.9% of the variations were attributed to the error term. There was no significant divergence observed among the panel techniques (pooled, fixed, and random) regression results found. Though, in most instances, for policy implication, the need to decide between fixed or random effect arises, especially to test if the unique errors are correlated with the regressors or the existence of endogeneity. To carry out this test, the Hausman test is conducted.

5.6. Discussion of the Hausman test

The results of the Hausman test presented in Table 7 confirmed the preference for the fixed effect regression compared to the random effect regression as the period random chi-square statistics (56.67) with p-value (0.001) which is less than 0.05. This provides adequate information to reject the null hypothesis and support the alternative that the unique errors (μ_i) are correlated with the regressors in the random effect regression.

5.7. Discussion of PGMM/D results

The study acknowledged the lagged effect of health expenditure and the *DNM* on the current *CHE*. The two variables were demonstrated by the PGMM/D model to positively and significantly impact the current *CHE* while other variables; *MMR*, *IMR*, and *NMR* do not find to be statistically significant. Though, this technique shows the significance of the previous health costs which propelled the current healthcare spending to improve the health outcomes among the SSA countries.

It can be felt from the extent of relevance to which most African countries accord the provision of healthcare needs of their citizens.

5.8. Discussion of test of hypotheses

Decision rule: The decision to accept or reject the null hypothesis is based on the probability value of 5% (0.05). Suppose the p-value of the estimated variables is less than or equal to 5% (0.05). In that case, the variable is regarded as statistically significant, and the null hypothesis will be rejected and accept the alternative view. If otherwise, the null hypothesis cannot be dismissed.

Therefore, in testing the above hypothesis, the result of the pooled regression estimate revealed that the explanatory variables (*MMR*, *NMR*, and *DNM*) were statistically significant, with their respective p-values less than 0.05. It provides sufficient evidence to reject the null hypothesis and accept the alternative hypothesis that there exist substantial pooled effects of health outcomes on the health care costs among the selected African countries. It implies that as the outcome increases, the health care cost increases. On the other hand, if it decreases, the cost of health care decreases.

The estimated results from the fixed effect model were used to test hypothesis number two. It was revealed from the impact that apart from the *IMR* variable, all other variables were significant, with their respective p-value less than 0.05. It provides adequate information to reject the null hypothesis that health outcomes significantly affect healthcare costs among the selected African countries.

The results from the random effect provide adequate evidence to support the alternative hypothesis and lead to the rejection of the null hypothesis, given the p-values of the variables, which are less than 5%.

The results from the PGMM/D estimated model were used. It was revealed that the lag period of *CHE* [*CHE*(-1)] has a statistically significant effect on the current cost of health care in the selected SSA countries. It was evidenced by its p-value of 0.001, which is less than 0.05, therefore providing enough ground to reject the null hypothesis and accept the alternative that there is a significant dynamic effect of lagged health cost on the current health cost in the selected SSA countries.

The country-specific time series estimated model of Nigeria and Uganda indicated symmetrical behaviour among the region's health outcomes variables and healthcare costs. These were confirmed by their specific p-values, which are less than 0.05 except for *MMR* in the case of the two countries. Therefore, providing sufficient information to reject the null hypothesis and support the alternative hypothesis that there is a significant convergence between country-specific to the pooled effect of health outcomes on healthcare costs in the selected SSA countries.

5.9. Policy implications

To promote improved health outcomes such as an increase in life expectancy of individuals and to reduce the level of *MMR*, which has remained a severe scourge in most countries of the world, especially developing countries like SSA, made it a center of policy attraction. The *IMR* is increasing, with some of the causes known to be malnutrition while others are related to climate change. Whatever the reason, this has remained a draining chunk of the *CHE* of the government of most countries of SSA which demands adequate health policy. The death that occurs among children within the first twenty-eight (28) days of birth, medically known as neonatal mortality, is another severe health outcome that health planners and policymakers must tackle. Although this study focused on the SSA countries, the *DNM* is a global challenge as hardly any country drawn from the developed countries prides itself on crossing the benchmark of 20 nurses and midwifery to a thousand population based on the knowledge of the researcher. This study found this variable to be an important one that attracts health policy-making for improved health outcomes.

To satisfy the health outcomes need of every country, government expenditure on health remains among the dominant roles of the government to improve accessibility and health outcomes of the individual. Given the relevance of *CHE*, this study makes it the study's dependent variable.

6. CONCLUSION

This study evaluated the cost and outcomes of healthcare services in some of the selected countries in Africa. Given the importance of improved health outcomes need of individuals and society at large, it is expected of the government of every nation to focus on the need to promote healthy living among its citizens, such as increased health budget to stimulate health outcomes. Most of the health outcomes like *MMR*, *IMR*, and *NMR* are still very high in most countries with low density of nurses and midwifery populations primarily in SSA.

The study, therefore, concluded based on the summary of findings and recommendations that SSAs are riding on the same health outcomes and healthcare costs that warrant the same regional health policy measures to boost their citizens' health outcomes.

However, the study is limited in the discovery of the interactional effects and shocks among variables in the model which would have enhanced identifying causality effects using the PVAR technique. This would have enabled the frontiers of policymaking towards areas in terms of health outcomes to be focused. In light of this, the stud suggested the application of the PVAR technique for further studies of this nature.

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